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Virtual Conference • June 16th - 18th

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2 Implementing Simulation Governance & Democratization

3 Advancing Manufacturing Processes & Additive Manufacturing

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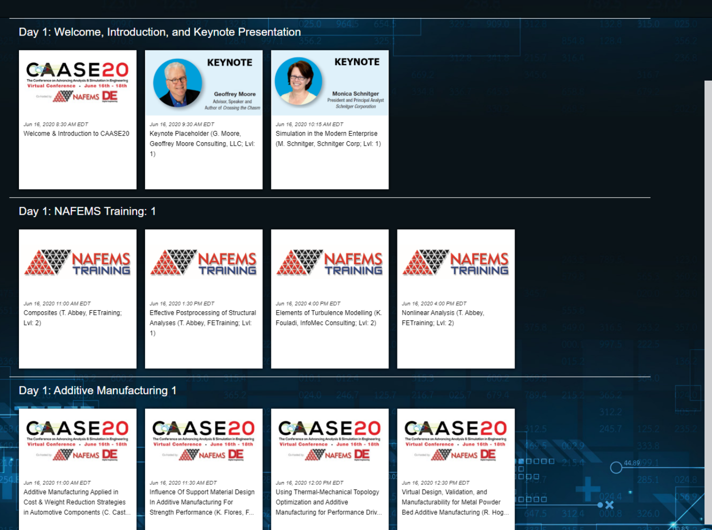

The CAASE20 Virtual Conference Will Feature:

3 full-days of ground-breaking content
7 parallel tracks
63 sessions
200 presentations,
17 training courses, and workshops
4 incredible keynotes
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SIMULATION FOCUS

Conference Preview

CAASE20

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DE Digital Engineering

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Join Us

Why You Should Attend CAASE20

Although many states are slowly easing some of the restrictions put in place to stem the spread of COVID-19, many parts of our lives are still on hold. Students aren't returning to school this year. There will be no pools to swim in this summer for many communities. Sports fans have had to get their live-sports fix watching Korean baseball and German soccer, played in eerily empty stadiums.

In-person technology conferences are also off the calendar for the foreseeable future, and nearly every major design and engineering conference has either been cancelled, postponed or transitioned to digital experiences. This virtual approach is likely to be the norm for quite some time, as large events as far out as November have been turned into online conferences.

The same is true for the Conference on Advancing Analysis & Simulation in Engineering (CAASE20) event June 16-18, co-presented by NAFEMS Americas and Digital Engineering. Originally created as a live event to be held in Indianapolis, the organizers at NAFEMS made the difficult decision to transition the conference to a virtual event. As it turns out, it was a wise move.

And the transition, although it happened very quickly, was successful. The event has more than 200 conference sessions and training sessions, and the vast majority of the presenters and keynotes originally scheduled for the event have pitched in to provide virtual versions of their presentations and speeches. That highlights the importance of these events. As we've seen from the content and attendance at other online industry events since the shutdown began, engineers and designers still want access to this type of high-level content and training, along with an opportunity to make personal and professional connections. That's critical, particularly in an environment that has been incredibly isolating in many ways.

As simulation becomes a more integral part of the design process, the challenges of democratization have become more apparent. Technology providers have responded by creating a variety of innovative ways to both enable simulation earlier in the design process, and provide greater access to simulation tools for non-experts across the value chain.

The importance of access has never been more apparent, as engineers, managers and clients alike have been forced to adopt new technologies to enable remote design, simulation and collaboration. Design engineers are more tuned in than ever to discovering new and better ways to work.

To help facilitate this discovery, *DE* has teamed up with NAFEMS, the international association for the engineering modeling, analysis and simulation community. NAFEMS has a proven track record of bringing experts from industry, government and academia together at its NAFEMS World Congress and its regional events, including in the Americas. CAASE20 marks the third event (one live and two virtual) that *DE* and NAFEMS have created to showcase the latest advances in simulation.

CAASE20 will feature more than 240 conference presentations and training sessions. For simulation newbies, there's plenty of content directed at design engineers who are not simulation experts. In addition to the technical presentations, there are many that focus on the business benefits and challenges of simulation that can help you build a return-on-investment case for implementing simulation more fully into your product design and development process.

For veterans of the space, there is advanced training and content available to help improve your productivity and the quality of your simulation results. You can dive into the specifics of particular processes, such as fatigue analysis, composite finite element analysis (FEA), nonlinear FEA, turbulence modeling or the physics involved in joints and connections, for example. We look forward to "seeing" you virtually at CAASE20. We will also provide live coverage of the event via Twitter (@DEeditor) and follow up with articles on DigitalEngineering247.com and in upcoming editions of *Digital Engineering*.

Please feel free to share your feedback about the CAASE20 conference, tell us what topics you'd like to cover and share how we can help you learn about the technologies that are transforming design engineering today. **DE**

Brian Albright
Editorial Director, *Digital Engineering*
E-mail me at: balbright@digitaleng.news

Welcome to CAASE20

The Conference on Advancing Analysis & Simulation in Engineering

It is our great pleasure to welcome you to CAASE20, the (now virtual) Conference on Advancing Analysis & Simulation in Engineering, which will be held June 16-18 online!

CAASE, which now represents a four-year effort, began as a discussion between *Digital Engineering (DE)* and NAFEMS to explore how they could better collaborate and support those working with engineering analysis and simulation. Based on the overwhelmingly positive feedback and support we have received over the years, it is clearly a partnership that is valued by both organizations and the community.

For those who are new to the NAFEMS community, we welcome you! Our mission is to provide knowledge, international collaboration and educational opportunities for the use and validation of engineering simulation.

NAFEMS, a not-for-profit organization established in 1983, is the only worldwide independent association dedicated to engineering modeling, analysis and simulation. Currently, there are more than 1,400 member organizations worldwide.

If you told us one year ago that CAASE20 would be a virtual event, we would have looked at you in disbelief. However, this is not the first time that CAASE has been a virtual event. Last year, *DE* and NAFEMS Americas hosted CAASE19, which was a one-day conference that featured presentations for some great minds representing: Jet Propulsion Laboratory (JPL), Embraer, Procter & Gamble, Ryobi Die Casting and Ford Motor Co. What may be even more surprising is that CAASE19 was not the first virtual event under our belts. The 2010 NAFEMS Americas Regional Conference was also a virtual conference. Thankfully, the technology available to us all has improved greatly since then!

Record Number of Innovative Contributions

The topics covered at CAASE20 address (nearly) every aspect of analysis and simulation, and were grouped into four main themes:

1. Simulation-Driven Design (of Physical Systems, Components & Products),
2. Implementing Simulation Governance
3. Advancing Manufacturing Processes & Additive Manufacturing, and
4. Addressing Business Strategies & Advanced Technologies

Once again, we received a record number of abstract submissions addressing each of these areas, and we could not be happier with the end result. CAASE20 attendees will have an opportunity to attend over 225 presentations highlighting innovative applications and best practices from some of the leading minds in our industry.

In addition to nine NAFEMS-accredited training courses, we decided to expand the opportunity for attendees to gain additional learning opportunities. This resulted in the committee accepting an additional eight community-developed training courses and workshops.

Furthermore, CAASE20 attendees will be treated to six amazing keynote speakers:

- On Tuesday (June 16), Geoffrey Moore, author of "Crossing the Chasm" will discuss high-tech adoption in the 21st century. (See page 8.) We will also hear from Monica Schnitger on simulation in the enterprise. (See page 7.)
- On Wednesday (June 17), Marc Halpern, P.E., Ph.D. (Gartner), and Peter Langsten, Ph.D. (Predict Change), will share their research on the trends and expectations in collaborative engineering, the emergence of governance—particularly simulation governance—in industrial innovation, and best practices and recommendations. (See page 10.)
- On Thursday (June 18), CAASE20 attendees will have the opportunity to hear from Maria Klawe, Ph.D. (president of Harvey Mudd College), who will discuss the importance and value of boosting diversity in computer science and engineering. (See page 9.)

Exploring the Virtual World

More than anything else, our goal is to deliver the same amazing CAASE experience to you even though all of us will be joining remotely. If you're new to virtual conferences, we welcome you to visit nafems.org/caase20 to watch a brief tutorial video and download the preliminary agenda so you know what to expect.

On a slightly more personal note, I want to take a moment to acknowledge the CAASE20 sponsors. As we worked incredibly hard to transition this event into a virtual conference, it was the steadfast support of our sponsors that truly made this transition during incredibly uncertain times even possible. We thank you:

MSC Software, Siemens Digital Industries Software, Dassault Systèmes SIMULIA, Front End Analytics, Altair Engineering, ANSYS, Cadence, TotalCAE, ESTECO, Endurica, Volume Graphics, Wolf Star Technologies, VCOLLAB, RecurDyn, BETA CAE Systems, Kinetic Vision, ROCKY, nTopology, Penguin Computing, HBM Prenscia, Nextflow Software, RAMDO Solutions, and INTES. DE

Matthew Ladzinski
Vice President, Americas
NAFEMS

BY THE NUMBERS | CAASE

1 Virtual Conference
To serve the engineering simulation community

2 Hosts
Digital Engineering and *NAFEMS*

3 -day conference
June 16-18, 2020

4 Key Themes:

1. Simulation-Driven Design (of Physical Systems, Components & Products),
2. Implementing Simulation Governance
3. Advancing Manufacturing Processes & Additive Manufacturing, and
4. Addressing Business Strategies & Advanced Technologies

4 Memorable Keynotes

- Geoffrey Moore, Ph.D., author of "Crossing the Chasm" will discuss high-tech adoption in the 21st century.
- Monica Schnitger will discuss simulation in the modern enterprise.
- Marc Halpern (Gartner) and Peter Langsten (Predict Change) will share their research on the trends and expectations in collaborative engineering.
- Maria Klawe (president of Harvey Mudd College) will discuss the importance and value in boosting diversity in computer science and engineering.

Image courtesy of Thinkstock / kasto80

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240+ presentations, courses and workshops

CAASE20 Conference Goes Virtual

The upcoming CAASE20 event (Conference on Advancing Analysis and Simulation in Engineering) kicks off June 16-18, for the first time completely online. The virtual event is expected to draw hundreds of attendees, while delivering a wide range of training and educational content that covers all facets of engineering analysis and simulation.

The independent, vendor-neutral conference is a joint partnership of NAFEMS, an international association for the engineering analysis community, and *Digital Engineering*. NAFEMS and *DE* previously co-hosted the successful CAASE18 event in Cleveland in 2018, as well as the one-day virtual CAASE19 event last year.

While the conference was originally planned to take place as a live event in Indianapolis, organizers decided early in the spring to transition to a virtual event in light of the global COVID-19 pandemic and the cancellation of large gatherings across the U.S. and around the world. Attendees and exhibitors alike found themselves working from home, in many cases accessing their simulation and design tools for the first time using mobile workstations, remote access solutions, cloud-based software and other technologies.

When announced that the conference would shift from a live to a virtual event, it was still unclear how the content would be affected. Fortunately, event organizers were able to rapidly pivot to a virtual platform, and the online event will be as packed with informative content as the live event in 2018.

CAASE20 is organized by a team of worldwide users across several industry sectors from the greater NAFEMS community, and the event highlights CAE-related technologies in a virtual, open-forum format. Attendees can discover and learn about current trends, common themes and future issues. Case studies, best practices, up-and-coming technologies and advances on the horizon in analysis and simulation will all be featured in the three-day affair through various presentations, training courses and workshops.

The three-day virtual event will feature more than 240 presentations, courses and workshops, and 15 hours of free NAFEMS-accredited training courses. The conference also has lined up an impressive array of keynote speakers and received strong support from leading simulation technology vendors and solution providers.

The training program this year will include sessions on composite material simulation, post-processing of structural analyses, nonlinear analysis, dynamic FEA, generative design, fatigue analysis and other topics.

The four scheduled workshops include: "How to Get Started with Simulation Process and Data Management," "Understanding a Generative Design Design Enabled Design Process Paradigm Shift," "Simulations Reality: How Simulation Can Act Like a Vehicle Loan from Tony Soprano's Jersey State Credit Union"and "Rubber Fatigue Analysis Using Load Reconstruction."

Regular sessions will include insights from numerous simulation experts and end users. There will be multiple sessions from major end users like Ford Motor Co., Eli Lilly, Ryobi Die Casting, Ingersoll Rand, Rolls-Royce, Caterpillar, the Air Force Research Laboratory, NASA Glenn Research Center, John Deere, Underwriters Laboratories, and Fisher Controls,.

For more details, visit nafems.org/caase20. **DE**

Disruption & Innovation

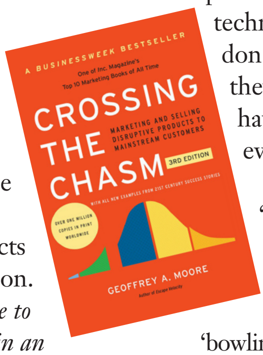
Opportunities abound as paradigms change.

BY BRIAN ALBRIGHT

Geoffrey Moore
Author
Crossing the Chasm

Innovative disruption is a fact of life for design engineers, given the push to more rapidly produce and iterate new designs. Simulation and design software vendors are also facing multiple disruptions with the advent of cloud-based software and flexible licensing models, as well as a push for a greater democratization of simulation systems.

That's why author and speaker Geoffrey Moore (www.geoffreyamoore.com) is such a good choice to present one of the opening keynote sessions at the upcoming CAASE20 (the Conference on Advancing Analysis & Simulation in Engineering) event, June 16-18, 2020.



Moore is the author of *Crossing the Chasm*, a best-selling book (most recently revised in 2014) focused on disruptive innovation and the "chasm" that exists between early adopters of new products and more widespread adoption. His most recent book is *Zone to Win: Organizing to Compete in an Age of Disruption* (2015). While his first book was focused on start-up companies, the most recent addresses the challenges large enterprises face when embracing disruptive innovations.

The Technology Adoption Lifecycle

According to Moore, there are four basic stages of adoption of new technology that can affect how a company markets new technology. The first stage involves early adopters. "They believe what you believe," Moore says. "They get what you are doing, they know it's early and they will have to do extra work, but they will buy in. They are fun to have as customers, because they are on your side of the table."

But once early adopters have embraced a product, that is when companies often face a chasm before reaching the rest of the market. How can you convince these other customers, who aren't "true believers," to get on the bandwagon?

"You target a niche of customers who are in pain," Moore says. "These are the pragmatists. They can't solve their problems with conventional solutions, and they are under increasing pressure to improve. They look to technologies, and although they don't believe what you believe, they think they need what you have. They will take a chance even if they aren't 100% sure."

Next is what Moore calls the "bowling alley" stage, where companies move across adjacent niche markets. "The simulation market is likely what we call a 'bowling alley forever' market because it is so specialized and so technical," Moore says. "It's not a horizontal application for average people on the street, but there is clear value in specific markets.

The next phase is referred to as the "tornado," when customers begin adopting the technology just to play catch-up to the early adopters. "They may not believe what you believe, but they want what those companies have," Moore says. "That creates huge spikes in demand that drive market caps in technology sectors through the roof. All of a sudden, a huge amount of budget comes out of nowhere."

This phase is when the technology providers try to grab as much market share as possible to become dominant. After that comes the "main street" phase, when customers begin to need the solution in order to stay competitive.

"Each of these phases requires a different go-to-market strategy, a different set of positioning ideas, and that is key to crossing the chasm," Moore says.

According to Moore, engineers tend to be biased to the front of the lifecycle because they are closest to these new innovations. "That's where it helps to have this framework," Moore says. "If you are butting your head against the wall trying to expand the market, you might be using the wrong play."

From Product-Focused to Consumer-Focused

The biggest change in the current market, Moore says, is that the product is no longer king. ""Before, the company sold a product, and when the consumer bought it they owned it, and it was their problem to get value out of it," Moore says. "In the 21st Century, the customer has more choices, and consumer power has trumped product power, because there is more supply than demand. When the customer is the scarce ingredient, you have to design backward from the customer base."

This could be a critical notion as the simulation industry searches for ways to expand its footprint beyond specialist engineers. "It's not that simulation solutions weren't good enough," Moore says. "It's that use cases require more generalists to be able to interface with the technology. The power has to be in the hands of the many instead of the few.."

The products that engineers design, and the software solutions that vendors are providing to those engineers, have to be designed from a user point of view. "Just dumbing it down doesn't work," Moore says. "You have to pay attention to use-case based design. The tool has to be designed in the context of a use case that will pay off that tool."

You can register for the event at the CAASE20 website. DE

A New Engineering Paradigm

The abrupt shift to working from home presents an opportunity to rethink old design and simulation processes.

BY MONICA SCHNITGER

Monica Schnitger
President
Schnitger Corp.

The world is a very different place today, compared to even just a few short weeks ago. We're all working hard to get our jobs and ourselves to a new normal standard of operations. But within today's trying-to-keep-the-ship-afloat crisis mode, there is a huge opportunity to move to a new and better way of working. The patterns and work processes we relied on for decades may not serve us when we can't get to the office or lab or factory floor. Now may be the perfect time to rethink old practices and redesign them to be more flexible and adaptable. Virtual everything? Maybe, maybe not — It's up to us to create work processes that leverage technologies that didn't exist when our old methods were first defined, and that we might not have been taking advantage of a few months ago.

Engineering in the cloud has always been problematic. Some companies aren't (weren't?) ready for the potential risk inherent in letting key intellectual property go outside the firewall — but is that risk any higher than a bad or clueless actor who charges an infected cell phone via a data-carrying USB cable? Others were unconvinced about latency, save rates and other technical issues. Such issues are rapidly being addressed, and it's time to move forward where cloud design makes sense.

This sheltering in place has shown us we weren't ready: yes, there are CAD-in-the-cloud apps, but our parts and assemblies were stuck on servers behind firewalls. We could do CAD but not on work-in-progress parts because we couldn't get to the parts we needed. Until someone fixed that for us, working on existing designs was impossible, even with a second license to use CAD at home, or access to virtualized CAD or CAD in a browser. And don't even get started with underpowered home PCs (or Macs) running commercial CAD. Turns out our most significant issues with engineering in the cloud weren't technical issues; they were process issues.

What about simulation? It's always been accepting of remote resources, since many jobs were already running in a cluster, grid, HPC center, supercomputer or whatever infrastructure was available, regardless of where it was physically located. The opportunity now is so much bigger than "simulate in the cloud", and we need to take advantage before it slips away.

Design processes that relied upon up old-school simulation, replacing a bend-and-break test with a simulation just before release to production, only solved part of the problem. Simulation along the design process, to explore concepts before settling on a few for refinement leads to more innovative designs. Exploring concepts in greater detail can mean early rejection of ideas that shouldn't make it to downstream stages, saving time and resources.

To effectively do this is disruptive for many organizations. It may mean changing job definitions, giving designers more tools and training and having methods engineers define parameters and processes for others to follow. It also means changing the value placed on simulation within an enterprise.

When I first started exploring CAE, the accepted norm was "no one trusts the simulation except the person who ran it, everyone trusts the measurement except for the person who made it." Expertise and an understanding of the shortcomings of each method meant there was distrust between disciplines. Fast forward to now, and test and simulation often work hand-in-hand.

This year's Conference on Advancing Analysis & Simulation in Engineering virtual event (June 16-18) will dive into these topics with new urgency. I'll give a presentation titled "Simulation in the Modern Enterprise," that will cover how to organize processes to use new technologies and ways of working. We'll look at how to manage simulation processes when we have newbies and experts collaborating on designs, the interaction of test and CAE, and how important governance is to make sure simulation is used to its full potential.

Join us! Online, from the comfort and safety of your home or office. **DE**

Monica Schnitger is president of Schnitger Corporation (schnitgercorp.com). Send email about this commentary to de-editors@digitaleng.news.

You can read more about Monica Schnitger's CAASE20 Keynote here (https://www.nafems.org/events/nafems/2020/caase20/keynotes/schnitger/), and register for the CAASE20 conference at https://www.nafems.org/events/nafems/2020/caase20/.

Working in the Post-COVID World

As offices shutter, new doors open for remote collaboration, digital twins, and 3D printing.

BY KENNETH WONG

Marc Halpern
Vice President
Gartner

Peter Langsten
Predict Change

For the foreseeable future, COVID-19 and the changes it has prompted are here to stay. To address this, Marc Halpern from Gartner, and Peter Langsten from Predict Change will deliver a new CAASE20 keynote, making the case that "Simulation Governance is Key to Delivering Best-of-Class Products in the Age of COVID-19."

Is it possible to implement "socially distant yet productive and collaborative design work"? The two presenters argue that, to make this happen, manufacturers must tackle a list of pressing priorities.

The Catalyst to Remote Work Protocols

In NAFEMS's April issue of Benchmark magazine (free download for members), Halpern and Langsten cowrote an article titled, "Overcoming COVID-19 Obstacles" (PP. 62-66). In it, the authors point out, "strict social distancing will be with us anywhere from 6 weeks to 1.5 years, depending on the country affected, recurrences of COVID-19, or any other virus effects."

The virus outbreak "accelerates the adoption of technologies and initiatives that allow for working with social distancing as a priority. Remote design and engineering, digitalization, automation, plus adoption of machine learning and robotic process automation (RPA) encourage a more productive social distancing work environment," they add.

Since the travel restrictions went into effect, some tech companies have begun offering their remote collaboration and cloud-hosted software at a deep discount or for free. PTC began offering free licenses of Vuforia Chalk (through August 31), an AR-based remote-assistance software. The company is also offering free use of its cloud-hosted CAD product Onshape to qualifying COVID-19-related projects. Similarly, Graebert offers its browser-based DWG editor software ARES Kudo for free during the outbreak.

These initiatives are prompted no doubt by a desire to help sustain clients' engineering projects. But they also hint at the collaboration software industry's recognition of the unexpected opportunity for recruitment afforded by the crisis.

PTC's Vuforia Chalk software, free to use during the COVID-19 lockdown (through August), points to new ways of collaboration and obtaining remote expert assistance. Image courtesy of PTC.

An Opening for Digital Twins

In their article, Halpern and Langsten made several recommendations, including replacing physical prototypes with simulation and optimizing manufacturing with simulation.

"If reliable simulations were conducted remotely, businesses could reduce the amount of testing—including prototype testing—required. This would allow for reduced presence of workers in R&D and testing labs, enabling as sufficient amount of social distancing and reduced design costs," they propose.

The impact of the slowdown in manufacturing during the shutdown cannot be underestimated, but the crisis also opens windows of opportunity for digital twin deployment. This means not just digital counterparts of parts and products but entire factories and systems.

According to Halpern and Langsten, "Simulating manufacturing operations offers insight into optimal placement, use, and scheduling of resources to ensure that the extent of human activities and the interactions of humans with other humans and their work environ-

Florida Polytechnic University laboratory technician Samuel de Oliveira uses a 3D printer to produce components for face shields. Image courtesy of Florida Polytechnic University.

ment remains safe from COVID-19 and OSHA (the US Occupational Safety and Health Administration) perspectives."

3D Printing's Time to Shine

On the eve of the crisis, witnessing the alarming PPE (personal protective equipment) shortage at hospitals, many tech firms, universities, maker communities, and creative individuals sprang into action. In many cases, the use of 3D printing turns out to be a quick and reliable way to kickstart production.

Examples of these include the AM (additive manufacturing) systems maker Stratasys's initiative to print and distribute face shields; on-demand manufacturing service portal Fictiv's launch of face shield production; the America Makes-led initiative to matchmake healthcare workers in need of PPE and those who can produce PPE; and more.

Halpern and Langsten also recommend expanded use of 3D printing to "[reduce] the degree of inter-dependencies across people to produce and deliver things." They point out, "users must learn technical aspects of designing parts for 3D printing along with overcoming the challenges of using different types of 3D printers."

Shops are Closed; the Cloud is Open

The centerpiece of remote collaboration during the lockdown is the cloud, the ever-present virtual infrastructure in the public domain. Many regular team meetings have shifted from corporate boardrooms and conference rooms to Zoom, Skype, and WebEx, with participants signing on from their home offices and private residences. This has exposed the paradoxical nature of corporate VPNs (Virtual Private Networks). The security measure once deemed essential in corporate settings turn out to be a hurdle in many cases for employees working from home.

"Feedback from engineers and designers shows mixed results on performance of engineering and design applications over a VPN. Sustained work beyond the immediate COVID-19 crisis requires greater compute power and network performance than that possible over a VPN. The cloud is the most practical and obvious source for that compute power, network bandwidth, and scalable storage," observe Halpern and Langsten.

"Data security is also a priority—particularly for industries with regulations mandating data protection," the authors add.

For certain IP-sensitive industries, such as military contractors, automotive, and aerospace, the current crisis is a dilemma. To facilitate engineers working from home, the firms may need to revise their security policies, or reengineer their IT frameworks. This blurs the line between private and professional equipment and raises new concerns over employers' access to employees' private data.

The authors conclude, "The post COVID-19 engineering environment will pose new demands on availability, integrity, usability of product data due to fundamental changes in the predictability of business operations, and requirements from product development, production and service activities." **DE**

To register for CAASE20, go to www.nafems.org/caase20.

Boosting Diversity in Computer Science and Engineering

BY KENNETH WONG

Maria Klawe
President
Harvey Mudd College

Dr. Maria Klawe, President of Harvey Mudd College, thinks academia's usual "Prove to me you belong here" attitude for computer science and engineering majors is detrimental to diversity.

"The first year or two are what's known as weed-out courses. They're supposedly designed to identify the students who have the intellectual muscle to figure things out," said Klawe. That attitude is a legacy of "a time when we didn't need nearly as many technically skilled talents," she added. "We now do, and we will need more in the future."

This survival-of-the-fittest approach, Klawe pointed out, discourages women and people of color to go into specialize areas. "Think of two different approaches," Klawe said. "One instructor says, this is a technically challenging course; everyone will have difficulties; but everyone who works hard will do fine. Another says, this is a technically challenging course, and you'll find out if you belong in this field or not. The second way has been the cultural tradition. This has a disproportionate impact on underrepresented groups in engineering."

The Harvey Mudd Difference

At Harvey Mudd, women account for 50% of the student body, and they are 50% in nearly every major, Klawe estimated. Furthermore, about 50% of the graduates in computer science, engineering, and physics are women, Klawe verified.

By contrast, the national average for women in computer science is only about 14% to 18%, according to the resource portal ComputerScience.org. The portal also lists top 20 schools with most women graduates in computer science. Harvey Mudd is #10 on the latest list for 2018.

"Women and men have no difference in their ability to understand technically challenging concepts," Klawe observed. "But how you teach influences how they learn." Figuring that out has been transformational for Harvey Mudd, she added.

Students today, Klawe said, are "more motivated by learning what they think will be important in tackling climate change or affordable healthcare, for example, than by learning abstract concepts."

Her recent conversation with DeepMind, a leading AI technology firm, reinforces this notion. "The company has works aimed at theoretical advances in machine learning, and works to apply machine learning for social good," Klawe recalled. "They said women's participation in the social good projects far outweighs their participation in theoretical works."

Chances for Diversity in Automotive

According to the 2015 study titled "Women at the wheel: Recruitment, retention, and advancement of women in the automotive industry" by Deloitte and Automotive News, "While women represent 47% of the total U.S. labor force, they comprise less than a third (24%) of the automotive workforce."

The automotive industry is now facing challenges in transforming itself to be less fossil fuel-reliant and more environment-friendly. Leading car makers are all developing hybrid models with this in mind. "Think about promoting these types of projects in recruitment to attract more women and increase diversity," Klawe advised.

When building project teams, Klawe suggested managers should avoid putting a single woman in a team. "In discussions, it often feels very isolated for the lone woman on the team," she pointed out. "In addition, providing female role models is incredibly important." To her, these measures are part of the strategy to increase diversity in engineering.
At CAASE, Klawe is scheduled to give a talk titled, "Increasing diversity in the STEM workforce might be easier than you think."

To register for the conference and learn more about Klawe, please visit the CAASE20 website. DE

Keynote Presentations

Geoffrey Moore, Ph.D.
Author of "Crossing the Chasm," "Zone to Win,"Escape Velocity," and many other bestsellers
Chasms, Bowling Alleys, Tornadoes, and Main Street: High Tech Adoption in the 21st Century

Monica Schnitger
President and Principal Analyst, Schnitger Corporation
Simulation in the Modern Enterprise

Tuesday
June 16th

Wednesday
June 17th

Marc Halpern, P.E., Ph.D. & Peter Langsten, Ph.D.
Gartner & Predict Change
Simulation Governance is Key to Delivering Best-of-Class Products in the Age of COVID-19

Maria Klawe, Ph.D.
President, Harvey Mudd College
Increasing Diversity in the STEM Workforce Might Be Easier Than You Think

Thursday
June 18th

Special Thanks...

To the NAFEMS Americas Steering Committee

Rodney Dreisbach (The Boeing Company, Retired, USA), Chair
Steve Arnold (NASA Glenn Research Center, USA)
Jack Castro (The Boeing Company, USA)
Duane Detwiler (Honda R&D Americas, USA)
Brian Duffy (Technip USA, USA)
Graham Elliott (De Havilland, CAN)
Mario Felice (Ford Motor Company, USA)
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Ronald Krueger (National Institute of Aerospace, USA)
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Marcus Reis (ESSS, BRA)
Charles Roche (Western New England University, USA)
Mahmood Tabaddor (Underwriters Laboratories LLC, USA)
Andrew Wood (NAFEMS, USA)

To the Digital Engineering (DE) Team

Brian Albright (DE)
Tom Cooney (DE)

To the CAASE20 Presenters

(for their tireless efforts to still develop and deliver their presentations to a virtual audience!)

To the CAASE20 Sponsors

(whose continued support during the transition to a Virtual Conference was so very important and appreciated!)

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CAASE20 Agenda & Content Line-up

In the following sections, and in the CAASE20 Preliminary Agenda, we have provided:

- An "**At-a-Glance**" agenda, which allows you to see the session date(s) and times
- A listing of "**Presentations, Training Courses, Workshops, and Panel Discussions**," which are grouped by session title (in alphabetical order; keynotes being the exception). A we will publish a preliminary agenda with the submissions below grouped into tentative sessions.
- A 200+-page detailed listing for each presentation, training course, workshop, and panel discussion, which includes: Presenter Name, Company, Session Title, Presentation Date & Time, Intended Learning Outcome, Keywords, Abstract, Speaker Biography, and more! This is only available in the CAASE20 Preliminary Agenda.

Day 1 *(Tuesday, June 16th)*

Tuesday (16th)							
9:00 AM	Conference Kick-off, Welcome & Keynotes						
11:00 AM	NAFEMS Training	Additive Manufacturing 1	CFD 1	Cultural Challenges	Data Management 1	Multiscale & Multiphysics 1	Structural Analysis 1
1:00 PM	Sponsor Sessions						
1:30 PM	NAFEMS Training	Additive Manufacturing 2	CFD 2	Data Management 2	Innovative Applications	Multiscale & Multiphysics 2	Structural Analysis 2
3:30 PM	Sponsor Sessions						
4:00 PM	NAFEMS Training	Additive Manufacturing 3	Crash, Impact & Shock	Data Management 3	Multiscale & Multiphysics 3	Thermomechanical	Verification & Validation 1

Day 2 *(Wednesday, June 17th)*

Wednesday (17th)							
9:00 AM	Welcome & Keynotes						
11:00 AM	NAFEMS Training	Durability & Damage Tolerance	Generative Design 1	Multiscale & Multiphysics 4	Manufacturing Process Simulation	Systems Modeling & Simulation	Verification & Validation 2
1:00 PM	Sponsor Sessions						
1:30 PM	NAFEMS Training	Advanced Materials & Multiphysics	Generative Design 2	MBE 1	Multiscale & Multiphysics 5	Optimization 1	Verification & Validation 3
3:30 PM	Sponsor Sessions						
4:00 PM	NAFEMS Training	AI-Guided Simulation	Electromagnetics & Electrostatics	FEA	MBE 2	Optimization 2	Uncertainty Quantification 1

Day 3 *(Thursday, June 18th)*

Thursday (18th)							
9:30 AM	Welcome & Keynotes						
11:00 AM	NAFEMS Training	Advanced Composites	Advanced Information Technologies 1	Digital Threads & Digital Twins 1	Optimization 3	Simulation Governance 1	Uncertainty Quantification 2
1:00 PM	Sponsor Sessions						
1:30 PM	NAFEMS Training	Advanced Information Technologies 2	Advanced Materials Engineering	Digital Threads & Digital Twins 2	Optimization 4	Simulation Governance 2	Uncertainty Quantification 3
3:30 PM	Sponsor Sessions						
4:00 PM	NAFEMS Training	Democratization	HPC & Cloud	Multibody		Systems Thinking	Uncertainty Quantification 4
5:30 PM	Conference Wrap-up						

Presentations, Training Courses, Workshops, and Panel Discussions

Note: Lvl 1 = Introductory, Lvl 2 = Intermediate, and Lvl 3 = Advanced (as assessed by the submitting author).

Type	Title, Speaker, Company, and Level	Session Title
Keynote	Chasms, Bowling Alleys, Tornadoes, and Main Street: High Tech Adoption in the 21st Century (G. Moore, Geoffrey Moore Consulting, LLC; Lvl: 1)	Keynote: Day 1
Keynote	Simulation in the Modern Enterprise (M. Schnitger, Schnitger Corp; Lvl: 1)	Keynote: Day 1
Keynote	Simulation Governance is Key to Delivering Best-of-Class Products in the Age of COVID-19 (M. Halpern, Gartner, Inc.; Lvl: 1)	Keynote: Day 2
Keynote	Increasing Diversity in the STEM Workforce Might Be Easier Than You Think (M. Klawe, Harvey Mudd College; Lvl: 1)	Keynote: Day 3
Presentation	Using Thermal-Mechanical Topology Optimization and Additive Manufacturing for Performance Driven Space Flight Hardware Design (D. Anderson, NASA Jet Propulsion Laboratory; Lvl: 1)	Additive Manufacturing 1
Presentation	Additive Manufacturing Applied in Cost & Weight Reduction Strategies in Automotive Components (C. Castro, Ford Motor Company; Lvl: 2)	Additive Manufacturing 1
Presentation	Virtual Design, Validation, and Manufacturability for Metal Powder Bed Additive Manufacturing (R. Hoglund, Altair Engineering, Inc.; Lvl: 2)	Additive Manufacturing 1
Presentation	Structural Optimization of FRep Models and Their Additive Manufacturing (D. Popov, Skolkovo Institute of Science and Technology; Lvl: 2)	Additive Manufacturing 2
Presentation	Assembly Consolidation in Additively Manufactured Waveguides (L. Salman, ANSYS Canada Ltd.; Lvl: 2)	Additive Manufacturing 2
Presentation	Towards High Throughput Simulations of Microstructure Mechanical Behavior in the AM Process (R. Saunders, Naval Research Laboratory; Lvl: 2)	Additive Manufacturing 2
Presentation	Geometrical Effects On Residual Stress and Distortion In Metal AM (L. Silva, Western Michigan University; Lvl: 1)	Additive Manufacturing 2
Presentation	Prediction of Microstructure within Additively Manufactured Parts through the Use of Finite Element Methods and Cellular Automata (M. Allen, TWI; Lvl: 2)	Additive Manufacturing 3
Presentation	Rapid 3D Inspection of AM Components Using CT: From Defect Detection to Thermal Performance Simulation (C. Butler, Synopsys (N.E) Ltd; Lvl: 2)	Additive Manufacturing 3

Presentation	Internal Flow Optimization: Next Level Performance Driven Engineering & Additive Manufacturing (T. Cole, Dassault Systemes; Lvl: 1)	Additive Manufacturing 3
Presentation	Taking into Account Defects in Structural Simulation of Additively Manufactured or Casted Components (B. Lauterbach, Volume Graphics GmbH; Lvl: 3)	Additive Manufacturing 3
Presentation	Application of a Composite Material Shell-Element Model in Ballistic Impact and Crush Simulations (T. Achstetter, George Mason University; Lvl: 2)	Advanced Composites
Presentation	On Post Processing of Carbon Composite Tubes in Compression Simulations: Justification and Validation (R. Cutting, Composites Manufacturing & Simulation Center; Lvl: 2)	Advanced Composites
Presentation	Capturing Multi-Scale Response of Composites with Homogenization Techniques (V. Palaiokastritis, BETA CAE Systems SA; Lvl: 2)	Advanced Composites
Presentation	Tensile Loading of 3D Woven Textile Composites: A Progressive Failure Analysis (D. Patel, Dassault Systemes SIMULIA Corp; Lvl: 3)	Advanced Composites
Presentation	Big Data for Durability and Reliability Engineers (J. Aldred, HBM Prenscia nCode; Lvl: 1)	Advanced Information Technologies 1
Presentation	Monetizing Digital: Where Engineering Meets Dollars (J. Betts, Front End Analytics LLC; Lvl: 2)	Advanced Information Technologies 1
Presentation	Engineering Analytics for the Automotive Industry (R. McConnell, SmartUQ; Lvl: 1)	Advanced Information Technologies 1
Presentation	Geodesic Convolutional Neural Network for 3D Deep-Learning Based Surrogate Modeling and Optimization (P. Baqué, Neural Concept Ltd.; Lvl: 2)	Advanced Information Technologies 2
Presentation	Physics Informed Machine Learning (PIML™): Surrogate Models Providing Deeper Insights with Less Data (S. Gondipalle, Front End Analytics LLC; Lvl: 2)	Advanced Information Technologies 2
Presentation	Numerical Prediction of Electrochemical Machining Processes Using Multiphysics Computational Tools (J. Mendez, Corrdesa LLC; Lvl: 2)	Advanced Materials & Multiphysics
Presentation	Corrosion Modeling using Multiphysics Computational Fluid Dynamics – From Ideal to Real Conditions (J. Mendez, Corrdesa LLC; Lvl: 2)	Advanced Materials & Multiphysics
Presentation	Microscale Modeling of Metal Filled Coating for Corrosion Protection (S. Palani, Corrdesa LLC; Lvl: 2)	Advanced Materials & Multiphysics

Presentation	Using Electrochemical Simulation to Both Optimize Alloy Electroplating Plating and Predict the Consequent Impact on Product Corrosion Resistance (A. Rose, Corrdesa LLC; Lvl: 2)	Advanced Materials & Multiphysics
Presentation	Optimizing the Performance of Adhesives Using Experiments and Predictive Simulations (S. Akarapu, 3M Company; Lvl: 3)	Advanced Materials Engineering
Presentation	Dynamic Response and Viscoelastic Heating of Elastomer Seals (A. Al-Quraishi, National Oilwell Varco Rig Systems; Lvl: 2)	Advanced Materials Engineering
Presentation	Numerical Analysis and Behavior of Ultra High-Performance Concrete (K. Bilal, Stantec; Lvl: 2)	Advanced Materials Engineering
Presentation	The Coming Engineering Analysis and Simulation Transformation (A. Ayala, Ford Motor Company; Lvl: 3)	AI-Guided Simulation
Presentation	Designing the Future with Optimization-Led Design & AI/ML Solution (A. Farahani, ETA Engineering Tech. Assoc.; Lvl: 3)	AI-Guided Simulation
Presentation	Heuristic Search for Optimal Breakpoints in Engine Mapping (G. Festag, Ford Motor Company; Lvl: 3)	AI-Guided Simulation
Presentation	Development of a Real-Time Engine Temperature Monitoring System, Using AI Based on Accurate and Validated Thermal Simulation Data (C. Semler, MAYA HTT; Lvl: 2)	AI-Guided Simulation
Presentation	A Computational Approach to Designing an Optimal Urea Mixer in a Diesel Exhaust System (S. Mishra, Ford Motor Company; Lvl: 3)	CFD 1
Presentation	Modeling Multiphase Flow in the GORE Mercury Control System (V. Rakesh, W.L. Gore & Associates; Lvl: 2)	CFD 1
Presentation	A New CFD Based Fire Risk Metric for Refrigerant Leakage Scenarios (M. Tabaddor, Underwriters Laboratories Inc; Lvl: 2)	CFD 1
Presentation	You already know about FVM or LBM? Discover SPH! (A. BANNIER, NEXTFLOW Software; Lvl: 2)	CFD 2
Presentation	Fully Coupled Conjugate Heat Transfer between 1D and 3D CFD (R. Euerby, Siemens Digital Industries Software; Lvl: 2)	CFD 2
Presentation	3D Modeling of Fuel Cells with a Complex Multi-Phase Approach: A Study on Geometry Influence. (C. Locci, Siemens Digital Industries Software; Lvl: 3)	CFD 2
Presentation	On Simulating Liquid Atomization Processes with High Fidelity and Speed (M. Sami, ANSYS Inc.; Lvl: 3)	CFD 2

Presentation	Using Vehicle Driver Population Variability to Identify Population Segments with Higher Injury Risk (N. Gaul, RAMDO Solutions, LLC; Lvl: 1)	Crash, Impact & Shock
Presentation	Impact Testing and Constitutive Modeling of PC for Failure Modeling (S. Teller, Veryst Engineering LLC; Lvl: 3)	Crash, Impact & Shock
Presentation	Cultural Challenges - Growing a Small Business Through a Lessons Learned Approach (A. Entwistle, McCormick Stevenson Corporation; Lvl: 1)	Cultural Challenges
Presentation	Making Believers out of Non-Believers: Psychology behind Transformation (C. Johar, AAON Inc; Lvl: 2)	Cultural Challenges
Presentation	How to Justify Increasing the use of Engineering Simulation in Your Company during and after COVID-19 (R. Keene, Consultant (Roger Keene); Lvl:)	Cultural Challenges
Presentation	The Two-Year-Old Revolution at the RevolutionInSimulation.org Community – Status and Next Steps (M. Panthaki, RevolutionInSimulation.org; Lvl:1)	Cultural Challenges
Presentation	An Update from the ASSESS Initiative (J. Walsh, The ASSESS Initiative; Lvl: 2)	Cultural Challenges
Presentation	Democratization of a Simulation Process Using a Workflow Engine and a SPDM Framework (N. Kasarekar, ESTECO North America, Inc.; Lvl: 2)	Data Management 1
Presentation	Utilizing SPDM to Democratize Complex Design Analysis and Generate Data Trends (J. Tyrus, Dana Holding Corporation; Lvl: 2)	Data Management 1
Presentation	Understanding the “Connected” Digital Enterprise (J. Zahner, Sigmetrix; Lvl: 1)	Data Management 1
Presentation	Open Data Formats in Commercial FEA Software (K. Walker, MSC Software; Lvl: 2)	Data Management 2
Presentation	VMAP Enabling Interoperability in Integrated CAE Simulation Workflows (K. Wolf, Fraunhofer SCAI; Lvl: 3)	Data Management 2
Presentation	An Industry Workflow to Integrate Simulation Data into a Unity Application (T. Cline, Honeywell Federal Manufacturing & Technologies; Lvl: 1)	Data Management 3
Workshop	How to Get Started with Simulation Process and Data Management (M. Norris, the SDMConsultancy; Lvl: 1)	Data Management 3
Presentation	Democratization of Simulation and Optimization Leads to Effective Decision Making at Cummins (K. Brittain, Cummins - STC; Lvl: 2)	Democratization
Presentation	The Case for Democratizing Simulation - Where Engineering Meets Dollars (S. Dewhurst, EASA Software; Lvl: 2)	Democratization

Presentation	Implementing Simulation Earlier in the Design Process (G. Westwater, Fisher Controls International LLC; Lvl: 2)	Democratization
Presentation	The Rise of the Digital Twin (S. Ferguson, Siemens Digital Industries Software; Lvl: 1)	Digital Threads & Digital Twins 1
Presentation	The Role of Analytics in the Digital Twin (G. Jones, SmartUQ; Lvl: 1)	Digital Threads & Digital Twins 1
Presentation	Digital Thread Based Verification Management Solution (G. Roth, Siemens Digital Industries Software; Lvl: 2)	Digital Threads & Digital Twins 1
Presentation	Real-Time Structural Integrity Evaluation Combining Digital Twin, Instrumentation and Finite Element Simulation (T. Roudier, E-Sim Solutions; Lvl: 2)	Digital Threads & Digital Twins 1
Presentation	Real Digital Twin for a Complex Process (A. Alizadeh, Front End Analytics LLC; Lvl: 2)	Digital Threads & Digital Twins 2
Presentation	Simulation-Based Digital Twins for Improved Asset Operation and Maintenance Management (A. Jatale, ANSYS Inc.; Lvl: 3)	Digital Threads & Digital Twins 2
Presentation	A Coherent Digital Thread as Enabler for Systems Thinking Across the System Lifecycle - Where's the Simulation? (E. Mottola, Toyota Motor Europe Technical Centre & M. Panthaki, ARAS Corporation; Lvl: 2)	Digital Threads & Digital Twins 2
Presentation	Digital Twin – Its Maturity Levels and Related Impact on Business Maturity and Competitive Position (F. Popielas, SMS_Thinktank; Lvl: 2)	Digital Threads & Digital Twins 2
Presentation	CAE-Driven Accelerated Durability Test for Carbon Canister Bracket Assembly (P. Darbandi, Ford Motor Company; Lvl: 3)	Durability & Damage Tolerance
Presentation	Virtual Simulation of Coupled Weld-Rupture Analysis of Automotive Assemblies (Y. Gooroochurn, ESI North America; Lvl: 2)	Durability & Damage Tolerance
Presentation	A Computer-Aided Engineering Method for Fan Blade Durability Assessment (V. Zamani, Ford Motor Company; Lvl: 3)	Durability & Damage Tolerance
Presentation	Multiphysics Modeling: Electro-Thermal Analysis of a Permanent Magnet Synchronous Machine for Electrical Vehicles (K. Illa, Siemens Digital Industries Software; Lvl: 2)	Electromagnetics & Electrostatics
Presentation	Electromagnetic Simulations for Antenna Design and Its Placement, RF Interference Analysis and Lightning Strike for Aerospace Applications (P. Jha, VIAS; Lvl: 3)	Electromagnetics & Electrostatics

Presentation	Design Challenges of Millimeter-Wave Beam-Steered Phased Array Transceiver for 5G Applications (L. Salman, ANSYS Canada Ltd.; Lvl: 2)	Electromagnetics & Electrostatics
Presentation	Enabling the Digitalization of Transformers (J. Wanjiku, Siemens Digital Industries Software; Lvl: 1)	Electromagnetics & Electrostatics
Presentation	Northrop Grumman Creating a 20-Node Hexahedral Element Model: An Innovative Solution to an Old Problem (J. Pura, MSC Software; Lvl: 2)	FEA
Presentation	Combined DEM and FEA Approach for Process Simulation of Granular Media (S. Sarkar, ESSS; Lvl: 2)	FEA
Presentation	Using Spline-Based Structural Simulation for Higher Accuracy and Faster Computation Speed (M. Sederberg, Coreform LLC; Lvl: 1)	FEA
Presentation	Simulation Tools for Designers: Generative Design and Meshless Simulation (J. Coors-Blankenship, PTC; Lvl: 2)	Generative Design 1
Presentation	Techniques for Generating and Simulating Lattice Structures (A. Vlahinos, Advanced Engineering Solutions LLC; Lvl: 2)	Generative Design 1
Presentation	Additively Manufactured High Performance Heat Exchangers (M. Vlahinos, nTopology; Lvl: 2)	Generative Design 1
Workshop	Understanding a Generative Design Enabled Design Process Paradigm Shift (J. Walsh, The ASSESS Initiative; Lvl: 2)	Generative Design 2
Presentation	Generative Design Use Case Requirements Assessment (J. Walsh, intrinSIM LLC; Lvl:)	Generative Design 2
Presentation	Will the Cloud Ever Work for HPC? (R. Knoechel, Oracle; Lvl: 2)	HPC & Cloud
Presentation	Choosing Between Managed HPC Clusters and Cloud for CAE - Challenges and Opportunities (R. Mach, TotalCAE; Lvl: 2)	HPC & Cloud
Presentation	The Effect of InfiniBand and In-Network Computing on CAE Simulations (Y. Qin, HPC-AI Advisory Council; Lvl: 3)	HPC & Cloud
Presentation	Maximizing Eigenfrequencies of PCB (R. Helfrich, INTES GmbH; Lvl: 3)	Innovative Applications
Presentation	Simulation for Developing Autonomous Vehicles in Context of the Indy Autonomous Challenge (S. Mittal, ANSYS, Inc.; Lvl: 2)	Innovative Applications
Presentation	Dynamic CT and Opportunities for Advancement of Validated Modeling & Simulation (J. Topich, Kinetic Vision; Lvl: 3)	Innovative Applications

Presentation	An Effective Approach for Elimination of Scrap Accumulation in Mass Stamping Production of Sheet Metals (A. Camanho, ESI North America; Lvl: 2)	Manufacturing Process Simulation
Presentation	An Introduction to Manufacturing Simulation and Smart Manufacturing (J. Huang, Ryobi Die Casting, USA; Lvl: 2)	Manufacturing Process Simulation
Presentation	Leveraging the Equivalance of I1-J2 and p-q Space to Simulate Powder Compaction Process (K. Kartikeya, ANSYS India; Lvl: 2)	Manufacturing Process Simulation
Presentation	Mission Focused MBSE (D. McCary, SAIC; Lvl: 1)	MBE 1
Presentation	The Future of Performance Design with MBSE Approach Using the Example of an Electric Powertrain (T. Reimer, Dassault Systemes Deutschland GmbH; Lvl: 2)	MBE 1
Presentation	Integrating Analysis with a Model-Based Feature Information Network (MFIN) (D. Seidensticker, MSC Software; Lvl: 1)	MBE 1
Presentation	Automation and Design Space Exploration for Improved ADAS Feature Performance (A. Bhivare, Ford Motor Company; Lvl: 2)	MBE 2
Presentation	New Ways to Create and Share High-Fidelity Simulation Insights Across the Product Lifecycle, to Increase Analyst Productivity and Improve Product Quality (P. Mandava, Visual Collaboration Technologies Inc; Lvl: 2)	MBE 2
Presentation	Vehicle NVH Analysis Based on Loads from a Multi Body Simulation - An Integrated Solution (M. Herbst, BETA CAE Systems SA; Lvl: 3)	Multibody
Presentation	Optimizing Dynamic Mechanisms Using CAE: Best Practices to Select the Design Variables and Objective Functions (S. Kim, FunctionBay, Inc; Lvl: 1)	Multibody
Presentation	Integrated Multi-disciplinary System Simulation with Streamlined Coupling Between FEA, Motion, DEM and Controls (K. Sundaresh, Altair Engineering, Inc.; Lvl: 2)	Multibody
Presentation	Using FEA, CFD, and Reliability Physics to Investigate Electronic Component Failure Behavior (T. Ferris, ANSYS; Lvl: 1)	Multiscale & Multiphysics 1
Presentation	Battery Aging Prediction for a Real-World Driving Cycle (K. Illa, Siemens Digital Industries Software; Lvl: 2)	Multiscale & Multiphysics 1
Presentation	System Level Electromagnetic and Thermal Co-Optimization for ECU Design (J. Liu, Cadence Design Systems, Inc.; Lvl: 2)	Multiscale & Multiphysics 1
Presentation	Electro-Mechanical Collaboration for Board-Level Thermal Analysis: An Integrated Approach for Design Optimization (Y. Sigmen, MAYA HTT; Lvl: 1)	Multiscale & Multiphysics 1

Presentation	Decreasing The Need For Prototyping By Taking A Coupled Approach To Complex Problems (J. Crist, EnginSoft USA; Lvl: 1)	Multiscale & Multiphysics 2
Presentation	Multiphysics Finite-Element Modeling for Vibration and Noise of Variable-Speed Permanent Magnet Brushless DC Motor (H. Niu, ANSYS Inc.; Lvl: 2)	Multiscale & Multiphysics 2
Presentation	Avoiding the Tipping Point: Using Quad-Physics to Optimize the Conveyance of a Fluid Product in Flexible Packaging (B. Ross, MotionPort; Lvl: 1)	Multiscale & Multiphysics 2
Presentation	Multiscale Characterization of the Mechanical Behavior of Metals from Finite Element Simulation of Crystal Microstructures (R. Mclendon, Dassault Systemes, SIMULIA; Lvl: 2)	Multiscale & Multiphysics 3
Presentation	Integrating Different Tools in Engine Simulation to Advance Towards a Conjugate Heat Transfer Solution (A. Megel, Southwest Research Institute; Lvl: 2)	Multiscale & Multiphysics 3
Presentation	An Integrated Workflow for Modeling Fiber-Reinforced Plastics with Multiscale Material Models (Y. Shi, Dassault Systèmes SIMULIA Corp; Lvl: 2)	Multiscale & Multiphysics 3
Presentation	Simulation is Childs Play, Broken Toys Aren't (R. Stupplebeen, Optimal Device; Lvl: 2)	Multiscale & Multiphysics 3
Presentation	FSI and Exergetic Analyses of Flexible vs. Rigid Pitching Airfoil (K. Fouladi, InfoMec Consulting; Lvl: 2)	Multiscale & Multiphysics 4
Presentation	Estimation of Material Properties of Noise Control Treatments from Random Incidence Transmission Loss Measurements (W. Yang, ESI North America; Lvl: 2)	Multiscale & Multiphysics 4
Presentation	Performance Benchmark of Fully Coupled Multiscale Simulations Using an Adaptive Multiscale Scheme (K. Malusare, Siemens Digital Industries Software; Lvl: 2)	Multiscale & Multiphysics 5
Presentation	Software Architecture and Hierarchy of the NASA Multiscale Analysis Tool (E. Pineda, NASA Glenn Research Center; Lvl: 1)	Multiscale & Multiphysics 5
Presentation	Application of the NASA Multiscale Analysis Tool: Multiscale Integration and Interoperability (T. Ricks, NASA Glenn Research Center; Lvl: 1)	Multiscale & Multiphysics 5
Training	Composites (T. Abbey, FETraining; Lvl: 2)	NAFEMS Training: Day 1
Training	Effective Postprocessing of Structural Analyses (T. Abbey, FETraining; Lvl:)	NAFEMS Training: Day 1
Training	Nonlinear Analysis (T. Abbey, FETraining; Lvl: 2)	NAFEMS Training: Day 1
Training	Elements of Turbulence Modelling (K. Fouladi, InfoMec Consulting; Lvl: 2)	NAFEMS Training: Day 1

Training	Dynamic Finite Element Analysis (T. Abbey, FETraining; Lvl: 2)	NAFEMS Training: Day 2
Training	Structural Optimization - Topology Optimization and Generative Design (T. Abbey, FETraining; Lvl: 2)	NAFEMS Training: Day 2
Training	Introduction to Practical CFD (K. Fouladi, InfoMec Consulting; Lvl: 1)	NAFEMS Training: Day 2
Training	CFD for Structural Designers and Analysts (K. Fouladi, InfoMec Consulting; Lvl: 1)	NAFEMS Training: Day 3
Training	Fatigue Analysis (T. Abbey, FETraining; Lvl: 2)	NAFEMS Training: Day 3
Training	Joints and Connections (T. Abbey, FETraining; Lvl: 2)	NAFEMS Training: Day 3
Presentation	Concept Structure Engineering and Optimization (A. Iti, Dassault Systemes CATIA; Lvl: 1)	Optimization 1
Presentation	Adjoint for Scale Resolving Simulation (T. Jadhav, ANSYS India; Lvl: 2)	Optimization 1
Presentation	Late Design Stage Optimization as an Important Task of the Product Development (G. Korbetis, BETA CAE Systems SA; Lvl: 2)	Optimization 1
Presentation	A Complete Framework for DOE Studies in Occupant Protection (N. Tzolas, BETA CAE Systems SA; Lvl: 3)	Optimization 1
Presentation	Optimizing Residual Thermal Stresses in High-Temperature Battery Cells (A. Ajdari, Exponent Failure Analysis Associates; Lvl: 3)	Optimization 2
Presentation	Combined Multi-Disciplinary Design Study and Structural Optimization Approach to Design Parts for Additive Manufacturing (R. Bokil, Vanderplaats Research & Development; Lvl: 1)	Optimization 2
Presentation	MAST: Multidisciplinary-Design Adaptation and Sensitivity Toolkit (D. Neiferd, Air Force Research Laboratory; Lvl: 2)	Optimization 2
Presentation	Design and Optimization of Cooling System Component for Enhanced Airflow (R. Mallyala, Dassault Systèmes; Lvl: 2)	Optimization 3
Presentation	Optimized Gun Barrel Based on Numerical Simulation to Produce Oil With Low BSW Content (U. Montañez Villamizar, PROCTEK SAS; Lvl: 2)	Optimization 3
Presentation	Automating CAD to CAE Preprocessing for Parametric Optimization Iterations (G. Roth, Siemens Digital Industries Software; Lvl: 2)	Optimization 3

Presentation	The Importance of Expensive Constraint Handling for Optimization Performance (C. Feridunoglu, Empower Operations Corp.; Lvl: 2)	Optimization 4
Presentation	Design Optimization of CNG Vessels Transportation (Z. Wen, Esteco SPA; Lvl: 2)	Optimization 4
Presentation	Implementing Simulation Governance & Democratization (S. Bhogle, Detroit Engineered Products; Lvl: 3)	Simulation Governance 1
Presentation	Most Effective ROI Models for Simulation Applications: Answers from Research (C. Jackson, Lifecycle Insights; Lvl: 2)	Simulation Governance 1
Presentation	Keeping a Large Enterprise Engaged in the Journey from Test-Centered Product/Process Development to Simulation-Led Product/Process Development (D. Meffert, Caterpillar Inc.; Lvl: 1)	Simulation Governance 1
Presentation	Using Machine Readable Physics for Simulation Governance and Democratization (J. Szarazi, Digitalweavers; Lvl: 1)	Simulation Governance 1
Presentation	Reinvesting Cost Optimization Savings to Fuel Digital transformation (L. Cole, Open iT, Inc.; Lvl: 1)	Simulation Governance 2
Workshop	Simulations Reality - How Simulation Can Act Like a Vehicle Loan from Tony Soprano's Jersey State Credit Union (M. Zebrowski, Consultant (Ford Motor Company, Retired); Lvl: 2)	Simulation Governance 2
Presentation	A Study of Structural Analysis for the Module of Pouch Type Battery, Including Swelling Effect (Y. Hahn, Dassault Systèmes SIMULIA Corp; Lvl: 2)	Structural Analysis 1
Presentation	Next Generation Contact Analysis (R. Helfrich, INTES GmbH; Lvl: 3)	Structural Analysis 1
Presentation	Durability Analysis of Tires at High Speed (W. Mars, Endurica; Lvl: 2)	Structural Analysis 1
Presentation	Standing Waves in Tires at High Speed (G. Paudel, Dassault Systemes SIMULIA Corp; Lvl: 2)	Structural Analysis 1
Presentation	Optimisation of the strength of a Composite Floor System by Numerical Simulation of Steel and Concrete interaction (H. Bastien, CREAFORM; Lvl: 3)	Structural Analysis 2
Workshop	GETTING BOUNCED: Pogo Stick Loads and Durability (T. Hunter, Wolf Star Technologies; Lvl: 2)	Structural Analysis 2
Presentation	Can You Crack the Crush Tube? A Nonlinear Deformation Challenge Problem (S. Huston, Ingersoll Rand; Lvl:)	Structural Analysis 2
Presentation	Introduction of a Generic and Independent XML-based Physical Description Language "SMILE" (D. Friedemann, HTW Berlin; Lvl: 2)	Systems Modeling & Simulation

Presentation	Systems Modeling and Simulation Community (SMS Community) (F. Popielas, SMS_Thinktank; Lvl:)	Systems Modeling & Simulation
Presentation	Calculation of Rolling Resistance for Off-Road Vehicles and Its Impact on Real Time Energy Simulations (A. Shrimali, John Deere India Pvt Ltd; Lvl: 2)	Systems Modeling & Simulation
Presentation	Reducing Physical Prototyping Via Real-Time Compliant Vehicle Dynamics Models (H. Kolera-Gokula, MSC Software; Lvl: 3)	Systems Thinking
Presentation	Automated Workflow for Reliability Analysis of Through Silicon Vias in 3-D Interconnects (K. Khan, ANSYS India; Lvl: 2)	Thermomechanical
Presentation	Wear Modeling of Brake Pad Due to Friction & Heat Generation between the Contacting Surfaces (S. Maiti, VIAS; Lvl: 2)	Thermomechanical
Presentation	Leveraging Boundary Condition Independent Reduced Order Models (J. Wilson, Siemens Digital Industries Software; Lvl: 1)	Thermomechanical
Presentation	Thermal Effect on Headlamp Lighting Performance (I. Yavuz, ANSYS Inc.; Lvl: 2)	Thermomechanical
Presentation	Statistical Model Validation & Calibration for Virtual Product Design (K. Choi, RAMDO Solutions, LLC; Lvl: 2)	Uncertainty Quantification 1
Presentation	Uncertainty Quantification and Digital Engineering Applications in Design and Life Cycle Management (G. Jones, SmartUQ; Lvl: 1)	Uncertainty Quantification 1
Presentation	Narrowing the Simulation – Test Gap with Statistical Calibration (G. Jones, SmartUQ; Lvl: 1)	Uncertainty Quantification 1
Presentation	What Are the Chances of the Ship Snapping? Considerations When Using Probabilistic Analysis (A. Karl, Rolls-Royce Corporation; Lvl:)	Uncertainty Quantification 2
Training	Introduction to Probabilistic Analysis and Uncertainty Quantification (G. Jones, SmartUQ; Lvl: 1)	Uncertainty Quantification 3
Training	Uncertainty Quantification with Complex Data (G. Jones, SmartUQ; Lvl: 2)	Uncertainty Quantification 4
Presentation	Application of a Verification and Validation Framework for Establishing Trust in Model Predictions (J. Hartl, Purdue University; Lvl: 2)	Verification & Validation 1
Presentation	Using Statistical Calibration for Model Verification and Validation, Diagnosis of Model Inadequacy and Improving Simulation Accuracy (R. McConnell, SmartUQ; Lvl: 1)	Verification & Validation 1

Presentation	Improving PDC times: Virtual validation using rapid prototyping, FEA & 3D scan (M. Mendoza Vazquez, Autoliv Mexico; Lvl: 1)	Verification & Validation 1
Presentation	Why Do My CAE Results Not Correlate with Test Results? (G. Roth, Siemens Digital Industries Software; Lvl: 2)	Verification & Validation 1
Presentation	Predictive Analytics and Uncertainty Quantification of a Microwave Ablation Simulation with Spatial and Transient Responses (G. Jones, SmartUQ; Lvl: 1)	Verification & Validation 2
Presentation	Assessing Computational Model Credibility Using a Risk-Based Framework: Application to Tibial Tray Component Strength (L. Knudsen, Syncroness; Lvl: 2)	Verification & Validation 2
Presentation	An End-to-End Example of Verification, Validation and Uncertainty Quantification (R. Actis, ESRD, Inc.; Lvl: 2)	Verification & Validation 3
Presentation	Accounting for Variability in NVH Design to Achieve Higher Customer Satisfaction (N. Gaul, RAMDO Solutions, LLC; Lvl: 1)	Verification & Validation 3
Presentation	V&V 3D Fatigue Crack Growth Modeling: From Deterministic to Uncertainty Quantification Assessment (A. Loghin, Simmetrix Inc.; Lvl: 2)	Verification & Validation 3
Presentation	Uncertainty Quantification and Probabilistic Risk Assessment for a Fleet of Layered Pressure Vessels (D. Riha, Southwest Research Institute; Lvl: 2)	Verification & Validation 3

Presenter Name: Abbey, Tony

Presenter Company: FETraining

Presentation Title: Composites (T. Abbey, FETraining; Lvl: 2)

Session Title: NAFEMS Training: Day 1

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 11:00 AM

Type: Training

Intended Learning Outcome:

Keywords:

Abstract:

Due to the nature of composite materials, stress analysis and failure prediction is far more complex than isotropic materials. The objective of this overview is to break down the composite FE analysis process into clearly defined steps, give an overview of the physics involved and show how to implement practical solutions using Finite Element Analysis.

Speaker Biography:

Tony Abbey has created and taught a wealth of FEA training material over the past 20 years. Thousands of engineers across the world have benefited from his live and e-learning based classes. He has developed a reputation for providing the student with an experience that is full of insight gained from his extensive experience, but which also challenges and motivates.Tony has been working with FEA for nearly 40 years, both in Industry and for leading FEA software providers in the UK and the US. His informal and interactive presentation style allows the key concepts to be taught in a manner which involves participants fully in the course material. Tony presents papers at NAFEMS and other conferences on a regular basis and has been involved with NAFEMS since its formation. He has written a series of very popular articles on FEA for Desktop Engineering magazine.

Presenter Name: Abbey, Tony

Presenter Company: FETraining

Presentation Title: Effective Postprocessing of Structural Analyses (T. Abbey, FETraining; Lvl:)

Session Title: NAFEMS Training: Day 1

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 1:30 PM

Type: Training

Intended Learning Outcome:

Keywords:

Abstract:

The range of post-processing options can be bewildering. However, understanding how to interrogate stress results is key to effective FEA. A road map is developed that shows how to use Von Mises, Cartesian and Principal stresses in a logical and authoritative manner. Examples of contour and XY plotting are shown. Load vectors and free body diagrams are also discussed.

Speaker Biography:

Tony Abbey has created and taught a wealth of FEA training material over the past 20 years. Thousands of engineers across the world have benefited from his live and e-learning based classes. He has developed a reputation for providing the student with an experience that is full of insight gained from his extensive experience, but which also challenges and motivates.Tony has been working with FEA for nearly 40 years, both in Industry and for leading FEA software providers in the UK and the US. His informal and interactive presentation style allows the key concepts to be taught in a manner which involves participants fully in the course material. Tony presents papers at NAFEMS and other conferences on a regular basis and has been involved with NAFEMS since its formation. He has written a series of very popular articles on FEA for Desktop Engineering magazine.

Presenter Name: Abbey, Tony

Presenter Company: FETraining

Presentation Title: Nonlinear Analysis (T. Abbey, FETraining; Lvl: 2)

Session Title: NAFEMS Training: Day 1

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 4:00 PM

Type: Training

Intended Learning Outcome:

Keywords:

Abstract:

Many problems facing engineers are nonlinear in nature, where the response of a structure cannot be simply assessed using linear assumptions. One of the most difficult tasks facing an engineer is to decide whether a nonlinear analysis is really needed and if so what degree of nonlinearity should be applied. This overview will examine these issues, and look at the best ways of creating an analysis plan that matches key objectives.

Speaker Biography:

Tony Abbey has created and taught a wealth of FEA training material over the past 20 years. Thousands of engineers across the world have benefited from his live and e-learning based classes. He has developed a reputation for providing the student with an experience that is full of insight gained from his extensive experience, but which also challenges and motivates.Tony has been working with FEA for nearly 40 years, both in Industry and for leading FEA software providers in the UK and the US. His informal and interactive presentation style allows the key concepts to be taught in a manner which involves participants fully in the course material. Tony presents papers at NAFEMS and other conferences on a regular basis and has been involved with NAFEMS since its formation. He has written a series of very popular articles on FEA for Desktop Engineering magazine.

Presenter Name: Abbey, Tony

Presenter Company: FETraining

Presentation Title: Dynamic Finite Element Analysis (T. Abbey, FETraining; Lvl: 2)

Session Title: NAFEMS Training: Day 2

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 11:00 AM

Type: Training

Intended Learning Outcome:

Keywords:

Abstract:

This a short overview of the basics of dynamics analysis, building quickly from normal modes analysis to transient and frequency response. The session is packed with hints and tips on the most effective ways to set up these analyses - and some reminders about the implications of a dynamic environment for designers and analysts. Attendees qualify for a 15% discount on Tony's new NAFEMS book, "How to Perform Linear Dynamics Analysis."

Speaker Biography:

Tony Abbey has created and taught a wealth of FEA training material over the past 20 years. Thousands of engineers across the world have benefited from his live and e-learning based classes. He has developed a reputation for providing the student with an experience that is full of insight gained from his extensive experience, but which also challenges and motivates.Tony has been working with FEA for nearly 40 years, both in Industry and for leading FEA software providers in the UK and the US. His informal and interactive presentation style allows the key concepts to be taught in a manner which involves participants fully in the course material. Tony presents papers at NAFEMS and other conferences on a regular basis and has been involved with NAFEMS since its formation. He has written a series of very popular articles on FEA for Desktop Engineering magazine.

Presenter Name: Abbey, Tony

Presenter Company: FETraining

Presentation Title: Structural Optimization - Topology Optimization and Generative Design (T. Abbey, FETraining; Lvl: 2)

Session Title: NAFEMS Training: Day 2

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 1:30 PM

Type: Training

Intended Learning Outcome:

Keywords:

Abstract:

This short overview looks at the range of optimization techniques available in FEA today. A brief history shows the development of these methods and the various strengths and weaknesses. The future role of optimization is discussed – particularly when aligned with new manufacturing methods and vastly improving computing resources. The final topic is the continuing role of the engineer in providing the required innovation and definition of the optimization task.

Speaker Biography:

Tony Abbey has created and taught a wealth of FEA training material over the past 20 years. Thousands of engineers across the world have benefited from his live and e-learning based classes. He has developed a reputation for providing the student with an experience that is full of insight gained from his extensive experience, but which also challenges and motivates.Tony has been working with FEA for nearly 40 years, both in Industry and for leading FEA software providers in the UK and the US. His informal and interactive presentation style allows the key concepts to be taught in a manner which involves participants fully in the course material. Tony presents papers at NAFEMS and other conferences on a regular basis and has been involved with NAFEMS since its formation. He has written a series of very popular articles on FEA for Desktop Engineering magazine.

Presenter Name: Abbey, Tony

Presenter Company: FETraining

Presentation Title: Fatigue Analysis (T. Abbey, FETraining; Lvl: 2)

Session Title: NAFEMS Training: Day 3

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 11:00 AM

Type: Training

Intended Learning Outcome:

Keywords:

Abstract:

This short course gives some insight into the methods behind high and low cycle fatigue and fracture mechanics methods. How are they different? When do we use them? What are the implications for FEA?

Speaker Biography:

Tony Abbey has created and taught a wealth of FEA training material over the past 20 years. Thousands of engineers across the world have benefited from his live and e-learning based classes. He has developed a reputation for providing the student with an experience that is full of insight gained from his extensive experience, but which also challenges and motivates.Tony has been working with FEA for nearly 40 years, both in Industry and for leading FEA software providers in the UK and the US. His informal and interactive presentation style allows the key concepts to be taught in a manner which involves participants fully in the course material. Tony presents papers at NAFEMS and other conferences on a regular basis and has been involved with NAFEMS since its formation. He has written a series of very popular articles on FEA for Desktop Engineering magazine.

Presenter Name: Abbey, Tony

Presenter Company: FETraining

Presentation Title: Joints and Connections (T. Abbey, FETraining; Lvl: 2)

Session Title: NAFEMS Training: Day 3

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 1:30 PM

Type: Training

Intended Learning Outcome:

Keywords:

Abstract:

Most structures involve some form of jointing or connection. This overview looks at popular FEA methods for simulating mechanical joints, welding and bonding. Different idealization approaches and element types will be reviewed. Hints and tips will be developed based on identifying key analysis objectives.

Speaker Biography:

Tony Abbey has created and taught a wealth of FEA training material over the past 20 years. Thousands of engineers across the world have benefited from his live and e-learning based classes. He has developed a reputation for providing the student with an experience that is full of insight gained from his extensive experience, but which also challenges and motivates.Tony has been working with FEA for nearly 40 years, both in Industry and for leading FEA software providers in the UK and the US. His informal and interactive presentation style allows the key concepts to be taught in a manner which involves participants fully in the course material. Tony presents papers at NAFEMS and other conferences on a regular basis and has been involved with NAFEMS since its formation. He has written a series of very popular articles on FEA for Desktop Engineering magazine.

Presenter Name: Achstetter, Tobias

Presenter Company: George Mason University

Presentation Title: Application of a Composite Material Shell-Element Model in Ballistic Impact and Crush Simulations (T. Achstetter, George Mason University; Lvl: 2)

Session Title: Advanced Composites

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 12:30 PM

Type: Presentation

Intended Learning Outcome:

The audience will learn how to apply a newly developed composite material model for crush simulations.

Keywords: Composites, Composite Materials, Crush, Ballistic Impact, Shell-Elements, LS-DYNA, MAT213, Crash, Unidirectional

Abstract:

While the response to loading of traditional engineering materials, such as plastics and steel, is well understood and can be simulated accurately, designers of composite structures still rely heavily on physical testing of components to ensure the requirements of load bearing capabilities are met. The majority of composite material models that have been developed rely on non-physical material parameters that have to be calibrated in extensive simulations. A predictive model, based on physically meaningful input, is currently not available. The developed orthotropic material model includes the ability to define tabulated hardening curves for different loading directions with strain-rate and temperature dependency. Strain-rate dependency was achieved by coupling the theories of viscoelasticity and viscoplasticity to allow for rate dependency in both the elastic and plastic regions of the material deformation. A damage model was implemented, where a reduction of stiffness and stress degradation in the individual material directions can be tracked precisely. Modeling of failure and Finite Element erosion was achieved by implementing a new strain-based generalized tabulated failure criterion, where failure strains can be precisely defined for specific states of stresses. The material model was implemented into the commercial finite element software LS-DYNA and was utilized to simulate ballistic impacts and a C-channel under crush loading. These validation simulations of the material model were performed to test the physical usefulness and robustness of the developed material model. Ballistic impact tests were chosen to highlight the capabilities of the material model in high speed impact applications. For the tested unidirectional composite material in the ballistic impact, extensive material data was available. In a recent study, Dong et al. calibrated an existing material model in crush simulations to match force-displacement characteristics of several crush experiments and a match between tests and simulations was achieved after several rounds of optimization. To highlight the capabilities of the new material model in crush load cases, its results were compared to the force-time history obtained in tests and simulations using MAT58. For both the ballistic impact and crush simulations, the same modeling approach was used.

Speaker Biography:

Dr. Tobias Achstetter is a CAE Engineer specialized in composite material modeling. He received his Bachelor of Science in Mechanical Engineering from the University of Stuttgart, Master of Science in Computational Science from George Mason University, and Ph.D. in Physics from George Mason University for his work on a Composite Material Shell-Element Model for Impact Applications. Currently Dr. Achstetter works as a Senior CAE Engineer at Tesla.

Presenter Name: Actis, Ricardo

Presenter Company: ESRD, Inc.

Presentation Title: An End-to-End Example of Verification, Validation and Uncertainty Quantification (R. Actis, ESRD, Inc.; Lvl: 2)

Session Title: Verification & Validation 3

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 2:00 PM

Type: Presentation

Intended Learning Outcome:

Practical example of the application of Verification, Validation and Uncertainty Quantification within the framework of Simulation Governance.

Keywords: Mathematical Model, Ranking, Predictive performance, simulation governance

Abstract:

An end-to-end example of verification, validation and uncertainty quantification with particular reference to a mathematical model formulated for the prediction of the fatigue life of structural components in the high cycle regime will be presented. Such models are needed for the formulation of design rules and making sound condition-based maintenance (CBM) decisions. The objective is to generalize the results of fatigue tests performed on notch-free and notched coupons under constant cycle uniaxial loading conditions to variable cycle triaxial conditions. The mathematical model comprises four sub-models: (i) A deterministic model of linear elasticity for estimating the elastic stress field, (ii) a deterministic predictor of fatigue failure defined on the elastic stress field that generalizes the results of experiments performed on notched coupons to arbitrary notches, (iii) a statistical model for the generalization of fatigue data obtained from notch-free coupons to notched coupons under constant-cycle loading, (iv) a model for the generalization of a constant-cycle fatigue model to arbitrary load spectra. Many plausible formulations can be proposed for the sub-models (ii) to (iv). These formulations are based on subjective decisions influenced by intuition, experience and personal preferences. Therefore it is necessary to have a process established for objective ranking of candidate models based on their predictive performance. We have defined and employed such a process based on the principles and procedures of Bayesian statistics. The choice of a mathematical model from a competing set of models is conditioned on the available experimental data. It is expected that new ideas will be proposed in the future and the available experimental data will increase over time. Therefore ranking and selection of mathematical models is an open-ended problem: It is necessary to establish a process for systematic revision and updating mathematical models. In industrial and research organizations this falls under the administration of simulation governance and simulation project management. The presentation will introduce a new kind of predictor of fatigue failure characterized by three parameters. The predictor was calibrated and validated on the basis of experimental data available in the public domain. An interesting aspect of the validation project described in this presentation is that whereas the model was calibrated on the basis of uniaxial experimental data, it was validated on the basis of independently obtained biaxial data. The formulation of any mathematical model must include a clear statement on the limits of admissible input data. Should a new model be proposed that will pass validation tests under less restrictive conditions, and/or have equal or higher measures of predictive performance, then that model should be preferred and the design rules and CBM decisions based on the old model should be revised and updated. The predictor described in this paper is ranked higher than the classical predictors proposed by Neuber and Peterson as well as the more recently proposed predictors based on the theory of critical distances.

Speaker Biography:

Dr. Ricardo Actis is the President and CEO of Engineering Software Research and Development, Inc (ESRD). Prior to his appointment as President and CEO in 2016 Dr. Actis was responsible for the implementation of advanced FEA procedures in the commercial finite element analysis software product StressCheck®, including material and geometric nonlinearities, thin solids formulation, plates and shells, multi-body contact, composite material analysis techniques, and extraction of fracture mechanics parameters for metallic and composite structures. Dr. Actis also holds an academic appointment as Adjunct Professor in the Department of Mechanical Engineering and Material

Sciences of the School of Engineering at Washington University in St. Louis where he has been teaching strength of materials, aircraft structures, and numerical simulation since 1994.

Presenter Name: Ajdari, Amin

Presenter Company: Exponent Failure Analysis Associates

Presentation Title: Optimizing Residual Thermal Stresses in High-Temperature Battery Cells (A. Ajdari, Exponent Failure Analysis Associates; Lvl: 3)

Session Title: Optimization 2

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 5:00 PM

Type: Presentation

Intended Learning Outcome:

design optimization using FEA

Keywords: optimization, thermo-mechanical, batteries, FEA, thermal stresses, reliability

Abstract:

High temperature batteries such as sodium-metal-halide and sodium-sulphur batteries experience extreme thermal conditions during manufacturing and operation. Temperature changes develop residual thermal stresses, where there is a difference in the coefficient of thermal expansion (CTE) between neighboring components. Residual stresses and total strain energy of deformed components could potentially result in crack initiation and subsequently crack propagation. In this work, residual thermal stresses in the glass seal area of a generic cell undergoing thermal shock are evaluated using Finite Element Analysis (FEA). To optimize the residual thermal stresses, this work focuses on the thermal characteristics of the glass seal material such as the set temperature and CTE value. Thermo-mechanical FEA analysis was used to quantify the max principal stresses in the glass seal and the ceramic tube. Total strain energy in the glass seal area (consisting of glass seal, ceramic tube and the collar) was also looked at as the other two variables. Variation in total strain energies and residual stresses are quantified for a range of thermal material properties and the resultant response surface is used to identify example glass materials which could minimize the max principal stresses and total strain energy in the glass seal area. Four example glasses are examined to optimize all three variables: max principal stress in the glass seal, max principal stress in the ceramic tube, and total strain energy in the glass seal area. Results indicate a glass seal with higher CTE and higher set temperature, in general, will increase the principal stress in the glass seal as well as the ceramic tube when the entire cell undergoes a thermal cooling. Total strain energy in the glass seal area, however, has a minimum quantity depending on the CTE value and the set temperature.

Speaker Biography:

Dr. Ajdari is a senior engineer at Exponent. He has extensive background in performing advanced computational modeling (and Finite Element Analysis) and experimental testing; including structural, thermal, thermo-mechanical, fatigue, crack-propagation modeling, crash and impact analysis. His expertise has been applied to develop design concepts, perform design optimization, root cause analysis, and product failure analysis in multiple industries including utility-scale energy storage, medical devices, defense, consumer products, and biotechnology. He can help clients with new product development focusing on computational analysis, prototype analysis, and customized testing. Prior to joining Exponent, Dr. Ajdari was a Senior R&D Engineer at DePuy Synthes Spine, a Johnson & Johnson Company, and prior to that, he was a Lead Product Development Engineer in GE Energy Storage. Dr. Ajdari earned his PhD in Mechanical Engineering in Dec 2011, followed by two postdoctoral fellowships at MIT (2012-2013) and Northwestern University (2012-2014) working on multi-disciplinary projects. His scientific publications include 20 peer-reviewed journal publications with over 1240 citations (June 2020), and more than 50 conference proceedings and presentations, and 4 patent disclosures.

Presenter Name: Akarapu, Sreekanth

Presenter Company: 3M Company

Presentation Title: Optimizing the Performance of Adhesives Using Experiments and Predictive Simulations (S. Akarapu, 3M Company; Lvl: 3)

Session Title: Advanced Materials Engineering

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 2:00 PM

Type: Presentation

Intended Learning Outcome:

How 3M characterizes pressure sensitive as well as structural adhesives using experiments and predictive material modeling.

Keywords: Adhesive, Experiments, Constitutive Material Modeling, Predicitve Simulations, Digital Material Cards

Abstract:

Adhesives (pressure sensitive and structural) can be designed to have structural load bearing capacity and can have many advantages over traditional joining technologies such as bolting, brazing and welding. From an energy and environmental aspect, adhesives enable light-weight aerospace and automotive components with a significant impact on improving fuel efficiency and reducing harmful environmental impact. Accurate structural analysis of adhesive-containing structures requires reliable material descriptions for bonds; however, many adhesives are soft materials which undergo large deformation and exhibit rate-dependent behavior. Therefore, understanding the adhesive behavior in a wide range of strain rates and operating temperatures is key to assess as well as predict product reliability. Towards this goal, 3M has developed novel experimental methods and advanced material models which accurately capture both large deformation and rate-dependent behavior. These material models are suitable for static and dynamic analysis, including impact. In the age of Industry 4.0, 3M is spearheading and setting a trend of digital material cards (DMC) to help various industries realize their digitization vision. In this talk, we discuss our methodology of careful calibration and validation of 3M material models and state of the art digitization of these models into DMCs in various formats amenable to commercially available general purpose finite element software packages. We also discuss and showcase the usage of these material models in a scooter assembled using only adhesive tapes. This case study will focus on workflow of a predictive simulation using 3M DMC which is capable of modeling material behavior in various service conditions. Comparisons to traditional material modeling strategies will be given. We will further demonstrate the necessity of modeling structural adhesives and pressure-sensitive adhesives using different material modeling paradigms, including an analysis of predictive errors observed when cohesive zone models are applied to structural adhesives. A brief overview of 3M communication portals to learn more about our adhesives and means to try DMC will also be presented.

Speaker Biography:

Sreekanth is currently working as Research Specialist in Corporate Research Systems Lab of 3M Corporate Research Labs. He has over 10 years of academic and industrial experience in computational mechanics and predictive simulations. Before 3M, Sreekanth has worked at ANSYS and Shell Oil on different projects and customers from various market segments. He obtained his PhD from Washington State University and was a research fellow at Johns Hopkins University. His current research interests include contact mechanics focusing on friction and adhesion especially on rough surfaces, Adhesive failure Geomechanics and Metal Plasticity.

Presenter Name: Aldred, Jon

Presenter Company: HBM Prenscia nCode

Presentation Title: Big Data for Durability and Reliability Engineers (J. Aldred, HBM Prenscia nCode; Lvl: 1)

Session Title: Advanced Information Technologies 1

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 11:30 AM

Type: Presentation

Intended Learning Outcome:

The value and the challenges of applying big data techniques to improving the reliability and durability of products.

Keywords: Big Data, CAE, durability, reliability, real time data, product usage, digital twin, predictive maintenance

Abstract:

Introduction: The term big data is used in many ways and for many applications. The increased connectivity and availability of sensor data is driving new big data opportunities for both the design engineering and asset operations communities. However, the reality of unleashing this potential is perhaps more challenging than is often portrayed by major information technology vendors. Product designers and OEMs are interested in understanding real product usage in order to enhance its functional design and make sure the new design is fit-for-purpose. For example, identifying the 95th percentile customer in terms of usage severity helps CAE and test engineers set representative design targets, thus reducing the risks of under or overdesign. Understanding usage information can also help to take important design decisions for example how usage differs around the world that may affect durability and warranty returns globally. Operators responsible for a vehicle fleet or machines in a plant are typically looking to enhance product reliability. Historical data stored in a big data system can be coupled with analytics to build a mathematical model, which can be then used to predict upcoming failures based on day-to-day usage data. Predicting the remaining useful life of components can improve readiness and enable optimized maintenance activities by reducing unscheduled downtimes, which means more throughput and less costs. However, the adoption of such predictive analytics can be jeopardized by too many false positives. So, the model must be trained and made robust by incorporating as much historical data as possible. Machine Learning can be used to make a predictive model effective, but again, it requires large amounts of good, meaningful measured data and failure data in order to converge towards reliable predictions. Common challenges of big data analysis: Simply gathering and having access to large volumes of data is not helpful in giving insights to the health of an asset for instance, unless appropriate quality and analytics strategies are put in place. The first step is to ensure the data can be trusted. Experience shows that quality and cleanliness are more important than quantity in the world of big data. Another concern of analyzing very large volumes of data is the ability of applying known workflows to much larger datasets. In the past, engineers would conduct time-at-level histogram calculations on heavily instrumented test vehicles on proving grounds, but now they want to also perform the same types of time-at-level calculations on regular vehicles on public roads. Existing software tools are often not appropriate or provide a performance bottleneck. General open source tools for handling big data systems are necessary to access the large volumes of data. However, they offer relatively little mathematical functionality and are often insufficient for performing real-world engineering analysis on time series data. Scaling up for real world applications: One of the primary challenges is how to scale the data handling, data management and data analytics of measured sensor data to real world applications. This presentation will include an example of a framework and components for handling and processing condition based maintenance datasets from a fleet of vehicles. It demonstrates the scalability required to processing data from 20,000 vehicles, 40 channels per vehicle, 2 hours of usage per day for 3 years, generating 11 million data files and approximately 100TB of searchable time series data to enable timely decisions on vehicle performance, reliability and operations.

Speaker Biography:

Jon Aldred is Director of Product Management, and is based in Southfield, Michigan. Now part of HBM Prenscia, Jon joined nCode over 20 years ago and is responsible for product management for nCode and ReliaSoft software brands for durability and reliability engineering. Previously, Jon worked on vehicle programs at Chrysler in Detroit and Jaguar Cars in the UK, performing CAE simulations for NVH, crash and durability.

Presenter Name: Alizadeh, Arash

Presenter Company: Front End Analytics LLC

Presentation Title: Real Digital Twin for a Complex Process (A. Alizadeh, Front End Analytics LLC; Lvl: 2)

Session Title: Digital Threads & Digital Twins 2

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 2:00 PM

Type: Presentation

Intended Learning Outcome:

In this paper we showcase the development of a fast running and highly predictive fatigue failure surrogate model based on data obtained from simulation runs of a complex mechanical system.

Keywords: Digital Twin, Predictive Analytics, Machine Learning,

Abstract:

In this paper we showcase the development of a fast running and highly predictive fatigue failure surrogate model based on data obtained from simulation runs of a complex mechanical system. The goals for the surrogate model were to create a Simulation Democratization tool for design exploration and a Digital Twin tool for field predictive maintenance and adaptive controls. Catastrophic failure or sudden failures that are caused by damage accumulation are very difficult to predict using field data. However, in the design process, to ensure that parts meet operational life requirements, catastrophic failure analysis using simulation is routine. Often these simulations are complex and incorporate multiple physical phenomena interacting in complex and highly coupled ways. Given this, simulations are often time consuming, labor intensive, and require expensive software. In the example being showcased, we faced the challenge of converting data from a small number of simulation runs for prediction of fatigue failure in an engine exhaust manifold, into a highly predictive surrogate model that could be used to predict real-time damage accumulation as expected failure point in field deployed products. Additionally, the same surrogate model could be used for design exploration. Thus, both operational and geometric variables were considered in the prediction of fatigue life and damage accumulation in the part. To accomplish these goals, we used our in-house Physics Informed Machine Learning (PIML™) technology and methods. The PIML™ approach has better accuracy than the traditional statistical and machine learning methods and requires a fraction of the data required for training. The outcome of this project was a physics informed PIML?? model that only used 17 simulation runs or experiments for training. The overall R^2 value for the PIML?? model was 0.97 & the average log error of the predicted life was 2% when compared to finite element simulation. Note that each finite element simulation took 3 weeks to run. Given this long run time and its expense, the use of conventional machine learning methods, which would have required thousands of simulation runs to create a low error surrogate for this problem, would have been impractical, if not impossible. The implications of PIML™ to industrial applications, where predictive maintenance and predictive failure are cost and revenue drivers, are enormous. The conventional approach has relied, with minimal success, on conventional machine learning techniques to identify patterns in field data that may indicate the advent of a failure. However, damage accumulation and fatigue are seldom produce a discernable signal that is anomalous to prior operational data. Moreover, field failures take time, and catastrophic failures are seldom recorded in the field with enough accuracy and frequency to train a machine learning model. With PIML™ we open the opportunity to use Simulation as a tool for Digital Twin generation.

Speaker Biography:

Arash Alizadeh is a senior Application Engineer at Front End Analytics. He has eight years of academic and industrial experience applying computational analysis into various projects. Mr. Alizadeh received his Master's degree in Mechanical Engineering & Computational Modeling from Northeastern University. He also received Post-graduate degree from Columbia Engineering on Machine learning and Artificial Intelligence. In his current role, he is a technical lead on developing a computational analysis software for mechanical analysis.

Presenter Name: Allen, Madie

Presenter Company: TWI

Presentation Title: Prediction of Microstructure within Additively Manufactured Parts through the Use of Finite Element Methods and Cellular Automata (M. Allen, TWI; Lvl: 2)

Session Title: Additive Manufacturing 3

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 4:30 PM

Type: Presentation

Intended Learning Outcome:

A method of microstructure prediction for metal additive manufacturing.

Keywords: Additive Manufacturing, Microstructure, Cellular Automata, Manufacturing Process Simulation

Abstract:

Additive manufacturing (AM) is an innovative manufacturing method hailed for its ability to produce complex, topology optimised parts with high material usage. However, the wide spread implementation of this process is hindered by the lack of reliability and certification of AM parts. In particular, the microstructure of additive manufactured parts varies considerably to that of the same part made, with the same material, by traditional methods such as casting. This is due to the complex thermal history experienced by the material within the additive procedure. Changes in microstructure result in different material properties in the built part, to that of their traditional counterparts, and therefore introduce uncertainty surrounding the performance of the final product. In order to accelerate the adoption of AM within industry, through increased reliability and certification, we must first be able to understand the links between process parameters, microstructure and resultant properties through the use of integrated computational materials engineering (ICME). Within this work a multi-scale model is implemented to facilitate the prediction of grain morphology within additively manufactured metal parts. A weak coupling is used between a thermal finite element (FE) model and a cellular automata (CA) model for solidification. Although thermal simulations of AM processes are usually used for residual strain and distortion predictions, they are used within this work to determine undercooling; the driving force behind solidification. CA works by applying a number of variables to a grid of cells. The variables are then updated according to a set of rules. In this scenario, these rules are representative of the physical nucleation and growth mechanisms. Probabilistic nucleation methods are implemented based on Gaussian distribution and grain growth and capture is determined through the assignment of a grain envelope representative of the crystal shape. This allows for the direct determination of effect of process parameters on microstructural features such as grain size and shape. The modelling approach has been validated through a case study using single laser scans on an IN625 substrate. Open source experimental data was used, from the NIST AM benchmark 2018, to verify the microstructure predictions both visually and qualitatively. The model has since been applied to powder bed fusion and wire-arc additive manufacturing methods, whereby additional features have been added to the CA algorithm to account for the deposition of new material, in powder or liquid form. Within these models, the development of functionally graded materials through process parameter variation has been simulated and compared against experimental results in literature. Furthermore, an attempt to predict columnar to equiaxed transitions based on solidification parameters has been undertaken. The ultimate goal of this work is to contribute towards an extensive modelling method that allows for process optimisation and design for metal AM parts, enabling microstructure tailoring and control. This work was made possible by the sponsorship and support of Lloyd's Register Foundation and was enabled through, and undertaken at, the National Structural Integrity Research Centre (NSIRC). NSIRC is a postgraduate engineering facility for industry-led research into structural integrity established and managed by TWI through a network of both national and international Universities. Lloyd's Register Foundation helps to protect life and property by supporting engineering-related education, public engagement and the application of research.

Speaker Biography:

Madie is a final year PhD student with Brunel University London and NSIRC Ltd. She has an integrated Masters in Maths (MMath) from Durham University and works in the Numerical Modelling and Optimisation team at TWI Ltd. Her PhD topic focuses on the simulation of microstructure in additively manufactured parts.

Presenter Name: Al-Quraishi, Ali

Presenter Company: National Oilwell Varco Rig Systems

Presentation Title: Dynamic Response and Viscoelastic Heating of Elastomer Seals (A. Al-Quraishi, National Oilwell Varco Rig Systems; Lvl: 2)

Session Title: Advanced Materials Engineering

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 1:30 PM

Type: Presentation

Intended Learning Outcome:

This work will discuss coupled thermal-structural finite element modeling of elastomer seals sujected to dynamic loads.

Keywords: Elastomer seals, hyperelasticity, viscoelasticity, thermomechanical, finite element

Abstract:

Elastomer seals are used extensively across various industries for sealing pressures across structural interfaces. In Oil and Gas (O&G) industry, elastomer seals serve a critical function of pressure control which is critical for both human and environmental safety. Over the years, significant analysis has been performed on the behavior of these seals using finite elements. The seals undergo finite deformations (sometimes folding on themselves), have highly nonlinear contact behavior and are modeled using hyperelastic material models. In addition, these seals are subjected to very high temperatures and pressures for O&G applications which makes these problems challenging to sole using the numerically. Nonetheless, these problems have been studied to understand the local stress state of the seals under various static operating conditions leading to estimates of fatigue life. In addition, fluid pressure penetration analysis is typically performed by applying fluid opening pressure at the contact interface to study the likelihood of pressure leakage. In summary, static deformation of hyperplastic seals has been studied extensively. However, in addition to static loads the seals typically undergo fluctuating loads during operations. The impact of high frequency dynamic loads on the performance of elastomer seals is an area which needs further exploration and is the primary focus of this work. In the current work, a computational framework is established to study the dynamic performance of elastomer seals using finite element method. The static material behavior of the seals is modeled using finite deformation theories and hyperplastic materials models. The frequency dependent response of the material is modeled by defining a viscoelastic model. This is achieved by defining a Prony series representation of the elastomer response. The solution to the structural problem follows the following steps – 1) resolve initial contact interpenetration to evaluate the preloads after seal installation, 2) apply static operational pressure loads and allow finite deformation of seals, 3) use the previous stress state as a preload and apply oscillating pressure loads (harmonic/random) at different frequencies using linear perturbation analysis. The performance of the seal is evaluated by estimating its fatigue life in response to the applied static and oscillating loads. In addition to the structural analysis, thermal analysis of hyperelastic seals plays a key role in determining both the sealing behavior and life estimates of elastomer seals since these seals are often used for high temperature applications. Typically for the case of static loads, an approximation is made that the temperature distributions of the seal do not change as it undergoes deformation. In this case, a thermal solution can be predetermined and applied as a temperature condition for the subsequent structural analysis (1-way thermal structural coupling). However, for the case where the contacts undergo significant changes during deformation and/or due to viscoelastic heating (rise in temperature due to internal friction between polymer chains) of elastomer seals under dynamics loads, a fully coupled thermal-structural solution is needed. In this work, a fully coupled 2-way thermal-structural solution is developed for elastomer seals when subjected to both static and oscillating pressure loads. A comparison of both 1-way and 2-way thermal structural coupling results will be presented. It is anticipated that this work will help understand the importance of studying dynamic behavior of elastomer seals. This work also provides a solution pathway for addressing the challenges associated with dynamic structural response of the seals and the associated thermal phenomenon – both of which affect the seal's performance and life.

Speaker Biography:

Ali A. Al-Quraishi Bio: Ali A. Al-Quraishi (Ph.D.) is currently a senior engineering analyst at National Oilwell Varco (NOV) since 2012. Before joining NOV, Ali worked with GE Oil & Gas company for over 5 years. Ali has over 13 years of experience in the Oil & Gas industry, and his work aimed to improve the performance and durability of polymer components by implementing numerical methods. Ali has 11 technical papers and 3 patents. He obtained his Ph.D. in mechanical engineering from The University of Akron. Adarsh Chaurasia Bio: Adarsh Chaurasia (Ph.D.) is currently a Senior Application Engineer at ANSYS Houston office and primarily supports industry efforts focused around structural mechanics. His background is in computational solid mechanics with focus on nonlinear material modeling and coupled physics solutions. He received his Ph.D. in Engineering Mechanics from Virginia Tech in 2016.

Presenter Name: Anderson, Devin

Presenter Company: NASA Jet Propulsion Laboratory

Presentation Title: Using Thermal-Mechanical Topology Optimization and Additive Manufacturing for Performance Driven Space Flight Hardware Design (D. Anderson, NASA Jet Propulsion Laboratory; Lvl: 1)

Session Title: Additive Manufacturing 1

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 12:00 PM

Type: Presentation

Intended Learning Outcome:

The power of using topology optimization to solve very complex multiphysics and how to interpret such designs in an efficient manner for space flight applications.

Keywords: topology optimization, optimization, multiphysics, additive manufacturing,space

Abstract:

A single case study describing the utilization of topology optimization and the associated interpreted design process for the development of a functional piece of space flight hardware is described. The space flight hardware consists of a star tracker bracket as part of a larger altitude control system on the Spacecraft Bus, a multi-purpose platform housing many mission critical electronics, for the SWOT (Surface Water and Ocean Topography) spacecraft jointly built by NASA and National D'Études Spatiales (CNES). The case study corresponds to a redesign and manufacture of an existing bracket configuration that was failing under thermal and mechanical mission load cases. The existing bracket configuration has undergone topology optimization, implementing mission defined transient thermal, mechanical and dynamic joint load conditions to achieve a weight and performance optimized design only manufacturable via Additive Manufacturing (AM). After passing design verification by Finite Element Analysis, the component has been fabricated by a powder bed laser based fusion AM process. The SWOT satellite observatory is a joint development by NASA and Centre National D'Études Spatiales (CNES) to effectively study how waves interfere. Using interferometry, or the study of how waves interfere, the SWOT mission will be NASA's most accurate study of water measurement levels across the globe. This accuracy is achieved by a combination of a microwave radar system and several subsystems effectively working together to provide extensive radar data. This data is then used to create global maps of Earth's water levels, providing essential information on large rivers, lakes, and reservoirs – along with Earth's global ocean – at least twice every 21 days. One such subsystem critical to the success of the SWOT mission is the Altimeter. The altimeter sends and receives signals that travel straight up and down from the Earth's surface. Each pulse's round-trip travel time will be used to determine orbital height. This paper focuses on the application of optimization from a pragmatic standpoint, addressing strict mission critical constraints with Altair OptiStruct's unique multidisciplinary optimization workflow. In addition to the mission requirements and optimization routine itself, a thorough outline of the results interpretation associated with topology output and potential refinement will be discussed. This all occurring in the lens of utilizing the free form nature of Additive Manufacturing technology to achieve part complexity not achievable in traditional manufacturing methods.

Speaker Biography:

Not Yet Provided

Presenter Name: Ayala, Alejandro

Presenter Company: Ford Motor Company

Presentation Title: The Coming Engineering Analysis and Simulation Transformation (A. Ayala, Ford Motor Company; Lvl: 3)

Session Title: AI-Guided Simulation

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 5:30 PM

Type: Presentation

Intended Learning Outcome:

The future for engineering simulation will be driven by Artificial Intelligence and advanced digital tools to enhance the designers and engineers on handling the increasing systems engineering complexity.

Keywords: Artificial Intelligence, Simulation, Engineering, Analysis, Systems Engineering, Systems Integration

Abstract:

The future for engineering simulation will be driven by Artificial Intelligence and advanced digital tools to enhance the designers and engineers on handling the increasing systems engineering complexity. The disruptive new technologies require large systems engineering with complex models and increasing number of elements that would reach thousands and even millions of interfaces, to face the changing customer needs, priorities and global market uniqueness. The designers and engineers are already starting the usage of AI and advanced digital tools to automate the design complex processes in order to generate the required efficiencies and preventive errors tools, to be focused on innovative and ideation process, to reinvent and evolve new products and services. From a business and human perspectives, the culture change within the organizations is a critical step to fully adopt AI and digital tools such as SMBSE and dilute barriers to change. Another human enabler is the priority of being customer centric, as the origin to accelerate the product development process with advanced models and architectures to anticipate the coming new necessities and priorities of diverse customers and entities. The proposed methodology integrates the latest new technologies and the emerging ones within an integrated solution to simplify the engineering analysis and simulation, in spite of the intrinsic growing complexity of the new technologies. The main tools of the proposed methodology are AI, SMBSE, virtual simulation and integration platforms to ensure a development ecosystem in accordance with the never-ending race to innovate and satisfy the global markets. The 2020 decade will be not just a full digital expansion, but also a smart environment in all the products and services. Shared hardware, software and computing services will reduce the cost of developing smart tools, so the usage of AI will be a must to compete and to gain competitive advantages in the global arenas.

Speaker Biography:

ACADEMIC BACKGROUND Electrical and Mechanical Engineering, La Salle University Mexico MBA, ITAM Mexico Master of Science in Product Development, University of Detroit Mercy, Michigan USA MIT Certificate: Architecture and Systems Engineering: Models and Methods to Manage Complex Systems MIT Certificate: Artificial Intelligence Applied to Business Strategy OTHERS Patent: Electromechanical Integrated Machine (EIM) for Electric Vehicles SAE Mexico President (2018-2019) PAPERS Smart Model Based Systems Engineering, US Army Industry GVSETS, Novi Michigan 2018 Artificial Intelligence applied in Design Optimization – in process RECENT CONFERENCES Artificial Intelligence Applied to the Auto Industry, ANSYS, Mexico, 2019 Artificial Intelligence Applied to MBSE, NAFEMS, Ohio, 2019 Artificial Intelligence Applied to the Auto Industry, MIT- IPADE, 2019 Artificial Intelligence 3D Model Generation, NAFEMS, ITESM Smart Model Based Systems Engineering , US Army Industry Global Vehicle Systems Engineering Technology Symposium (GVSETS), Novi, Michigan USA 2018 Automotive Industry and the Future of Mobility, PPG 2018 LABOR BACKGROUND 32 years of experience at Ford of Mexico and Ford US, mainly as executive of Product Development Office, extending the generation and application of virtual and smart tools in the global design processes.

Presenter Name: BANNIER, Amaury

Presenter Company: NEXTFLOW Software

Presentation Title: You already know about FVM or LBM? Discover SPH! (A. BANNIER, NEXTFLOW Software; Lvl: 2)

Session Title: CFD 2

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 3:00 PM

Type: Presentation

Intended Learning Outcome:

A short guide to get through the maze of Computational Fluid Dynamics (CFD) and identify your most relevant method

Keywords: Smoothed Particle Hydrodynamics, Finite Volume, Lattice Boltzmann, CFD methods, Automotive, Aerospace

Abstract:

Each method comes with its own strengths and its own limitations, which may be explained by the underlying physical assumptions, the discretization approaches and the numerical techniques… Depending on the problem to solve, the “ideal” solver may not be the same. This presentation intends to provide some background information and ease which solver to choose. Instead of tackling one-by-one the wide diversity of CFD solvers, the main differentiating approaches and techniques will be explained, and their strengths and weaknesses underlined. From technical characteristics to physical capabilities, from numerical aspects to meshing user experience, the suitability of each methods in addressing specific application fields will be explained. A special focus will be placed upon the "conventional" FVM (Unstructured body-fitted Finite Volume Methods), the octree-based immersed-boundary FVM, the LBM (Lattice-Boltzmann Methods) and the SPH (Smoothed Particle Hydrodynamics) method. With all these strengths and limitations in mind, the applicative capabilities of the SPH methods will be illustrated with several representative cases from the automotive and aerospace industries. Note that multi-fluid flows, thermal analysis, surface tension, cavitation, Fluid-Structure Interaction (FSI), CFD-method coupling... may all be involved!

Speaker Biography:

Amaury Bannier is Product Manager at Nextflow Software, an independent software vendor startup specialized in Computational Fluid Dynamics (CFD). Bannier has enrolled in 2008 at French "Grande École" Ecole Polytechnique to graduate in Mechanical Engineering. Then, he went to UCLA, California, graduating in 2012 with a M.Sc. degree in Aerospace Engineering. He received his Ph.D. in 2016 from the Pierre and Marie Curie University, Paris, for his research on turbulence control.

Presenter Name: Baqué, Pierre

Presenter Company: Neural Concept Ltd.

Presentation Title: Geodesic Convolutional Neural Network for 3D Deep-Learning Based Surrogate Modeling and Optimization (P. Baqué, Neural Concept Ltd.; Lvl: 2)

Session Title: Advanced Information Technologies 2

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 2:00 PM

Type: Presentation

Intended Learning Outcome:

Latest trends in the use of machine learning methods accelerate CAE simulations and optimise shape designs.

Keywords: Deep Learning, AI, Surrogate Model Optimisation.

Abstract:

For decades, the role of numerical simulation in product development has been growing dramatically. Today, even more prominent with the rise of industry 4.0, simulation has shifted from being a validation tool of mature designs into a means of exploration of product design space. The growth of high performance computing infrastructure and the progress in high-fidelity simulation methods have certainly contributed to numerical simulation being key in the reduction of physical testing and in product performance improvement. Yet, the time required to run a simulation is, most of the time, a bottleneck in the engineer's optimisation loop and for larger design spaces it can result in automated shape optimization being simply intractable. This needs to be addressed on the way to better simulation-driven design. Unsurprisingly and like in many other disciplines, machine learning has got an answer. The promise is to leverage the untapped value of historical simulations to learn a surrogate model as a cheaper data-driven substitute for the numerical simulator. Surrogate models are used in CFD simulations as well as many other simulations such as structural analyses involving a finite element solver. Most of the existing surrogate modeling approaches rely on Gaussian Process regressors (Kriging) and are thus limited to predicting the performance of shapes with a fixed low-dimensional parameterization. On top of that, kriging methods are meant for predicting global scalar values but they are not capable of predicting fields (e.g. velocity or pressure values at every point of the shape). More recently [1], authors proposed using a deep neural network as a regressor, which takes polycube-mapped meshes as inputs. Unfortunately, this means that the method is only applicable to surface meshes that have been remapped to the same polycube topology and are composed of a single connected component. One way to overcome this issue is to rely on geometric deep learning techniques [2, 3] that directly operate on 3D meshes. In this abstract, we give an account of the successful application of 3D geometric deep learning techniques powered by the Neural Concept Shape software to accelerate and automate shape design optimization in real industrial use cases. More particularly, we demonstrate the case of a fixed-wing drone shape optimisation. We train a deep Geometric Convolutional Neural Network (GCNN) to reproduce the flow and pressure field, normally obtained using a CFD solver, directly as a Neural Network prediction. Importantly, the input of our Neural Network can be a mesh representation of the shape since we rely on spatial mesh convolutions as described in [3]. In our software, we use geodesic coordinates for convolutions on the surface of the objects, and Euclidean coordinates for convolutions in the bulk of the domain. As opposed to existing methods, we do not use an interpolation on a regular grid or an image, and do not require prior re-meshing of the shape. The reported approach is beneficial on many critical aspects: first, it allows us to compute approximate solutions orders of magnitude faster than the typical numerical simulators (tens of milliseconds instead of multiple hours); and, second, it allows to compute the gradients of the objective (e.g. aerodynamic efficiency) with respect to the input shape. This ultimately allows us to run optimization loops in reasonable time and makes it possible to use first-order optimization methods.

Speaker Biography:

Pierre received an engineering degree in Applied Mathematics and a Masters degree in Operations Research (Combinatorial Optimization) from Ecole Polytechnique in Paris. He started his career working as an Engineer for Credit-Suisse in London, where he developed numerical optimization and statistical analysis tools in the Equity Derivatives division. In the same period, Pierre started working on algorithmic optimization for engineering and co-developed the software CarmenV2 for optimization in ropeways engineering. Pierre then joined the Computer Vision Laboratory at EPFL where he got his doctoral degree in early 2018 under the supervision of Prof. Pascual Fua and Francois Fleuret. His research focused on Deep Structured Learning and Variational Inference applied to Computer Vision. During his PhD, Pierre worked on shape optimization problems using Deep-Learning and on multiple topics related to 3D Deep-Learning. He is the author of multiple papers in tier-1 conferences in Machine Learning, optimization and related fields. As a result of his doctoral thesis, Pierre founded Neural Concept in 2018 with his former thesis advisor. He is now leading the company and still very active in the research field through many collaborations with EPFL.

Presenter Name: Bastien, Hugo

Presenter Company: CREAFORM

Presentation Title: Optimisation of the strength of a Composite Floor System by Numerical Simulation of Steel and Concrete interaction (H. Bastien, CREAFORM; Lvl: 3)

Session Title: Structural Analysis 2

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 1:30 PM

Type: Presentation

Intended Learning Outcome:

How advanced Simulation Techniques can step aside typical rules in the field to allow the optimisation of a composite structure (steel-concrete) load rating

Keywords: Composite Floor Structure, Composite Beam, LS-Dyna, Tie-Break Contact

Abstract:

Optimisation of the strength of a Composite Floor System by Numerical Simulation of Steel and Concrete interaction The use of composite beam structures in buildings advantageously combine compression strength of concrete and tension strength of steel. Deflecting as a single unit, a composite slab shows high stiffness and strength and is known to be the highest quality type of floor systems construction. More specifically, the CANAM Hambro composite steel joist system consists in composite T-beams, integrated in a transversally reinforced continuous slab. The bottom chord acts as a tension member, while bent rods serve as a web to resist vertical shear. The top chord withstands compressive loads prior to the addition of the concrete and act as a continuous shear connector between the steel and concrete in the composite system through adhesion and friction. Characterisation and optimisation of the adhesion and friction interface is believed to be one of the key factors to enhance the load-carrying capacity of the structure. In order to understand mechanics behind that interface, detailed Finite Element Models (FEM) were developed. The effects of specific features were studied independently in simpler localized FEMs, then correlated using physical testing. These FEMs were finally used to build a Global FEM taking into account all the different features to predict the entire structure performances. To maximize the shear strength of the concrete-steel interface, a complex steel profile including localized features has been studied. A detailed FEM has been developed in LS-Dyna. Structural behaviour of concrete has been driven by a model previously developed for the automotive industry. Adhesion of concrete on steel, which might lead to a specific mode of failure of the structure has been represented using a tie-break contact. Steel frame with local geometrical feature has been represented in detail with its concrete surrounding by a high-density 3D mesh. This first model allowed to establish a first correlation of the algorithms used with the physical results and to study variations in localized geometrical features and frame cross-section. The loss of adhesion in shear on the concrete-steel interface has then been characterized and performance due the geometrical details in the frame has been optimized. This first FEM was correlated experimentally. In addition to the effect of single design features, the behaviour of specific interfaces was studied. A second FEM has been developed to study a specific interface with a different failure mode. Plastic deformation of the steel and compression failure of the concrete were deemed to play a more important role in that interface rather than steel-concrete shear adhesion. Correlation with physical testing allowed to establish the critical parameters in the representation of that specific interface and demonstrated ability of the FEM to represent that second mode of failure; driver for a certain structure region. Once the specific Finite Element Models were refined and correlated separately, the whole structure was modeled for the reproduction of the global performance test. The Global FEM, uniting the different techniques developed in the above-mentioned specific FEMs was meant to establish the load rating of the entire structure. The specific failure modes previously studied interact closely together in the global structure load-rating mechanical test. Failure load and load vs displacement predicted by the Global FEM were studied and showed to match closely the available test data. From that FEM, a better understanding of the different failure modes and their interaction was reached. Moreover, it consists of an interesting tool for optimizing the whole structure. Within that study, it has been possible to test different designs iterations and compare their performance without being dependent on costly physical testing.

Speaker Biography:

Since 2006, Hugo has been working extensively with the numerical simulations for product development within a highly skilled Engineering Team. He has acquired a solid knowledge of structural analysis in various fields. He has been performing Finite Element Analyses using multiple codes to predict the behavior or assess the strength of products in the aerospace, aeronautic, military, bioengineering, transport, naval and heavy industry fields. Working as a consultant, Hugo has the opportunity to combine the technical knowledge acquired in the multiple fields to help the customers establishing a strong design process where structural analysis plays an optimal role. Dealing with various kind of models; from the simple linear few elements for the proof of concepts to the complex meshes for the precise stress prediction. Hugo's target is to use the powerful tool that FEA is in an optimal manner for each individual project.

Presenter Name: Betts, Juan

Presenter Company: Front End Analytics LLC

Presentation Title: Monetizing Digital: Where Engineering Meets Dollars (J. Betts, Front End Analytics LLC; Lvl: 2)

Session Title: Advanced Information Technologies 1

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 12:00 PM

Type: Presentation

Intended Learning Outcome:

Physics Informed Machine Learning can power and monetize Simulation Powered Design and Predictive Digital Twins

Keywords: machine learning, artificial intelligence, simulation democratization, digital twins

Abstract:

The Digital Revolution has fundamentally transformed the role that predicting product performance plays in the business model of companies. Customers are increasingly buying directly the outcomes and experiences that result from the product use rather than the products themselves. This fundamental shift in customer attitudes now requires for companies to not only design products, but to also accurately predict the outcomes these products produce based on actual customer usage and moreover tune, in real-time, the performance of these products to desired customer expectations. Engineering Simulation as it stands today is simply not up to this task. Physics Informed Machine Learning (PIML™) technology converts complex and time-consuming engineering simulation workflows into fast running instantaneous solvers. PIML™ in contrast to purely Data-Driven Machine Learning techniques, is much more accurate, requires significantly less data, gives users insight as to how to improve the solver's predictive capability, is more robust to changes in the environment and can be integrated into Bayesian information fusion frameworks. Applications include: 1. Simulation Democratization: PIML™ powered surrogate solvers can be integrated into your existing simulation powered design democratization initiatives. 2. Sales Accelerators: PIML™ can also be used to accelerate product sales using your company's existing sales and distribution lines. PIML™ enables companies to create complex configurators and demonstrators that can be web-enabled or enhanced through virtual reality (VR) showcasing to customers how your products will perform under real-world complex scenarios. 3. Warranty Claim Occurrence Predictor: PIML™ could also help reduce your company's warranty claims. We recently demonstrated to a customer that we could feed field data to our PIML™ solver and accurately predict where a warranty failure would occur. 4. Data Classification & Virtual Sensor: PIML™ can be used as classification tool to distinguish "good" data vs. "bad" data say in a test environment. 6. Model Based Controls: PIML™ speeds models to make them usable in model-based control architectures that require models to run faster than real time in application such as system performance simulation, autonomous systems, climate control, to name a few. These model-based control architectures can then eventually be incorporated into Digital Twins 7. Digital Twins: PIML™ powered surrogate solvers can be embedded into onboard processors creating Predictive Digital Twins that can provide in real-time the response of key performance parameters to input operating conditions.

Speaker Biography:

Not Yet Provided

Presenter Name: Bhivare, Abhay

Presenter Company: Ford Motor Company

Presentation Title: Automation and Design Space Exploration for Improved ADAS Feature Performance (A. Bhivare, Ford Motor Company; Lvl: 2)

Session Title: MBE 2

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 4:30 PM

Type: Presentation

Intended Learning Outcome:

How to leverage MBSE and optimization tools to improve the performance of ADAS features.

Keywords: MBSE, Optimization, ADAS

Abstract:

The rapid growth of Advanced Driver Assist Systems (ADAS) is presenting many challenges to the automotive development engineers. On one hand, the development of the ADAS features requires an in depth knowledge of the desired customer experience. In fact, not only the performance of these features is becoming a differentiator between the different OEMs and customer usage data reveals a lack of satisfaction with the operation of certain ADAS features. On the other hand, the validation of these features requires advanced MBSE methods as it cannot rely solely on physical testing due to the significant number of scenarios required for the validation. As an alternative to physical testing, simulation and virtual validation methods appear to be the tools of choice for the development of complex ADAS features. For example, the Fully Assisted Park Assist feature (FAPA) can be validated based on scenarios defined by a specific corporate validation test procedure. Typically, the scenarios involve an ego vehicle, moving at a speed below 30 Km/h, and different parking slot scenes such as between two cars or between a car and a curb. The key parameters monitored during the FAPA validation are the number of turns, the backward and forward steps, the final parking position and the time to park. It is obvious that in real world situation, there is a significant variation in the parameters that define the parking spot and the vehicle being parked. These variations result in significantly larger number of possible scenarios compared to what is defined by the standard validation test. Consequently, simulation is the only way to assess the performance of FAPA under the real world situations. The MBSE simulation of FAPA requires the modelling of ultrasonic sensors, parking logic, vehicle dynamics, steering and powertrain. Customers exhibited some initial excitement using FAPA, but the long term customer satisfaction depends on key performance indicators such as the time to park, number of turns to park and accuracy to park. These indicators can be improved by tuning various design parameters. However, this tuning depends on the scenario considered. The combined number of tuning parameters and parking scenarios becomes huge and requires a sophisticated optimization approach to develop the tuning that maximizes customer satisfaction. This paper presents an analytical method to identify the tuning parameters for best FAPA performance. This method integrates MBSE simulation and optimization using FAST optimizer with a genetic algorithm. The genetic algorithm is used to create the required design space in order to perform a multi-objective optimization using a large number of design parameters and scenarios. Results of this optimization method are discussed and the performance of the optimized FAPA is compared to the current status.

Speaker Biography:

Abhay Bhivare: MS in mechanical engineering and MBA in general management. Currently works as supervisor in ADAS Virtual Verification and Validation department responsible for Parking, Trailoring and Lighting Simulation 25+ years of Automotive product development experience.

Presenter Name: Bhogle, Sanket

Presenter Company: Detroit Engineered Products

Presentation Title: Implementing Simulation Governance & Democratization (S. Bhogle, Detroit Engineered Products; Lvl: 3)

Session Title: Simulation Governance 1

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 12:30 PM

Type: Presentation

Intended Learning Outcome:

Smart processes to automatically define contacts and auto fix contacts are being added to make it easier for engineers to save time. With this process automation a CAE user does not need to be an expert with any programming language.

Keywords: Process Automation, Virtual Validation, Auto Parameterization

Abstract:

Automation is very important part of industry 4.0 and it is no different in the virtual validation scenario as well. Traditionally CAE model building activities that are time consuming have been core focus of automation besides creating presentation files from the FE results data base. In most organizations CAE SoPs (standard operating procedures) are already in place. This satisfies one of the important necessary conditions for initiating automation. Today, as the product development cycle time is being shrunk there is more emphasis on virtual validation. This has led to more workload for CAE/FE analysts. Automation of the CAE SoP provides an opportunity to CAE/FE analysts to overcome the time crunch without any compromise to quality of results. In this paper, effort is being made to explain a novel approach to CAE process automation. The paper looks at automation for preparing ready to run FE model of clutch assembly. The Clutch assembly is usually built with some parts that are discretized with hexa elements and others with higher order tetra elements. This depends on the SoP or best practice followed by engineering teams. The process automation that is discussed in this paper is designed to generate ready to run solver deck from input CAD data. This process automation captures geometry clean-up tasks for clutch assembly parts, meshing clutch assembly parts as per the guidelines or SoP, assigning material properties, creating connection as per model assembly guidelines and creating the analysis load steps. Smart processes to automatically define contacts and auto fix contacts are being added to further save engineers' time. The process automation does require inputs from the user and they are channeled through "drag and drop" menus or User Panels that are easy to create. These are a part of process automation methodology. The key four steps for the process automation are Record, Create UI, Plumb the Process and Publish. Auto parameterization of the FE model provides ability to add intelligence to the FE model assembly. This ability eases the 'what if' scenario. This holistic process is estimated to save time drastically upwards of 50 percent to the CAE user. The Process Automation that is created by a CAE engineer using the above mentioned process does not require an expertise with any programming language. CAE activities in product development tend to be resource intensive. CAE process automation is very important to reduce the time spent on mundane CAE activities including certain pre-processing and post-processing steps. This is the inception for democratizing CAE activities as it enhances the efficiency from all resources.

Speaker Biography:

Sanket Bhogle Biography (bullet points/headers only!) • Sanket Bhogle is a Post Sales Engineer at Detroit Engineered Products where he is responsible for global development and support of MeshWorks and CAD Morpher • He graduated from Michigan Technological University with a Masters in Mechanical Engineering and has more than 4 years of experience in CAE with a focus in process development and product design • He has a masters' thesis on "Advanced Computational Modelling of the internal structure of smart wind turbine blades" from Michigan Tech • In 2014 he joined DEP as Project Engineer. He was recognized for his valuable contribution in CAE design process flow development by a major OEM Current position / tasks POST SALES ENGINEER: Global development and support of MeshWorks and CAD Morpher

Presenter Name: Bilal, Kamel

Presenter Company: Stantec

Presentation Title: Numerical Analysis and Behavior of Ultra High-Performance Concrete (K. Bilal, Stantec; Lvl: 2)

Session Title: Advanced Materials Engineering

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 2:30 PM

Type: Presentation

Intended Learning Outcome:

Innovative methodology in simulating and predicting the most reliable behavior of UHPFRC by realistically modelling the fibers inside the specimens which will lead to achieving an accurate value of resultant compressive strength.

Keywords: Concrete Mixes, Ultra High-Performance Fiber Reinforced concrete, Concrete Damage Plasticity, Nonlinear finite element analysis, ABAQUS.

Abstract:

Ultra-High-Performance Concrete (UHPC), an enhanced version of High Strength Concrete (HSP), is a newly developed class of concrete utilizing the latest concrete technology. The main characteristic of this modified concrete material is the addition of fibers to the concrete mix, which increases strength and durability. Existing research shows that the advantages of using ultra high-performance fiber reinforced concrete (UHPFRC) include higher compressive strength, higher tensile and flexural strengths, higher ductility and durability which contribute to improved overall performance of the enhanced material as well as decreased maintenance costs. However, research in this field remains limited to experimental studies only which require very high load capacity testing equipment to obtain strength characteristics of various specimens. This raises a need to perform numerical investigation of UHPFRC to eliminate any difficulties in mixing and assembling the samples as well as achieve accurate capacity results in a time and cost-effective approach. This research proposes an innovative methodology in simulating and predicting the most reliable behavior of UHPFRC by realistically modelling the fibers inside the specimens which will lead to achieving an accurate value of resultant compressive strength. Three-dimensional non-linear finite element (FE) models were built using ABAQUS to compare and validate the behavior of UHPFRC mixes against experimental results. The models include detailed analysis and investigation of the concrete and fiber components behavior up to failure using Concrete Damage Plasticity (CDP) Material Model. Fibers were randomly positioned using six different variables, three primary representing the fibers' position within the specimen`s region and three secondary representing the fibers' local orientation. The embedded region constraint was used to model the interaction between the fibers and concrete. Good comparison between the FE results and previously tested specimens has been achieved. The presented framework can then be used to estimate the capacity of different specimens with different fiber weight ratios.

Speaker Biography:

Not Yet Provided

Presenter Name: Bokil, Rohan

Presenter Company: Vanderplaats Research & Development

Presentation Title: Combined Multi-Disciplinary Design Study and Structural Optimization Approach to Design Parts for Additive Manufacturing (R. Bokil, Vanderplaats Research & Development; Lvl: 1)

Session Title: Optimization 2

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 4:00 PM

Type: Presentation

Intended Learning Outcome:

How the combined multi-disciplinary design study and structural optimization approach can be used in designing parts for 3D printing.

Keywords: Multi-Disciplinary Design Study, Structural Analysis and Optimization, Sizing Optimization,Additive Manufacturing

Abstract:

In today's competitive markets, companies are constantly looking for new ways to reduce cost and bring their products faster to market. Emerging new additive manufacturing (AM) techniques opens up new opportunities in creating lightweight parts and accelerate parts production. New AM machines are becoming more and more capable to print complex organic shaped structures and lattice structures. Lattice structure is a type of structure made of two or three-dimensional beams or struts, that can dramatically reduce weight, retain structural integrity and provide other advantages such as high surface area, desirable noise damping and shock absorption properties. To take full advantages of AM processes, designers are starting to include lattices structures in design of new parts. In this paper, we discuss an approach that combines multi-disciplinary design study techniques with structural optimization methods to design a part with lattices which can be manufactured using additive manufacturing. To illustrate our proposed approach, we use an example in which the goal is to find the best lattice cell type that will provide maximum structural stiffness for a given mass for specified load cases. In our example, the part is subjected to 3 different load cases i.e. torsion, bending and shear. The FE analysis of the part with lattices is carried out by using a homogenized material that represents the lattice type. To maximize part stiffness, each lattice cell bar diameter is optimized using sizing optimization technique. The multi-disciplinary design study technique is used to find the best lattice cell type that will provide the highest stiffness for the specified loadcases. Three key advantages of using the proposed combined approach are a) The sizing optimization method efficiently finds the stiffest structure for the given mass fraction and lattice cell type. b) The multi-disciplinary design study technique finds the best lattice cell type with maximum stiffness. c) The multi-disciplinary design study technique also provides valuable insights into the design space. In the example problem, the structural analysis and optimization software, GENESIS, and the multi-disciplinary design study and optimization software, VisualDOC are used to demonstrate the proposed combined optimization approach.

Speaker Biography:

Rohan Bokil works as a Deputy Project Manager, R&D at Vanderplaats Research and Development in Novi, MI. He holds a Master's degree in Mechanical Engineering from Clemson University and joined VR&D in November 2017 as a part of the VisualDOC software development team.

Presenter Name: Brittain, Kevin

Presenter Company: Cummins - STC

Presentation Title: Democratization of Simulation and Optimization Leads to Effective Decision Making at Cummins (K. Brittain, Cummins - STC; Lvl: 2)

Session Title: Democratization

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 4:00 PM

Type: Presentation

Intended Learning Outcome:

How Cummins is changing the way we are doing product development through the use of MDO toolsets.

Keywords: MDO, Democratization, Modeling and Simulation

Abstract:

A plethora of factors like expanding technologies, complexity of the products, reduction in time to market led to Cummins adopting a strategy of Simulation Based Product Development. As simulation and modeling capability matured the impact of this strategy was felt across the product development lifecycle from component level detailed design to subsystem and system level design. Cummins started leveraging the benefits of application of Multidisciplinary Design Optimization (MDO) techniques for integrating multiple disciplines in complex workflows and then using mathematical optimization and data driven decision-making techniques for generating more value out of the simulations. This strategy led Cummins to move to a more holistic design approach where product architects, system engineers, design engineers and simulation engineers were all involved in the decision-making process using simulation as a backbone. Use of optimization and decision-making techniques moved to early stage design in the product development cycle. This presented a challenge of enabling effective use of system simulation tools and analytical decision-making methods to various stakeholders in the product development cycle. In this paper we explore the use of desktop and web-based MDO platforms to democratize simulation workflows, mathematical optimization and decision-making techniques to enable a Simulation Based Product Development The case study highlights the evolution in Cummins' approach to the use of simulation from architecture to detailed design enabled by an MDO and Systems approach. We will highlight the migration from a desktop and manual share of models approach to a web-based simulation platform to democratize decision-making and simulation/optimization capabilities. This final piece enables creation of a seamless decision-making platform which can be deployed across the broader design community and leverage the value of simulation and optimization for effective and efficient product design. We will present some specific examples to illustrate our vison for the use of MDO tools and their impact on the product development process.

Speaker Biography:

Kevin Brittain has worked for Cummins in structural analysis and MDO for 9 years. He received his Master's degree in Mechanical Engineering at the University of Illinois Urbana-Champaign in 2011 with an emphasis on structural optimization. Currently he is leading a global MDO team within the Power Systems Business Unit and also leading cross functional initiatives across the company to proliferate the use of optimization within simulation based product development.

Presenter Name: Butler, Celia

Presenter Company: Synopsys (N.E) Ltd

Presentation Title: Rapid 3D Inspection of AM Components Using CT: From Defect Detection to Thermal Performance Simulation (C. Butler, Synopsys (N.E) Ltd; Lvl: 2)

Session Title: Additive Manufacturing 3

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 4:00 PM

Type: Presentation

Intended Learning Outcome:

How to use models generated from X-ray CT images to inspect and detect defects in "as-built" Additive Manufactured structures, and create image-based models for simulating the structure's real performance.

Keywords: Additive manufacturing, image-based modelling, image-based simulation, CT, NDT inspection

Abstract:

Metal Additive Manufacturing (AM) can be used to produce topologically complex designs, which are difficult or impossible to engineer using traditional manufacturing techniques. Non-destructive inspection and testing of such structures can be challenging due to internal or inaccessible features. Inability to find and correct for defects in built parts can lead to increased performance testing, as well as potentially more failures and therefore increased scrappage of parts; wasting precious time and resources. Here a “hot box” heat exchanger is presented as an industrial example of how X-ray Computed Tomography (CT) can be used as part of a non-destructive testing process to inspect complex structures. From the CT scan, an image-based model was built to identify and analyse defects and deviations from the original design. At this stage, the part could be deemed fit for use if any deviations fall within allowed tolerances or inspected further using image-based simulation. Inspection at this stage also means changes can be made to the manufacturing process for future manufacturing runs (such as a design change for trapped powder extraction). Image-based simulation allows virtual performance testing of the “real” part (as opposed to a CAD idealisation). This representation of the “as-built” structure includes any defects, pores, warping etc. which could have occurred during the manufacturing process. In the “hot box” heat exchanger example, defects in the structure were identified. This was mainly in the form of trapped powder in narrow channels, and some deviation to the lattice structure. An image-based simulation of the “as-built” structure was undertaken to show the impact of these deviations from the “as-designed” structure. This simulation focuses on the thermal performance of key areas of the “hot box”. The ability to perform dimensional, integrity and surface inspection in a single workflow proved to be highly beneficial for the current production process of the “hot box”. It has the potential to reduce inspection time and remove the need for additional inspection equipment, therefore reducing costs, cycle times and potentially increasing workable floorspace.

Speaker Biography:

Dr Celia Butler is a Senior Applications Engineer at Synopsys; working with engineers, researchers and medical professionals to generate models used to solve complex problems. Celia has previous experience leading research projects and product development in commercial and academic teams. She is a Honorary Senior Lecturer at the University of Exeter.

Presenter Name: Camanho, Arthur

Presenter Company: ESI North America

Presentation Title: An Effective Approach for Elimination of Scrap Accumulation in Mass Stamping Production of Sheet Metals (A. Camanho, ESI North America; Lvl: 2)

Session Title: Manufacturing Process Simulation

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 12:00 PM

Type: Presentation

Intended Learning Outcome:

Elimination of Scrap Accumulation in Sheet Metal Stamping

Keywords: Scrap Shedding, Metal Stamping Manufacturing, Optimization

Abstract:

An important issue in metal stamping manufacturing is the successful shedding of scrap from trim dies. Because scrap is not the primary product, it receives less attention than the finished products. However, not evacuating scrap from the die in an efficient manner causes production delays due to shut down, reduces die efficiency, and increases cost of stamping production. Thus, it is critical to establish trim die design integrity as early as possible in the design process to eliminate scrap shedding related shutdown of the press line of production. An efficient simulation/optimization process is proposed to identify the critical design parameters to eliminate scrap shedding related shutdown and inefficiencies, thus improving the manufacturing, product quality and lifetime of the trimming dies at reduced capital and operating costs. Simulation of sheet metal forming is becoming increasingly popular and has become essential in the automotive industry for sheet metal product design, die design developments, and production stamping. Simulation shortens lead times since it can be used to reduce development cost while assessing the feasibility of part geometry. A typical stamping simulation process for a single sampling point (design variable) involves the design of die, creation of die, tryout of die, validation of die, and completion of die. The aim of the optimization is to determine the variables that cause the accumulation and subsequent jamming of scraps in the metal stamping process. Parameters such as die velocity and type of trim operations affect the metal shedding. Since these parameters influence the forming and trimming operations, scrap shedding investigation requires the simulation of the entire, computationally expensive process. Additional parameters such as contact surface area, distance between gravity center and geometric center, shape complexity, weight and angle of inclined plane, change of friction due to accumulation of metal dust, and design of scrap chutes also affect the scrap-related inefficiency.

Speaker Biography:

Arthur Camanho Smart Manufacturing Director, ESI Group Arthur Camanho brings over 20 years of experience in mechanical engineering, manufacturing processes and technical support. He is considered an expert in metal forming simulation and FEA engineering with a concentration on stamping, casting and welding manufacturing processes. Camanho earned his mechanical engineering degree from FEI University in Sao Paulo, Brazil. He spent 19 years in the Sao Paulo area working in various capacities for ESI before moving to the North American headquarters to take the lead in the virtual manufacturing arm of the company. Arthur, his wife and two children reside in Metro Detroit.

Presenter Name: Castro, Christian

Presenter Company: Ford Motor Company

Presentation Title: Additive Manufacturing Applied in Cost & Weight Reduction Strategies in Automotive Components (C. Castro, Ford Motor Company; Lvl: 2)

Session Title: Additive Manufacturing 1

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 11:00 AM

Type: Presentation

Intended Learning Outcome:

The audience will learn how Additive Manufacturing can be applied on weight/cost improvement strategies for automotive components.

Keywords: Additive Manufacturing, CAE, FEA, 3D Printing, Altair, Automotive, Optimization

Abstract:

As we know, Additive Manufacturing is a technology that allows the rapid fabrication of components via 3D printing. The process is so diverse (as it uses different materials and substances such as: metal powders, ceramics and plastics.) that it can be applied in several industries. This type of process is just ramping up in its applications as printers and materials are evolving at important rates. There are two main reasons why this manufacturing method is rapidly gaining popularity: 1) 3D printers evolve rapidly and allow more complex components to be manufactured in less time, with less costs and with more innovative materials. 2) Just as the fuel saving approach has evolved the designs of automotive components to make them more efficient in weight and cost, we are now facing a second evolution of designs that aim to improve the efficiency of charge in batteries included in electric cars. Explaining the details on the second point: we have detected a philosophy of "plasticization" of components that were previously made of steel, aluminum or different alloys. The new plastic components explore the possibility of building new geometries (more complex and more efficient) by means of topological and topographic optimizations but also to establish the bases that would allow these components to be manufactured by 3D printing methods. This paper attempts to explain and exemplify how the Additive Manufacturing process can help not only to design components that are thought of as 3D printables but ones that are thought also in an intuitive, graphic and rapid process of structural optimization. This process, first, must be supported by software such as solidThinking Inspire, which allows the designer / engineer to go hand in hand in the design and implementation of rapid prototyping and printing components. All thanks to the fact that optimizations can be carried out by simulating the actual loading conditions of the system that is being designed.

Speaker Biography:

Christian Castro Guzmán Electromechanical Engineer based in Mexico City. Powertrain CAE Engineer from 2012 to 2019 and currently Powertrain CAE Supervisor for Ford of Mexico, broad experience validating powertrain finite element models through vibration, durability & static analyzes in several vehicle systems such as: cooling, fuel, engine and air induction. Eight-year background in new CAE methods development and technical research. Amara Regalado As a Technical Account Manager at Altair, Amara Regalado is responsible for delivering Altair's simulation, modeling, optimization and data analytics technologies to designers, engineers and simulations specialists in product design leading companies located in Mexico. She earned a bachelors degree in mechatronics engineering and a postgraduate degree in Robotics in Universidad Panamericana. Kristian Flores Part of the PT CAE Core team, in charge of evaluate NVH and Durability requirements for powertrain mounts using finite element methods with broad experience in optimization and its application in the product development cycle. He earned his bachelor’s degree in mechanical engineering in the National Autonomous University of Mexico (UNAM).

Presenter Name: Choi, K.K.

Presenter Company: RAMDO Solutions, LLC

Presentation Title: Statistical Model Validation & Calibration for Virtual Product Design (K. Choi, RAMDO Solutions, LLC; Lvl: 2)

Session Title: Uncertainty Quantification 1

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 4:00 PM

Type: Presentation

Intended Learning Outcome:

Statistical methods for virtual product design

Keywords: V&V, Model Validation, Model Calibration, Uncertainty Quantification, Probabilistic Analysis, Virtual Product Development

Abstract:

STATISTICAL MODEL VALIDATION & CALIBRATION FOR VIRTUAL PRODUCT DESIGN K.K. Choi, Jaekwan Shin and Nicholas Gaul RAMDO Solutions, LLC, Iowa City, IA 52240, USA kyung-choi@ramdosolutions.com, jaekwan-shin@ramdosolutions.com, nicholas-gaul@ramdosolutions.com As industries are urged to make trade-offs between speed of product development, cost, quality and reliability, many are starting to develop Virtual Product Development (VPD) process. To develop an effective VPD process, it is critical that simulation models are statistically and quantitatively validated. However, there are a number of challenges to perform quantitative statistical simulation model validation and calibration in practical industrial applications: (1) limited numbers of input data for modeling input distributions, (2) possibly biased simulation models, (3) inaccurate surrogate models, and (4) limited numbers of output test data in the context of statistical and quantitative model calibration and validation. Numerous statistical model calibration and validation methods have been developed over two decades. However, many of them are too theoretical and complicated for practical use by industry engineers. This development presents computational methods to generate simulation output distributions (uncertainty quantification) using the Dynamic Kriging (DKG) method, which automatically selects the best combination of basis and correlation functions for Kriging model from 54 possible combinations over the variance window for highly accurate and very efficient surrogate models. Using simulation model output distributions obtained from the DKG surrogate models and limited output test data, target output distributions, which provide good approximations of true output distributions, are obtained using Bayesian analysis. These target output distributions are used to measure the biasness of simulation models for statistical model validation. In addition, an optimization based calibration (i.e., inverse problem) method is developed, by minimizing convex Hellinger distance (similarity) measure, for unknown input parameter distributions. Furthermore, the cumulative distribution function of the simulation model prediction error is proposed to provide (1) the most probable model prediction error and (2) model confidence level at a user-specified error, which are clear and easy for practicing engineers to use. Practical industrial application and analytical example for an internal combustion engine are used to demonstrate effectiveness of the developed statistical model validation & calibration methods.

Speaker Biography:

Dr. K.K. Choi is Roy J. Carver Professor of Mechanical Engineering at the University of Iowa. His research areas are uncertainty quantification, reliability analysis, reliability-based design optimization, design sensitivity analysis, and mathematical theory of optimization and its applications. He has co-authored over 400 papers, including 176 journal papers in leading national and international engineering journals. He has co-authored several graduate engineering texts (Design Sensitivity Analysis of Structural System, 1986; Methods of Engineering Mathematics, 1993; Design Sensitivity Analysis of Linear and Nonlinear Structural Systems - Two Volume, 2004). At the University of Iowa, he is one of the founding members of the Iowa Board of Regents approved Center for Computer Aided Design (CCAD). He has served as Associate Director (1990-93), Deputy Director (1993-95), and Director (1995-2003) of CCAD. He is associate editor of five national and international journals. He is Fellow of American Society of Mechanical Engineers (ASME), Fellow of American Institute of Aeronautics and Astronautics (AIAA), Fellow of Society of Automotive Engineering (SAE), and President Elect of the International Society for Structural and

Multidisciplinary Optimization (ISSMO, 2007-2011). He was appointed as a World Class University Professor at the Seoul National University in Korea during 2008-2013. He has co-founded RAMDO Solutions, LLC in 2013 and is the Managing Member.

Presenter Name: Cline, Teri

Presenter Company: Honeywell Federal Manufacturing & Technologies

Presentation Title: An Industry Workflow to Integrate Simulation Data into a Unity Application (T. Cline, Honeywell Federal Manufacturing & Technologies; Lvl: 1)

Session Title: Data Management 3

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 4:00 PM

Type: Presentation

Intended Learning Outcome:

The expectation at the end of the discussion is for the audience to learn about a workflow for integrating simulation data into Unity applications, including Augmented Reality applications.

Keywords: CFD, simulation, Augmented Reality, Unity

Abstract:

Simulation data is becoming more and more imperative to decision making in the design and engineering world. How will industries keep up with the ever-changing technologies to integrate simulation data into advanced visualization technologies like Augmented Reality (AR), Virtual Reality (VR), and other advanced platforms? How can simulation engineers answer the question, “How do we utilize AR technology in the most effective way to connect people to simulation solutions and make more informed engineering-based decisions?” Come learn how a team of simulation engineers worked to integrate physics-based simulation data into an AR application utilizing a game engine platform called Unity, a computer animation package called 3dsMax, finite element analysis software packages like COMSOL, and other simulation software packages. The simulation focused on computation fluid dynamics simulations with the goal of integrating stress and strain simulation solutions into game engine platforms, as well. Discover current industry trends for decision making based on simulations including learning about the simulation department at Honeywell and the growth of the influence of simulation solutions throughout the business. Recognize the importance of verification and validation (V&V) in simulation data and how to integrate V&V and keep the integrity of V&V within advanced visualization technologies for showcasing simulation data. Learn about a workflow for using simulation data in animation and game engine platforms like Unity and 3ds Max. Then, learn how the team loaded computational fluid dynamics simulation data onto an Augmented Reality head mounted display. Learn how to create your own simulation story through a similar advanced visualization workflow in order to influence your own business and make more informed physics based decisions. Finally, participate in a discussion to understand the best use case is for integrating simulation data into Augmented Reality and Virtual Reality applications and determine the right visualization tool for the right simulation analysis.

Speaker Biography:

Not Yet Provided

Presenter Name: Cole, Tonya

Presenter Company: Dassault Systemes

Presentation Title: Internal Flow Optimization: Next Level Performance Driven Engineering & Additive Manufacturing (T. Cole, Dassault Systemes; Lvl: 1)

Session Title: Additive Manufacturing 3

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 5:30 PM

Type: Presentation

Intended Learning Outcome:

You will learn about technologies available to advance manufacturing processes and additive manufacturing

Keywords: generative design, cognitive augmented design, topology optimization, additive manufacturing

Abstract:

Over the past year, the adoption of generative design and optimization technologies has significantly picked up steam as a growing number of industry-leading companies invest in the “Factory of the Future” and “Industry 4.0”. There is no doubt they see the benefits associated with automation and data exchange in manufacturing technologies, which are the same benefits and principles clearly evident for design and simulation in generative design. Generative design captures all of the best practices from a previously disjointed process and reduces the amount of time for engineers to identify new shapes that can maximize their business needs, weight, and development time. Additionally, there are cost savings associated with consolidating and optimizing parts in the context of how they will be manufactured, including constraints and optimization functionality suited for milling, casting, and additive manufacturing. With the newest trend for optimization technology being flow optimization, there are a new set of challenges to understand and address, such as finding feasible flow paths that form complex networks throughout a product, while ensuring consistent maximum flow rates. Additionally, simulation plays a critical role in understanding and assessing the manufacturability of these parts. This session will cover: • Potential use cases and industries who can benefit from flow optimization • The challenges and benefits of flow design and optimization • Deep dive into an end to end flow optimization case study for a passenger vehicle HVAC system, including an assessment of the methods available to simulate the additive manufacturing process of the part

Speaker Biography:

Tonya is a Senior Solution Consultant at Dassault Systèmes where she specializes in lightweight engineering, which includes additive manufacturing and composites applications. Tonya has a unique career story, allowing her to bring real-life technical experience to her position at Dassault Systemes for the past 10 years. She began her career as a shop floor machine operator where she discovered her passion for engineering. Her career progressed from there to take on more challenging roles at GKN Aerospace related to engineering, manufacturing, and quality control before she accepted a position with Dassault Systèmes. Tonya also currently holds a Bachelor degree in Business Management. In her current role, she is responsible for educating, demonstrating, inspiring and supporting solutions on the 3DEXPERIENCE Platform.

Presenter Name: Cole, Linda

Presenter Company: Open iT, Inc.

Presentation Title: Reinvesting Cost Optimization Savings to Fuel Digital transformation (L. Cole, Open iT, Inc.; Lvl: 1)

Session Title: Simulation Governance 2

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 3:00 PM

Type: Presentation

Intended Learning Outcome:

Through a focus on cost optimization, core efficiencies will improve and generate savings that can be reinvested into new innovations to fuel company growth.

Keywords: cost optimization, savings, digital transformation, growth, CIO,

Abstract:

Growth is the top priority for the majority of respondents in Gartner's 2019 CEO and Senior Business Executive Survey. For CIOs, more than 60% named saving money to fund digital transformation as their main motivation for optimizing IT. The general reaction to saving money consists of a reduction or elimination of expenses but this lends itself to a short-term solution. What is actually needed is a shift to a long-term approach through a focus on cost optimization which will improve core efficiencies and create savings that can be reinvested into new innovations to fuel growth. Having access to the latest and most innovative CAD, CAE or CAM applications is essential but has becoming increasingly more expensive. Therefore, it is equally important to be equipped with the right tools to maximize the utilization of these applications. Without the proper data analytics to measure the effectiveness and return on the software investments, organizations too often waste money by purchasing and renewing more licensing contracts than are actively being used. Understanding true active usage empowers companies to optimize their software licensing which in turn frees up monies for other assets or to fund new projects and services. Usage data reports provides not only a more structured and automated approach to cost management, but it reduces the complexity and time spent on managing critical engineering applications while also gaining more control and visibility. Optimizing IT costs can be a challenge but by being equipped with an efficient IT asset management system, business leaders and IT managers can analyze trends, mitigate risks, and forecast future costs more accurately. These cost savings can then be reinvested into other assets that align with the company's goals to foster innovation and growth. In this presentation, we will showcase customer case studies of utilizing advanced data analytics to increase productivity and generate significant savings. Join us and learn more on how you can achieve cost optimization of your 3D applications.

Speaker Biography:

Linda M. Cole is a Business Solutions Consultant at Open iT, Inc. She has been in the IT industry for over 30 years in many capacities including General Manager, Branch Manager and others giving her P&L responsibility and experience with challenges across many departments that her clients may face. Her industry experience also includes virtualization, cloud adoption and IT infrastructure management. Linda has been consulting clients for the past 6 years at Open iT on the benefits of software usage metering and how to utilize the various data points to optimize licensing. Her experience and expertise have helped her clients save millions of dollars on software licensing. These strategies include how to utilize process, work-flow and technology to solve business problems in a cost-effective way. Linda is a high-energy seasoned speaker and keeps her talks interactive with the audience.

Presenter Name: Coors-Blankenship, Jesse

Presenter Company: PTC

Presentation Title: Simulation Tools for Designers: Generative Design and Meshless Simulation (J. Coors-Blankenship, PTC; Lvl: 2)

Session Title: Generative Design 1

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 12:00 PM

Type: Presentation

Intended Learning Outcome:

The audience will learn how combining generative design and meshless simulation will improve the product design process.

Keywords: Meshless Simulation, Generative Design, Concurrent Engineering, Cloud-based collaboration, computational fluid dynamics

Abstract:

Over the last several years, meshless FEA has begun to revolutionize the product design process, particularly when you are designing complex assemblies rather than individual parts. Whereas mesh-based FEA was a time-intensive and expert undertaking, the mathematical models underlying the meshless approach have drastically reduced the time needed to run simulations, accelerating the speed to innovation. In this talk, we will focus on the power of meshless FEA and CFD simulation to accelerate and improve the design process, particularly in the context of generative design practices. Through specific, real-world use cases, we will highlight several classic design challenges that can be solved by combining generative design with meshless simulation. Mr. Coors Blankenship will specifically address: - The value of concurrent engineering and cloud-based collaboration in the product design process. Concurrent engineering is a product design strategy in which the different engineering stages run at the same time rather than consecutively. Deploying such a strategy accelerates product development, gets products to market faster, and cuts costs. -How a cloud-based “marketplace” can democratize expert level capabilities in generative workflows. Such a marketplace will make it possible for engineers to access models, simulations and tools created to solve specific design problems or model specific parameters. You can think of this as an app store or GitHub specifically for generative design use cases. -How generative design will advance as it incorporates more complex methods for modeling real world conditions. For example, as computational fluid dynamics improves, engineers can examine complicated phenomena like fluid flow and heat transfer. Another example is modal states, which examine natural or resonant frequencies (eigenvalues) of the design model and the relative displacements of the geometry when the model is vibrating at these frequencies. Working with such virtual tools helps engineers who might otherwise have used expensive physical testing to optimize products.

Speaker Biography:

Not Yet Provided

Presenter Name: Crist, James

Presenter Company: EnginSoft USA

Presentation Title: Decreasing The Need For Prototyping By Taking A Coupled Approach To Complex Problems (J. Crist, EnginSoft USA; Lvl: 1)

Session Title: Multiscale & Multiphysics 2

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 2:30 PM

Type: Presentation

Intended Learning Outcome:

Attendees will gain a better understanding of the importance of considering coupled behavior in fluid/dynamics problems and the effort required to accomplish such as analysis.

Keywords: system simulation, multibody dynamics, computational fluid dynamics, particle-based simulation, mechanical system

Abstract:

Many problems which are critical to simulation-driven design require multi-body dynamics and fluid dynamics knowledge, which until recently couldn't be captured quickly enough using simulation to inform early design decisions. In the past these disciplines operated independently, sometimes because the problems were truly uncoupled, but also because the toolchain and computing hardware to perform these simulations weren't available. Advancements in commercial tools and available computer power at the desk and in the cloud make this problem approachable for use in today's design environment. Implementing this approach early in the design lifecycle can return information to designers more quickly, reduce the need for prototyping, and ultimately allow for quicker time to market. This talk will present several examples of this approach across multiple industries. Gearbox lubrication analysis is typically done with the prescribed motion of the gears, focusing only on the fluid behavior. This assumption can be valid, but in some cases the churning losses within the gearbox will be high enough to break this assumption, a problem that may not be caught until expensive physical testing is done. By coupling the fluid and dynamics problems the assumption is reduced to an input torque rather than a set speed. This change allows designers and analysts to understand how oil fill levels will affect not only lubrication but more broadly the gearbox performance. Depending on design stage and specifications this can be used to specify a necessary input torque for a specified output speed or generate curves of output speed based on a known input torque. Proper understanding of vehicle dynamics requires a known mass distribution for the vehicle; gathering mass properties of most components is easy while including the mass of fuel is nontrivial. As the vehicle moves the fuel will slosh around, changing the handling of the vehicle and all of this changes with fill level, that is to say this is an inherently coupled problem. By efficiently co-simulating the fluid dynamics of the fuel with the vehicle handling simulation it is possible to run through a series of handling tests while varying fuel tank placement, design, and fill level to approach an optimal design. This requires many iterations but much of the work can be automated in the initial model setup. These examples demonstrate the need for coupled simulations of dynamics and fluids, and how this type of analysis can be implemented in today's workflows.

Speaker Biography:

James is a Senior Application Engineer at EnginSoft USA where he focuses on helping customers solve complex multi-physics problems. James obtained his Bachelor's in Aeronautical and Mechanical Engineering from Rensselaer Polytechnic Institute where he concentrated on numerical methods and simulation studies. His career started at UTC Aerospace Systems before moving on to CoreTechnologie where he was responsible for training and supporting customers on a variety of CAx interchangeability software and tools ranging from file conversion to simplification to model analysis.

Presenter Name: Cutting, Rebecca

Presenter Company: Composites Manufacturing & Simulation Center

Presentation Title: On Post Processing of Carbon Composite Tubes in Compression Simulations: Justification and Validation (R. Cutting, Composites Manufacturing & Simulation Center; Lvl: 2)

Session Title: Advanced Composites

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 11:30 AM

Type: Presentation

Intended Learning Outcome:

The audience will learn about a new post-processing method that can be applied to composite compression simulations to prevent model calibration.

Keywords: Carbon fiber, Crushing Response, Crash Simulation, Finite Element Analysis

Abstract:

Finite element modeling of carbon composites materials in axial compression uses element deletion to simulate material failure. During progressive failure of geometries with a single loading surface, rows of elements can be deleted simultaneously causing the compressive load on the structure to be released, initiating a traveling stress wave. The release of the compressive load causes the reaction force at the loading surface to immediately vanish, and the resulting time history of the reaction force has a saw-tooth shape corresponding to element deletion and subsequent geometry reloading. The saw-tooth loading history is not representative of the physical reality that occurs during experimentation of such materials and geometries. Researchers have taken several approaches to deal with this phenomena when modeling, including filtering the results, incorporating new contact definitions, and altering material properties to get simulation results to match experiment. This work proposes a new method for post-processing axial compression results of carbon composites that uses characterized material properties and addresses the cause of the irregular oscillatory behavior. In a continuous system for progressive failure, the impacting wall maintains contact during the failure process. The saw-tooth shape of the reaction force seen in finite element analysis is solely a function of discretization within the model. As the size of the elements decrease, the gap between peaks reduces linearly. Ideally, as the element size goes to zero, the saw-tooth curve disappears and provides a continuous curve. One-dimensional and two-dimensional compression models are introduced to show the effect element discretization has on the behavior of the load history for simplified geometric representations. The post-processing method of connecting the peaks of the saw-tooth reaction force curve is then justified. The post-processing method is implemented into a hollow tube model with characterized material properties and compared to experimental results without model calibration. Finally, the limitations of the method and its usefulness in complex geometries are discussed.

Speaker Biography:

Rebecca Cutting obtained her PhD in Aeronautics and Astronautics from Purdue University in 2019 focusing on crash performance of prepreg platelet based molded composites. Since then, she has been working as a composites engineer at the Composites Manufacturing and Simulation Center at Purdue University.

Presenter Name: Darbandi, Payam

Presenter Company: Ford Motor Company

Presentation Title: CAE-Driven Accelerated Durability Test for Carbon Canister Bracket Assembly (P. Darbandi, Ford Motor Company; Lvl: 3)

Session Title: Durability & Damage Tolerance

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 11:30 AM

Type: Presentation

Intended Learning Outcome:

CAE-Driven Accelerated Durability Test for Carbon Canister Bracket Assembly

Keywords: CAE, carbon canister, Accelerated test

Abstract:

CAE-Driven Accelerated Durability Test for Carbon Canister Bracket Assembly Payam Darbandi, Alan Gregory Carbon canister is one of the key components for emission control system in vehicles. Performance of this component is assessed using different analytical and physical testing tools. To determine the in-service reliability of the components, numerous life-representative durability test is being performed during different stages of product development process. The first step for conducting the durability tests for different automotive components is preparing a special type of durability tests profiles which are based on converting the random, stationary and gaussian accelerations time series acquired from proving ground to frequency-based data. Performing the test based on these test profiles can be very expensive and time consuming. Although, the durability performance of the carbon canister assembly can be assessed using FEA and fatigue calculations some components in the assembly can be so complex that it is not possible to produce a detailed computational model for the system; hence some degree of physical testing is unavoidable. On the other hand, since cost and time are very critical in today's product development processes, implementing a reliable and efficient accelerated test is very desirable element in designing a robust and efficient carbon canister. In this study an accelerated durability test, based on a Power Spectral Density (PSD) profile has been proposed. Evaluation process involves using validated CAE models to compare the stress and acceleration response of different carbon canister designs to proposed PSD versus an existing (time-consuming) PSD. In order to conduct the CAE analysis, modal analysis has been conducted and frequency response functions of carbon canister structures have been calculated in different loading directions. Fatigue life, acceleration and statistical values of stresses have been calculated to estimate the durability performance for steel and plastic components for both PSDs. CAE results show good correlation in terms of stress and acceleration responses for the existing and the proposed PSD. Significant cost and time reduction are expected with using this accelerated test profile.

Speaker Biography:

Payam Darbandi: He received his PhD degree in Mechanical engineering from Michigan State University, East Lansing MI in 2014. Before joining Ford Motor Company, Dearborn, MI in 2013 as a CAE structural engineer in powertrain installation, he was a visiting scientist with GM R&D and research assistant with Michigan State University.

Presenter Name: Dewhurst, Sebastian

Presenter Company: EASA Software

Presentation Title: The Case for Democratizing Simulation - Where Engineering Meets Dollars (S. Dewhurst, EASA Software; Lvl: 2)

Session Title: Democratization

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 5:00 PM

Type: Presentation

Intended Learning Outcome:

The democratization of modeling and simulation to functions other than engineering, for example sales and marketing, training, etc. enables modeling to directly contribute to revenue, rather than always being an R&D expenditure.

Keywords: democratization, model deployment, engineer-to-order, designed-to-order

Abstract:

Historically, efforts to democratize simulation and modeling have been half-hearted at best. While we have seen a few forward-thinking companies embrace the concept (and reap significant rewards), most companies see it as an unnecessary luxury. Most companies still regard modeling and simulation activities as an expense, and democratization only adds to this expense. And there's the fundamental issue; modeling and simulation, like most R&D activities, is still seen as a cost. Democratization of simulation models for use by other engineers and scientists does not change this. In contrast, democratization of simulation models for use by staff OUTSIDE of traditional engineering or R&D groups can take simulation out of R&D expenditures and instead associate it directly with revenue. Examples include deployment of engineering tools to customer-facing staff such as sales & business development, enabling the scaling of engineered-to-order products; another scenario - democratized simulation tools used to train operators, directly reducing the training costs and reducing costs associated with operating errors. In case you think this is a fad, and of limited value, or only relevant to certain industries, let's imagine our companies and the products we make 10 years from now, or perhaps less. Do we believe our customers will be satisfied ordering "off-the-shelf" products when our competitors are offering a high degree of customization – at no extra charge, and without any compromise in the quality of the engineering going into the product? Put another way - if you're still in business 10 years from now, you probably won't be selling off-the-shelf products. Most products will be custom built - and therefore custom designed - to the customer's specific requirements. 3-D printing and other manufacturing techniques make this almost inevitable. Incidentally, we are seeing this trend in other industries such as healthcare, for example - see "Personalized Medicine Market Emerging Opportunities, Growing Demand and Significant Trends by 2026" https://www.globalbankingandfinance.com/category/news/personalized-medicine-market-emerging-opportunities-growing-demand-and-significant-trends-by-2026/ . However, many products where some level of customization is desirable will still need to be modeled to ensure the customization itself does not result in a failure. Having expert modelers do this will not generally be feasible. Instead, the modeling activity needs to be deployed out to the appropriate part of the business (sales, training, etc.) and integrated into existing tools such as CRM. Furthermore, this exponential increase in modeling will set the scene for more advanced techniques which are not as resource-hungry as conventional modeling, for example machine learning based methodologies – see "A Real-Time Physics Informed Predictive Analytics Digital Twin for Thermal Mechanical Fatigue", J. Betts, Front End Analytics – NAFEMS World Congress 2019. Some examples will be presented: Democratization of structural analysis on built-to-order automotive components at ZF Incorporating engineering and analysis into the proposal generation process at GE Deploying optical analysis tools to non-engineers at Visioneering Technologies Automation and streamlining the certification of electrical equipment at Schneider Electric Automation of CAD generation as part of the proposal generation process at Siemens In summary, the democratization of modeling and simulation to functions outside engineering can directly contribute to revenue, rather than always being seen as an expenditure.

Speaker Biography:

Seb obtained his Bachelors in Mechanical Engineering and his Doctorate in Experimental Fluid Mechanics from the University of Oxford. His under-graduate internship was at NASA's Glenn Research Center in Ohio, USA, and focused on wind-tunnel testing of aircraft engine components. His doctoral thesis "The Application of Three-Dimensional Laser Doppler Anemometry" covered subjects such as fluid flow, heat transfer, computational fluid dynamics and data visualization. While post-graduate, he held a lectureship at Oxford and taught Mathematics, Thermodynamics and Fluid Mechanics. In the early 2000s, Seb led a team that developed a new low-code platform called EASA, designed specifically to facilitate the deployment of sophisticated engineering and scientific models within an enterprise. In 2008, EASA was spun off, and today, the primary focus is helping customers secure and deploy spreadsheet models, machine learning models, and engineering or scientific models. EASA serves diverse customers such as AIG, Bayer, Caterpillar, Corning, Eli Lilly, General Electric, Hewlett-Packard, Pfizer, Procter & Gamble, Zurich, and many others. Seb learned to fly with the Royal Air Force and remains an active pilot, with instrument, multi-engine, seaplane and helicopter ratings. He is also an active SCUBA diver and mountain biker. Seb serves on two boards at the University of South Florida: the USF Research Foundation Board, and the Mechanical Engineering Advisory Board. He also serves on the board of HyALTA Aeronautics, Inc., an aerospace start-up.

Presenter Name: Entwistle, Andrew

Presenter Company: McCormick Stevenson Corporation

Presentation Title: Cultural Challenges - Growing a Small Business Through a Lessons Learned Approach (A. Entwistle, McCormick Stevenson Corporation; Lvl: 1)

Session Title: Cultural Challenges

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 11:00 AM

Type: Presentation

Intended Learning Outcome:

Executives and management personnel can use the history of McCormick Stevenson as an example for growth and future planning through a lessons-learned discussion.

Keywords: Cultural Challenges, Engagement of Simulation Engineering Executives, Implementing New Processes, Lessons Learned

Abstract:

This presentation discusses changes in company culture through 20 years of growth of a small Product Development Company; McCormick Stevenson. Through a lessons-learned approach, executives and management personnel can use the history of McCormick Stevenson (MCCST) as an example for growth and future planning. From the start of the company with 2 engineers to today with almost 50 full-time employees, the successes and opportunities for improvement provide an excellent case study in example-based learning. This presentation identifies how MCCST was able to effectively shift the responsibilities of executive involvement from technical to managerial, establish levels of internal management, as well as optimize day-to-day operations through use of a program management team. The evolution of the company shows how areas of management become more important as the company grows, while stressing the lessons learned along the way. In order to meet customer need, MCCST has understood the challenges of staffing and has changed executive motivations for hiring. For early-stage companies, decisions made by MCCST act as a guide for meeting needs at several stages of company growth. Today, educated staffing decisions can be made based on a broad history of data. Finally, this presentation will identify the ways in which MCCST has overcome the challenges of establishing training procedures for its analysts. MCCST is able to identify engineers with an aptitude for analysis, invests in simulation and other related training, and creates analysts that are better prepared to support engineering. The lessons that McCormick Stevenson has learned over the last 20 years are shared so that other companies can make educated decisions for the unknown future. By identifying similar situations and expected patterns, companies can use what McCormick Stevenson has done to improve their position in their industry. Finally, companies can observe the effects of the investments made by McCormick Stevenson to improve internal procedures and evaluate if similar methods would be game-changing in their own company.

Speaker Biography:

Andrew Entwistle is an Advanced Engineer at McCormick Stevenson. After Receiving a Bachelor of Science in Mechanical Engineering at the University of South Florida, Andrew started full-time as an engineer at McCormick Stevenson in 2017. Since then he has studied in analysis and project management, while working in the defense industry. Andrew has developed proficiency in several CAD and analysis software, allowing him to be a versatile engineer at the company. Ambitious to develop future skills, Andrew is excited to share what he has learned at McCormick Stevenson with others at CAASE20.

Presenter Name: Euerby, Richard

Presenter Company: Siemens Digital Industries Software

Presentation Title: Fully Coupled Conjugate Heat Transfer between 1D and 3D CFD (R. Euerby, Siemens Digital Industries Software; Lvl: 2)

Session Title: CFD 2

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 1:30 PM

Type: Presentation

Intended Learning Outcome:

In this session attendees will learn about 1D/3D co-simulation workflows using conjugate heat transfer across the 1D/3D boundaries.

Keywords: 1D CFD, Simcenter, 1DHT, Siemens, CHT, cosimulation, Conjugate heat transfer

Abstract:

1D and 3D CFD co-simulation has always been a hot topic in the simulation community, leveraging the speed and flexibility of 1D and the fidelity of 3D in a single solution is very appealing for engineering applications. The complexity of models in recent years has increased dramatically and different methods for simulating these complex problems have been created with co-simulation being one of these. Classic co-simulation approaches transfer boundary condition information at predefined time steps during a solution process. However, this approach has stability and accuracy limitations. Simcenter Flomaster and Simcenter FLOEFD have demonstrated that fully implicit coupling, using the "OneSim" aggregated temperature and pressure solver, is more stable and accurate. This allows fluids from the 1D domain to flow in and out of the 3D domain and is applicable to both steady and transient solutions. This capability has now been extended to allow linear elements in the system model to exchange heat directly along their length with the 3D domain. For conjugate heat transfer, a 'chain' of 1D components is associated with 2D CAD faces, through which heat is exchanged. The conjugate heat transfer is simulated using the same implicit, aggregated solver approach as the hydraulic coupling. This technology has applications far beyond simple geometries and pipes in a 3D domain. It can be used in large heat exchangers applications where the pipe work is too complex to be resolved using 3D CFD within a reasonable time frame. It can be used to assess the performance and reliability of heat transfer in complex 3D systems, e.g. in Gas Turbines – 3D primary flow over a 3D solid blade with 1D internal duct and secondary air system model. This paper will provide a case study showing the use of this technology in various heat exchangers and how this novel technology increases the simulation speed whilst also retaining the accuracy in the simulation.

Speaker Biography:

Richard Euerby is the Product Owner for 1D/3D collaboration for Mechanical Analysis at Mentor, Siemens. Prior to joining the Simcenter team, he had worked on several research and EU funded industrial projects focusing on modelling and simulation and has a background in Applied Mathematics from Loughborough University.

Presenter Name: Farahani, Akbar

Presenter Company: ETA Engineering Tech. Assoc.

Presentation Title: Designing the Future with Optimization-Led Design & AI/ML Solution (A. Farahani, ETA Engineering Tech. Assoc.; Lvl: 3)

Session Title: AI-Guided Simulation

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 5:00 PM

Type: Presentation

Intended Learning Outcome:

The presentation will expose the audience to the following: (1) Optimization-led design product development that uses topology optimization (generative design) and 3G (geometry, grade & gauge) optimization, (2) AI/ML solutions to drastically speed up opti

Keywords: AI, ML, Optimization, Multi-disciplinary, Light weighting, Topology, 3G Optimization, Accelerated, Optimization System

Abstract:

The technology landscape for design engineering tools continues to shift and evolve. Design solutions, like Artificial Intelligence (AI) and Machine Learning (ML), are becoming entrenched in the design and analysis engineer's toolbox to speed up simulation time on all fronts, specifically in crash & occupant safety, CFD, and optimization simulations. The two technologies, "Optimization Driven Product Design" and "AI/ML," are responding to the three primary challenges faced by OEMs and Tierone suppliers worldwide: process collaboration, cost reduction, and to shorten product development cycle time. The future of product design and development for Electric Vehicles (EV) and Battery Electric Vehicles (BEV) for OEMs and suppliers relies on common platform and technology, shorter vehicle development duration, and lightweighting. However, this is an uphill battle, in which they must design and produce products requiring a balance between a variety of competing factors. These frctors include cost, mass, multi-disciplinary performance, multi-material function, joining, and manufacturability. Furthermore, they must achieve this balance while meeting new regulations in the EU, North America, and Asia. The ACP OpDesign capabilities include: • An environment created to provide the ability to assist the product design team in balancing stiffness, strength performance, and weight constraints in BIW or any sub-system structure. • An optimization system that allows a user to perform any type of optimization in real-time within the ACP OpDesign/ANSA/META environment. This research shows that using the integration of ACP OpDesign and the ODYSEE (AI/ML) tools platform can dramatically reduce product design and analysis time for full vehicle design. The efficiency of the integration of ACP OpDesign and the ODYSEE software solution for full vehicle Low Fidelity Design Concept (LFDC) of FSV (Future Steel Vehicle) and the high fidelity design for a few sub-systems for manufacturing are demonstrated. The presentation will provide an overview of the optimized design approach using ACP OpDesign and ODYSEE ML tools for front crash and torsional stiffness load cases. This integration structure based on the generative design, 3G design optimization and AI/ML solution provides a much faster turnaround for any optimization led-design process such as ACP OpDesign.

Speaker Biography:

Dr. Akbar Farahani CEO and President, Engineering Technology Associates Inc. (ETA Inc.) For more than 30 years, Dr. Farahani has held several leadership roles within ETA. His areas of expertise include: - Lightweighting technologies based on optimization-led design solutions for product design and development. Vehicle design from concept design to production. Improvements in vehicle crash/safety, durability, NVH, and vehicle dynamics performance while investigating the best material and manufacturing processes for a full vehicle system. - Management and execution of over 20 full vehicle CAE programs from concept to production in the US, EU, and Asia. Along with proving extensive knowledge in advanced material functions for full vehicle development. - Leading the development of ETA's patented technology “ACP Process” (Accelerated Concept to Product Process) and 3G Optimization Technology in ACP OpDesign (Optimization led design software developed by BETA CAE Systems and ETA.) - Implementation of AI/ML/ROM technology using CADLM products within ETA's software, product design and engineering solutions Education - Ph.D. in Civil Engineering/Structural from Brigham Young

University (BYU) Utah - Master’s Degree in Structural Dynamics from the University of California, Irvine (UCI) - Bachelor’s Degree in Civil Engineering from the University of Nevada, Reno (UNR).

Presenter Name: Ferguson, Stephen

Presenter Company: Siemens Digital Industries Software

Presentation Title: The Rise of the Digital Twin (S. Ferguson, Siemens Digital Industries Software; Lvl: 1)

Session Title: Digital Threads & Digital Twins 1

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 11:30 AM

Type: Presentation

Intended Learning Outcome:

For all the talk about Digital Twins, there are very few real life examples, in this talk we will examine the key criteria that any Digital Twin must fulfil, and examine real life examples of them in industry today.

Keywords: Simulation, Digital Twins

Abstract:

The Gartner Hype Cycle plots the path of new technologies from emergence through to adoption. Digital Twins currently sit at the top of the "peak of inflated expectation" (the state of maximum hype). This means that they are about to begin their plunge into the "trough of disillusionment" (where interest wanes as early adopters of the technology fail to realize the promised potential), before finally reaching the "plateau of productivity" (when technology finally becomes useful in for real world applications). While everyone is talking about Digital Twins, there is a general lack of consensus about what a Digital Twin actually is, and how much value it delivers in the context of real industrial application. Despite the considerable buzz around the topic, there are very few real life examples of Digital Twins in industrial application. This presentation explores the key qualities that any Digital Twin must exhibit in order to justify the title, and investigates, with the aid of real life industrial examples, how the Digital Twin is finding practical application in all industries today: from outer space to the depths of the ocean. Each of the examples presented will incorporate simulation, test and in-use data obtained via “the internet of things” By the end of the presentation the audience will understand what sets a real life Digital Twin apart from “just another collection of simulation models” and will gain an appreciation of the considerable value gained by adopting and creating Digital Twins for their own industrial applications. The presentation will also argue that the fastest way of reaching the “plateau of productivity”, whilst avoiding falling into “the trough of disillusionment”, is to begin investing in a Digital Twin philosophy today and will provide a practical pathway towards its adoption as a standard part of the product development and lifecycle management.

Speaker Biography:

Not Yet Provided

Presenter Name: Feridunoglu, Cenk

Presenter Company: Empower Operations Corp.

Presentation Title: The Importance of Expensive Constraint Handling for Optimization Performance (C. Feridunoglu, Empower Operations Corp.; Lvl: 2)

Session Title: Optimization 4

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 2:00 PM

Type: Presentation

Intended Learning Outcome:

I would like to showcase the importance of expensive constraints.

Keywords: expensive constraint handling, optimization algorithm performance

Abstract:

A typical engineering design optimization goal is to find a better performing design compared to a baseline design. Most of the optimization problems involving engineering simulation are nonlinear and might contain a mixture of continuous and discrete design variables which are subject to constraints. Constraints are typically formed as inequalities. Commercial optimization software tools on the market do not clearly differentiate between expensive and cheap constraints. Expensive constraints depend on simulation outputs and cheap constraints are easy-to-compute mathematical or logical relationships between design variables. Cheap constraints must be satisfied before expensive simulation calls; satisfying these cheap constraints heavily depends on the initial method of sampling. Expensive constraints are the desired performance criteria set at the beginning of an optimization run. Since there is no a priori knowledge about the relationship between design variables and simulation outputs, how expensive constraints are handled is critically important for the success of the optimization in a given run time budget. Any design point that violates an expensive constraint is considered as an infeasible design and often discarded. This point, however, entails important information that may be useful for the selection of the next design point. Penalty methods are widely accepted and used for constrained handling for various optimization algorithms. The main idea is to add constraint violation as a penalty function to the objective function value to direct the search into a feasible region. From a practicing engineer's stand point, a constrained optimization algorithm's performance could be measured as how many iterations are required to find the feasible space and how good the optimum is in a given iteration/time budget. This talk will first present our recent research results on developing an adaptive aggregation-based approach (SAKS-TRO) for expensive constraint handling for simulation-based optimization. Then a benchmark mathematical problem will be used to demonstrate the graduate sampling redirection behavior of the expensive constraint in OASIS software. Such a strategy resamples new points that close or on the boundaries of the feasible space with frugal computational costs. Real-world applications including slurry pump design optimization and crash simulation for automobiles will be given and discussed at the end of this talk.

Speaker Biography:

Cenk has spent 20 years at various fields ranging from academic research, engineering design and software development. He was involved in manufacturing while managing a hot forging facility in Istanbul, Turkey. He has also worked in the international Oil & Gas industry implementing database systems to leverage engineering, health & safety, e-learning and ERP projects in Kazakhstan. He believes simulation driven engineering design coupled with state of the art optimization is the next curve.

Presenter Name: Ferris, Tyler

Presenter Company: ANSYS

Presentation Title: Using FEA, CFD, and Reliability Physics to Investigate Electronic Component Failure Behavior (T. Ferris, ANSYS; Lvl: 1)

Session Title: Multiscale & Multiphysics 1

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 11:00 AM

Type: Presentation

Intended Learning Outcome:

An introduction into quantifying electronics reliability at the PCB level by simulating different environmental loading factors.

Keywords: Reliability, Physics of Failure, Electronics, PCBA

Abstract:

Understanding the failure behavior of printed circuit board assemblies (PCBAs) that are exposed to different environments can help inform key design aspects, like optimized location within an assembly, board housing geometry, and expected maintenance schedule. This presentation outlines a design analysis methodology using reliability physics and finite element analysis that provides fast and accurate life predictions for electronic hardware at the component, board, and system levels in early design stages. The failure behavior is predicated on the strain magnitudes created from various environmental loading conditions, and how different electronic packages/materials handle different levels of strain. The design simulation workflows presented here employ structural simulations to determine time varying stress strain data. These structural loading simulations may include scenarios such as random vibration or impact loading. Additionally, a PCBA may see temperature loading from the internal heat dissipation from electronics that is affected by the surrounding airflow. A coupled heat transfer and computational fluid dynamic simulation is employed to compute the resulting thermal profile for the assembly. The strain and thermal history from the structural and conjugate CFD simulation is the input for a reliability physics analysis that predicts the reliability of the PCBA over time. The proposed methodology is illustrated with an example application for a PCBA placed on the rooftop of an autonomous vehicle. The fatigue life is determined for common automotive mechanical loads, such as those from driving on potholes, random vibrations associated with everyday driving, and door slamming. The thermal effects from component heating during power cycling and convective airflow during vehicle motion are included. Utilizing a simulation-based reliability physics analysis early in the design phase allows engineers to better understand how reliability changes with duty cycle. It makes possible the rapid identification and mitigation of certain failure risks with an overall goal of ensuring passenger safety, meeting warranty targets, and reducing physical test times.

Speaker Biography:

Tyler Ferris is an expert in the use of reliability physics simulations and principles to provide valuable insight into the reliability and durability of electronic systems. As a member of the Ansys staff, Tyler has consulted with customers in the aerospace, automotive, industrial controls, and data center industries to evaluate system, PCBA, and component-level failure risk. Applying techniques of finite element analysis and hands-on laboratory failure analysis, Tyler has insight and experience with the theoretical mechanisms that drive electronics failure and their physical effects on actual systems. Tyler has B.S. and M.S. degrees in Mechanical Engineering from the University of Pittsburgh.

Presenter Name: Festag, Georg

Presenter Company: Ford Motor Company

Presentation Title: Heuristic Search for Optimal Breakpoints in Engine Mapping (G. Festag, Ford Motor Company; Lvl: 3)

Session Title: AI-Guided Simulation

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 4:00 PM

Type: Presentation

Intended Learning Outcome:

Apply techniques of artificial intelligence in calibration to achieve design verification efficiency

Keywords: Artificial intelligence, heuristic, engine mapping

Abstract:

Engine mapping calibration deals with large amount of test data. When the calibrator generates an engine mapping table, the calibrator leverages his personal experience and trial and error method is applied. This approach slows down the engine development and validation. In addition, the trial and error method may create inaccurate engine mapping table, which may result in a waste of time and other resources. To improve the fidelity of maximum brake torque sparking timing tables, a robust process for the selection of optimal load break points of the timing tables is developed and validated. This robust process utilizes artificial intelligence to do a heuristic search of finite set of load break points. When the optimal set of load break points is found, the high-fidelity tables are generated for each operating condition. The breakpoints should be valid and consistent for hundreds of driving conditions. Each condition may be drastically different when compared with others. To support the robust process an optimization strategy is developed. The process consists of the following steps: 1. Pre-processing (padding for missing test cases, filtering for noisy data and sorting) of engine test data at relevant operating conditions, 2. Apply optimization strategy to the cleaned data, 3. Run optimization of the load break points using heuristic algorithm, 4. Validation of the optimal load break point based on calculated error of maximum brake torque spark timing, 5. Generation of the high-fidelity engine mapping tables at desired operating conditions. Normally, the engine mapping table is a 2D table, the horizontal header represents the engine speeds while the vertical header represents the engine loads. The high-fidelity engine mapping tables require a value for each combination of engine load and speed. The test, however, cannot be run under certain combinations of engine load and speed due to test limitations and/or resource allocation. To generate appropriate engine mapping tables when the data is not collected for certain load and speed combinations, the padding is applied in the paper. To demonstrate the process, this paper presents a case study on the I4 engine.

Speaker Biography:

Not Yet Provided

Presenter Name: Fouladi, Kamran

Presenter Company: InfoMec Consulting

Presentation Title: Elements of Turbulence Modelling (K. Fouladi, InfoMec Consulting; Lvl: 2)

Session Title: NAFEMS Training: Day 1

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 4:00 PM

Type: Training

Intended Learning Outcome:

Keywords:

Abstract:

This course is focused on understanding turbulence, need for turbulence modeling, and various modeling approaches. Discussions on the advantages and limitations of various models should help CFD users in selecting appropriate turbulence models for their simulations.

Speaker Biography:

Kamran Fouladi Ph.D., PE. is an Assistant Professor of Mechanical Engineering at Widener University teaching undergraduate and graduate thermal fluid courses. He is an educator, researcher, and specialist in Computational Fluid Dynamics (CFD) and thermal management with more than 25 years of engineering and teaching experience. Kamran is a licensed Professional Engineer in Pennsylvania. Kamran's career began in aerospace arena working at NASA Langley and United Technologies' Pratt and Whitney (P&W) prior to establishing InfoMec CFD Consulting in year 2000. With InfoMec, Kamran has provided engineering and CFD support to projects of national importance (NASA Crew Exploration Vehicle, NASA Orion's Launch Abort Vehicle, NASA Orbital Space plane, and NASA supersonic transport and business jet aircraft) using in-house, public domain,and commercial CFD software. Kamran's research work is currently aimed at developing and utilizing state-of-the-art airflow, heat transfer, and energy simulation tools focusing on complex configurations and mission critical applications.

Presenter Name: Fouladi, Kamran

Presenter Company: InfoMec Consulting

Presentation Title: FSI and Exergetic Analyses of Flexible vs. Rigid Pitching Airfoil (K. Fouladi, InfoMec Consulting; Lvl: 2)

Session Title: Multiscale & Multiphysics 4

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 11:30 AM

Type: Presentation

Intended Learning Outcome:

The need for use of fluid-structure interaction in place of CFD alone.

Keywords: FSI; CFD, autonomous vehicle

Abstract:

FSI Analysis of an Autonomous Underwater Vehicle in Oscillating Motion The development of Autonomous Underwater Vehicle (AUV) systems has progressed significantly in the past decade. These systems are being designed to be thrust efficient and highly maneuverable by aiming to reproduce the fish-like locomotion mechanism. Additionally, some recent studies have investigated the energetic benefits of individual fish swimming near an obstruction or swim in tandem with other fish. For an individual fish, obstructions or other fish create flow conditions and eddies that fish can benefit from to reduce the energetic cost of holding station in water. The flow physics in the vicinity of the oscillating flexible body can be significantly different than flow physics observed over a single rigid body. Furthermore, the kinematics of oscillation as well as maneuvers result in highly coupled nonlinearities in fluid dynamics and structural dynamics. Therefore, it is believed that fluid-structure interaction simulation is needed for AUV systems with flexible characteristics, and the FSI approach can increase the accuracy of such vehicles compared to computational fluid dynamics alone. The FSI approach considered in the present study will be strongly coupled, nonlinear, and multidisciplinary, which would require a strong numerical coupling approach. The present study is set to investigate the propulsion characteristic differences of a fish-like AUV system with flexible material compared to one with rigid material. Both configurations have their tails set in oscillating motion and placed in a low Reynolds numbers water flowing in a channel. Similar exercises with flexible and rigid airfoils set in oscillating motion have already been completed in the first phase of the study. In the first phase, we investigated a two-dimensional NACA 0012 airfoil set in purely sinusoidal pitching motion with the axis of rotation at the quarter-chord point The configuration used in this investigation is a two-dimensional NACA 0012 airfoil set in purely sinusoidal pitching motion with the axis of rotation at the quarter-chord point at various angles of attack, pitching frequency, and pitching amplitude. The comparison of FSI simulation results indicated flexible airfoil clearly outperforming the rigid airfoil at about 57% for the range of conditions considered. The enhanced propulsion of the flexible material is likely due to larger trailing-edge vortices generated when the flexible material is used. The comparison of the streamlines for both rigid and flexible material shows that for the same conditions (similar Re, k, and), flexible material produced larger trailing-edge vortices.

Speaker Biography:

Kamran Fouladi Ph.D., PE. is an Assistant Professor of Mechanical Engineering at Widener University teaching undergraduate and graduate thermal fluid courses. He is an educator, researcher, and specialist in Computational Fluid Dynamics (CFD) and thermal management with more than 25 years of engineering and teaching experience. Kamran is a licensed Professional Engineer in Pennsylvania. Kamran’s career began in aerospace arena working at NASA Langley and United Technologies’ Pratt and Whitney (P&W) prior to establishing InfoMec CFD Consulting in year 2000. With InfoMec, Kamran has provided engineering and CFD support to projects of national importance (NASA Crew Exploration Vehicle, NASA Orion’s Launch Abort Vehicle, NASA Orbital Space plane, and NASA supersonic transport and business jet aircraft) using in-house, public domain,and commercial CFD software. Kamran’s research work is currently aimed at developing and utilizing state-of-the-art airflow, heat transfer, and energy simulation tools focusing on complex configurations and mission critical applications.

Presenter Name: Fouladi, Kamran

Presenter Company: InfoMec Consulting

Presentation Title: CFD for Structural Designers and Analysts (K. Fouladi, InfoMec Consulting; Lvl: 1)

Session Title: NAFEMS Training: Day 3

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 4:00 PM

Type: Training

Intended Learning Outcome:

Keywords:

Abstract:

This course aims to introduce the essential principles of fluid dynamics, important flow phenomena, and basics of CFD process to structural engineers for their multidisciplinary problems. This course provides a brief overview of the essential concepts and principles of fluid dynamics, CFD, turbulence, and heat transfer relevant to structural analyses through simple examples and case studies.

Speaker Biography:

Kamran Fouladi Ph.D., PE. is an Assistant Professor of Mechanical Engineering at Widener University teaching undergraduate and graduate thermal fluid courses. He is an educator, researcher, and specialist in Computational Fluid Dynamics (CFD) and thermal management with more than 25 years of engineering and teaching experience. Kamran is a licensed Professional Engineer in Pennsylvania. Kamran's career began in aerospace arena working at NASA Langley and United Technologies' Pratt and Whitney (P&W) prior to establishing InfoMec CFD Consulting in year 2000. With InfoMec, Kamran has provided engineering and CFD support to projects of national importance (NASA Crew Exploration Vehicle, NASA Orion's Launch Abort Vehicle, NASA Orbital Space plane, and NASA supersonic transport and business jet aircraft) using in-house, public domain,and commercial CFD software. Kamran's research work is currently aimed at developing and utilizing state-of-the-art airflow, heat transfer, and energy simulation tools focusing on complex configurations and mission critical applications.

Presenter Name: Fouladi, Kamran

Presenter Company: InfoMec Consulting

Presentation Title: Introduction to Practical CFD (K. Fouladi, InfoMec Consulting; Lvl: 1)

Session Title: NAFEMS Training: Day 2

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 4:00 PM

Type: Training

Intended Learning Outcome:

Keywords:

Abstract:

Through a simple and moderately technical approach, this course covers topics such as the role of CFD, basic formulation, governing equations and use of model equations, steps in CFD process, need for turbulence modeling, and CFD best practices.

Speaker Biography:

Kamran Fouladi Ph.D., PE. is an Assistant Professor of Mechanical Engineering at Widener University teaching undergraduate and graduate thermal fluid courses. He is an educator, researcher, and specialist in Computational Fluid Dynamics (CFD) and thermal management with more than 25 years of engineering and teaching experience. Kamran is a licensed Professional Engineer in Pennsylvania. Kamran's career began in aerospace arena working at NASA Langley and United Technologies' Pratt and Whitney (P&W) prior to establishing InfoMec CFD Consulting in year 2000. With InfoMec, Kamran has provided engineering and CFD support to projects of national importance (NASA Crew Exploration Vehicle, NASA Orion's Launch Abort Vehicle, NASA Orbital Space plane, and NASA supersonic transport and business jet aircraft) using in-house, public domain,and commercial CFD software. Kamran's research work is currently aimed at developing and utilizing state-of-the-art airflow, heat transfer, and energy simulation tools focusing on complex configurations and mission critical applications.

Presenter Name: Friedemann, Darius

Presenter Company: HTW Berlin

Presentation Title: Introduction of a Generic and Independent XML-based Physical Description Language “SMILE” (D. Friedemann, HTW Berlin; Lvl: 2)

Session Title: Systems Modeling & Simulation

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 12:00 PM

Type: Presentation

Intended Learning Outcome:

SMILE is an independent and standardized modeling language to enable an automated simulation model creation.

Keywords: Modelling Languge, SMILE, XML, Independent

Abstract:

Today, a large number of simulation programs are used in the automotive development process. To engineer a single component multiple tools, like in FEM FE Simulations (Abaqus Explicit & Abaqus Standard or LS-Dyna), CFD (XFLOW), Metal forming (DYNAFORM) and others are needed. It is therefore not unusual for one component to be modelled in several different codes. Each of these programs requires the basic model input code in its specific program format. The physics of a component are nevertheless unique. Transferring one simulation model completely and automatically from one program to another is not working very well, especially for complex models. One reason for this is the software-dependent implementation of physical problems. The same physics (for example welding spots) are modelled differently for different loadcases. The metalanguage “SMILE” (Unified Simulation ModellIng LanguagE) is designed to solve this problem. The approach is, to document all primary and secondary information of a component in a common format, in order to build a database, that can be used to create an inputdeck automatically for any simulation software or discipline. This works due to a strict separation of geometry and physical properties. An important point for the conversion of an independent modeling language is the renunciation of explicit modelling of the materials. The material in SMILE is assigned by a name reference and must be available in a material database. The basic syntactic requirements of the various simulation tools can be stored and accessed in databases (□ “democratisation of simulation”). This approach offers a good basis to realize an automated simulation model generation for any software. A "translator" must be provided for each simulation software. In this presentation the basic idea and features of the language will be presented. Also some examples, defined in SMILE and simulated in Abaqus and LS-Dyna will be shown.

Speaker Biography:

Prof. Dr.-Ing. Darius Friedemann - since 2017: Chair of vehicle simulation at HTW Berlin - 2011 to 2017 Project manager at IATmbH (Occupant Safety Simulations) - 2008 to 2011 Doctor of engineering at Technical University Berlin (Research of realtime capable Multibody Simulations for suspension systems) - 2005 to 2008 Engineer at IATmbh (Occupant Safety Simulations and Driving Simulators) - 1999 to 2005 Masters Degree in Automotive Engineering at TU-Berlin (passed with distinction)

Presenter Name: Gaul, Nicholas

Presenter Company: RAMDO Solutions, LLC

Presentation Title: Using Vehicle Driver Population Variability to Identify Population Segments with Higher Injury Risk (N. Gaul, RAMDO Solutions, LLC; Lvl: 1)

Session Title: Crash, Impact & Shock

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 4:00 PM

Type: Presentation

Intended Learning Outcome:

How to account for variability in driver BMI, stature, age, and gender can be used to identify driver population segments with higher injury risk in order to help improve designs.

Keywords: Crash and Safety Analysis, Variability, Uncertainty Quantification, Data Science

Abstract:

Designing a vehicle restraint system is a complex and difficult problem to solve. One of the challenges is how to design a restraint system that works for all the various drivers. The variability in driver BMI, stature, age, and gender presents the engineer with a huge challenge to try to come up with a restraint system that can help reduce injury risk for all drivers. One solution is to design an adaptive restraint system that has different settings. The idea is that if all drivers would use the best setting for them, their injury risk would be reduced in the event of an accident; therefore, reducing the injury risk for all drivers. The new challenge then becomes how to segment the population into groups so that an adaptive restraint system can be designed to reduce the injury risk of each group. It will be shown how using the injury risk simulations together with uncertainty quantification and data science provides a method to segment the driver population into different groups that have higher injury risk. The variability of the driver BMI, stature, age, and gender is represented using distributions, which are obtained from data collected by the National Center for Health Statistics. These distributions are not known standard distribution types but are unique and even multimodal. This variability will be propagated using uncertainty quantification to obtain the variability in the predicted driver injury risk. The uncertainty quantification results will provide injury risk variability as distributions. Due to the complexity of the injury risk simulations and the nonstandard distributions representing the driver variability, the injury risk distributions are nonstandard distributions as well. Once the injury risk distributions are obtained it then becomes a data science problem to figure out how to use all this data to segment the driver population into groups that have high injury risk. It will be demonstrated how to use the driver variability distributions and injury risk distributions together in order to identify population segments with high injury risk.

Speaker Biography:

Dr. Nicholas Gaul has 10+ years of experience working with uncertainty quantification (UQ), reliability analysis, reliability-based design optimization (RBDO), and surrogate modeling. He has co-authored 20+ papers related to uncertainty quantification, reliability analysis and reliability-based design optimization across a wide range of disciplines. Some of the disciplines he has applied UQ to are: CFD, multibody dynamics, durability, NVH, vehicle safety analysis, blast survivability analysis, die casting simulations, welding, wind turbine design, drag in shock-particle interactions, terramechanics connected with geospatial for the creation of vehicle speed maps for Next Generation NATO Reference Mobility Model (NRMM). He is interested in talking with anyone who is doing UQ, has questions about UQ, or wants to know how UQ might benefit them.

Presenter Name: Gaul, Nicholas

Presenter Company: RAMDO Solutions, LLC

Presentation Title: Accounting for Variability in NVH Design to Achieve Higher Customer Satisfaction (N. Gaul, RAMDO Solutions, LLC; Lvl: 1)

Session Title: Verification & Validation 3

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 1:30 PM

Type: Presentation

Intended Learning Outcome:

How to achieve higher customer satisfaction by accounting for variability in manufacturing and material properties in NVH design.

Keywords: NVH, Variability, Uncertainty Quantification (UQ), Probabilistic Analysis, Reliability-Based Design Optimization (RBDO)

Abstract:

The automotive industry is extremely competitive with customer satisfaction being one of the driving factors. Customers expect their vehicles to be of the highest quality, meaning fuel efficient, high durability, and a smooth and quiet ride. Automotive NVH engineers are constantly working on trying to meet this high customer satisfaction by improving vehicle designs to provide the quietest vehicle possible. The traditional NVH approach is to use deterministic optimization together with NVH simulations in order to find a vehicle design that has a noise level under a given threshold. When the industry first started to do this, it was a great technic in order to lower vehicle noise levels significantly and increase customer satisfaction. In order to maintain a competitive edge by achieving higher customer satisfaction with the ever-increasing customer expectations, the automotive industry is constantly seeking new technics to help them further improve the NVH performance of their vehicles. Now that deterministic optimization is becoming more of a standard practice in the automotive industry for improving NVH performance, the next step to try to further improve NVH performance is to account for the variability in manufacturing and material properties. With NVH simulations constantly improving and computing capabilities continuously growing, studying the affect of manufacturing and material property variability is a much more feasible problem. NVH problems are extremely challenging with a large number of variables and the noise response being a nonlinear function in terms of the variables. Uncertainty quantification (UQ) can be used to account for the manufacturing and material property variability, referred to as the input variability, in order to determine the variability in the noise level. The variability of the noise level is referred to as the output variability. In this work it will be shown how UQ is used together with NVH simulations to propagate the input variability, i.e., the manufacturing and material property variability, in order to obtain the noise level variability. The noise level variability will be captured as distributions. The distributions of the noise level are then used to plot NVH curves, i.e., noise vs. frequency, that show the variability in the noise level by plotting the 95% interval band of the NVH curve. These noise variability curves provide a powerful and simple way of understanding the variability in the noise level. These curves let the engineer easily see how much variability can be expected in the noise level for a given design at each frequency. The new standard for NVH is to account for the noise level variability and have it under some target noise level threshold. It will be shown how reliability-based design optimization (RBDO) can be used to achieve exactly this. The engineer defines a noise level threshold and target reliability, in the example shown the noise level threshold is 57 dBA and the target reliability defined to be 90%. This means that when considering the noise level variability, 90% of the noise level will be less than the 57 dBA threshold. It will be shown that by carrying out RBDO it is possible to find a design that achieves these targets. Thus, by using UQ and RBDO the NVH engineer can achieve an even higher level of NVH performance, thus, further improving customer satisfaction.

Speaker Biography:

Dr. Nicholas Gaul has 10+ years of experience working with uncertainty quantification (UQ), reliability analysis, reliability-based design optimization (RBDO), and surrogate modeling. He has co-authored 20+ papers related to uncertainty quantification, reliability analysis and reliability-based design optimization across a wide range of disciplines. Some of the disciplines he has applied UQ to are: CFD, multibody dynamics, durability, NVH, vehicle safety analysis, blast survivability analysis, die casting simulations, welding, wind turbine design, drag in shock-particle interactions, terramechanics connected with geospatial for the creation of vehicle speed maps for Next Generation NATO Reference Mobility Model (NRMM). He is interested in talking with anyone who is doing UQ, has questions about UQ, or wants to know how UQ might benefit them.

Presenter Name: Gondipalle, Sreekanth Reddy

Presenter Company: Front End Analytics LLC

Presentation Title: Physics Informed Machine Learning (PIML™): Surrogate Models Providing Deeper Insights with Less Data (S. Gondipalle, Front End Analytics LLC; Lvl: 2)

Session Title: Advanced Information Technologies 2

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 1:30 PM

Type: Presentation

Intended Learning Outcome:

Importance of Physics Informed Machine Learning and it's ability to have higher predictive accuracy with smaller training data sets.

Keywords: Physics Informed Machine Learning, Digital Twins, Higher R-squared value

Abstract:

Historically in the field of engineering, computational simulations such as Structural FE (Finite Element) Analysis, CFD (Computational Fluid Dynamics) analysis were conducted to predict the behavior of a design subjected to a specified set of boundary conditions. However, Simulations of complex real-world problems using Computer Aided Engineering (CAE) software tools may take hours or even days to compute. Due to this limitation, quite often these computationally expensive CAE simulations are not directly employed for design space exploration and optimization. However, Global product competition has placed greater importance for reduced product development cycles and for digital twin applications across several engineering fields. Therefore, building efficient surrogate models or Reduced order models which are simplified mathematical representations of the complex CAE simulations, to predict the outcomes of complex engineering problems has become the need of the hour. Currently several data driven approaches such as Neural Networks, Radial Basis Functions, Kriging etc. are implemented to build these models. In order to build a good quality surrogate model, a sufficiently large training data set is typically created using Design of Experiments (DoE) strategy which will spread the designs uniformly across the design space. However, for expensive CAE problems; that may take days to compute, and have non-linear responses, building such DOE's would take several months of computational effort if not more and so is not a feasible option. So, we need to identify approaches to build surrogate models with smaller sets of training data; without compromising on the quality of the model built. Using physics informed machine learning (PIML™) techniques developed at Front End Analytics, surrogate models are built over significantly smaller training data sets with a high predictive accuracy. This presentation provides an illustrative powertrain example that compares the development of a Surrogate Model using state-of-the-art machine learning method against PIML™. The data obtained for the Surrogate Model was obtained from a Finite Element Modeling and Simulation.

Speaker Biography:

Sreekanth Gondipalle has over 8 years of experience in the field of design optimization and structural simulations. He is currently working for Front End Analytics as a Senior Analytical Engineer. In his current role he has been working on building Physics Informed Machine Learning and Digital Twin models for several clients across multiple industries. Prior to joining Front End Analytics he has worked for Ford Motor Company as a CAE Optimization Engineer for over 6 years He received his Master of Science degree in Mechanical Engineering from Clemson University.

Presenter Name: Gooroochurn, Yogendra

Presenter Company: ESI North America

Presentation Title: Virtual Simulation of Coupled Weld-Rupture Analysis of Automotive Assemblies (Y. Gooroochurn, ESI North America; Lvl: 2)

Session Title: Durability & Damage Tolerance

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 11:00 AM

Type: Presentation

Intended Learning Outcome:

The effect of welding on the performance of steel and magnesium alloy automotive assemblies

Keywords: Coupled Weld-Rupture analysis, Finite Element Methods, Steel and Aluminum Alloys

Abstract:

The development for lightweight-driven design of vehicles in automotive industry necessitates the use innovative materials such as steel (high strength steel (HSS), ultra-high strength (UHSS), advance high strength steel (AHSS) and Aluminum alloys) and aluminum (series 5000 and 6000) alloys to meet performance requirements. Suppliers usually achieve performance requirement such as strength by altering the chemical composition of these alloys. Different strengthening mechanisms such as work hardening, and heat treatment are typically used to meet the initial strength requirements. When these alloyed structures are welded together, depending on the welding heat input, the material chemistry and thickness, they either harden or soften in the heat affected zone, which in turn affects the performance of the weldment during service. Traditionally, performance analyses such as crash, rupture, fatigue, etc. of weldments using computational methods like finite element methods use base material properties that do not consider change of microstructure and mechanical properties in the heat affected and fusion zones due to welding. Given the fact that welding processes affect the mechanical properties in the heat affected zone, using base material properties to represent the areas surrounding the weld during finite element analyses can either over or under predict the performance which in turn hinder/limit potential weight reduction strategies. Computational weld analyses can accurately predict the changes in the microstructures and mechanical properties in the heart affected zone in addition to the prediction of deformation, residual stresses and plastic strains. Thus, accurate prediction of performance of structures made of these welded alloys requires the incorporation of the welding effects through the coupling of welding simulation with performance simulation. In this presentation, examples problems are used to demonstrate the impact of welding processes on the performance of weldments by coupling ESI's welding software SYSWELD with the performance software VPS, seamlessly. A final example that demonstrates the applicability of the coupled weld-rupture analysis to the solution of an industrial problem will be presented by investigating an automotive battery package.

Speaker Biography:

Yogendra Gooroochurn (a.k.a: San), is a Business Development Manager (Advance and Innovative Projects) at ESI Group Inc. focusing providing software solutions to customers for resolving real life challenges that go across disciplines (welding, heat treatment, casting, additive manufacturing, forming, rupture, performance, fatigue, CFD, system…). San has a Masters in Mechanical Engineering from France (ENISE) and an Executive MBA from Colorado Technical University. He started his career in the manufacturing sector as a welder and workshop supervisor prior to acquiring his MSME/MBA and worked his way up by taking new challenges, acquiring new degrees and gaining tremendous amount of industry experience. He has a 24 years combined work experience, working in Mauritius, France, Belgium and the US in the Manufacturing, Steel and Software industries including 15 plus years in the software Industry with ESI. Modeling has been a huge part of San's professional career. His past manufacturing experiences (Construction and Steel Industries) and his educational background have helped him approach complex industrial challenges in pragmatic ways and allowed him to provide realistic modeling solutions to customers in various industries across disciplines. San is a key driver in the software development strategies for the ESI's Welding Simulation software products. He understands complex customer problems, translate them into needs and identify proper modeling techniques and workflows to implement within the ESI software (SYSWELD, Visual Weld, Visual Assembly, Visual Heat Treatment, Visual Process, Virtual Performance). Within ESI, San is considered a leader in identifying approaches to complex coupled multi-physics driven challenges and delivering user friendly customized solution to customers. San has long been a driver in helping bridge the modeling adoption gap between research and industry by first ensuring that research projects have a clear implementation plan to help industry rip the benefits of their investment; second by ensuring that undertaken research projects actually enhance the state of the art; third by ensuring that methods are being developed to solve real industry challenges, fourth by helping industry members use state of the art modeling tools and remove bottlenecks which hinder their access to such tools and finally, educate young engineers and graduates on modeling software to help build a workforce of the future.

Presenter Name: Hahn, Youngwon

Presenter Company: Dassault Systèmes SIMULIA Corp

Presentation Title: A Study of Structural Analysis for the Module of Pouch Type Battery, Including Swelling Effect (Y. Hahn, Dassault Systèmes SIMULIA Corp; Lvl: 2)

Session Title: Structural Analysis 1

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 12:00 PM

Type: Presentation

Intended Learning Outcome:

The audience will have a better understanding on how to build and analyze the pouch type battery module finite element model.

Keywords: battery, pouch, structural analysis, swelling

Abstract:

The battery becomes more important in the vehicle electrification nowadays. Among various battery types, a secondary lithium-ion battery is widely used as in the electric vehicle due to its energy density advantage. Even though many researchers and engineers are investigating to increase more energy density and battery life without degradation, the structural integrity in the module and pack is also getting more attention due to swelling in the case of pouch type battery in the electric vehicle. Swelling is the volumetric change during charging and discharging history in the battery. In the electric vehicle battery, this swelling behavior is very important on structural integrity since it changes the overall stress status of the battery module and pack structure. In this study, we build the finite element model of the pouch type battery module. The module has several pouch battery cells. The pouch cells are constrained by the belt and the housing cover is also constrained by the bolt. Using this finite element model, we simulate the pretension effect for constraining battery cell and housing. And the swelling analysis is followed considering SOC (state of charge) change. In this analysis, we can check how much stress in the module is increased by the swelling behavior of the pouch type battery. The stress change is also considered in further analysis due to aging using a simple relationship between stress change and SOH (State of Health). Considering the swelling effect of the battery module structure, most of the structural analyses for the module, which are widely used in the market, are performed: crush analysis, nail penetration analysis, mechanical shock analysis, and rollover analysis. Before performing the finite element analysis, each pouch cell material property is calibrated with reference experiment results, such as compression and indentation test. Overall simulation conditions and results are introduced and discussed.

Speaker Biography:

Youngwon received his PhD in Mechanical Engineering and Scientific Computing from the University of Michigan at Ann Arbor. After completing a post-doctoral research fellowship at U-M, he worked at Modine Manufacturing Company as a Senior Finite Element Engineer, and in 2008 joined SIMULIA. He is currently working as Sr. Portfolio Technical Specialist at SIMULIA HQ, in the fields of Durability, MBD, NVH, Turbomachinery, and Battery. Prior to completing his PhD he worked at KIA Motor Company as a CAE Engineer in the suspension and chassis group.

Presenter Name: Hartl, Jakob

Presenter Company: Purdue University

Presentation Title: Application of a Verification and Validation Framework for Establishing Trust in Model Predictions (J. Hartl, Purdue University; Lvl: 2)

Session Title: Verification & Validation 1

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 5:30 PM

Type: Presentation

Intended Learning Outcome:

The audience will see how the individual steps of an established V&V framework contribute towards establishing trust in model results and hear about the authors' experience of implementing the framework in an industrial environment.

Keywords: Trust in results, phenomena identification, solution verification, validation metrics, uncertainty quantification, centrifugal compressor

Abstract:

Engineers across many industries rely upon modeling and simulation (M&S) to develop new products, make decisions, and optimize designs. The introduction of initiatives, such as the Department of Defense (DoD) Digital Engineering Strategy, further highlights the fact that M&S activities are becoming more prominent in engineering applications. Applying M&S in engineering activities has the well-established business and technical benefits of reducing development costs, exploring broad design spaces, and demonstrating technologies. For M&S to successfully yield the proclaimed benefits, engineers conducting the M&S must be able to prove that the results are credible and trustworthy. However, methodologies for promoting credibility and trust, usually contained within verification and validation (V&V) activities, are commonly not well developed, nor well implemented in engineering practices. This makes the problem of determining how much to trust M&S challenging in almost any setting, but it becomes even more formidable for industries with products that have strict budget and schedule constraints, high levels of complexity, or rigorous performance requirements. As an example, the aerospace industry produces many systems that have high-consequences of failure, experience complex physical interactions, and compete for narrow increments of improvement in performance. Rolls-Royce is an organization in the aerospace industry that has recently partnered with Purdue University to implement a well-documented V&V framework for a centrifugal compressor modeling project with the intent of addressing the issue of trust in M&S. This presentation will discuss observations from implementing a new, rigorous V&V framework and will evaluate the effectiveness of the V&V framework in establishing trust in model predictions. The key observations and results will come from the following steps of the V&V framework: • Specifying accuracy requirements, application domain, validation domain, system response quantities of interest, and uncertainties • Performing phenomena identification and ranking table (PIRT) and gap analysis activities • Acquiring code verification documentation • Acquiring experimental data and measurement uncertainties • Performing solution verification • Propagating uncertainties through the model • Estimating prediction error • Assessing model adequacy While the discussion will speak in general terms about the qualities of the V&V framework and the process of implementing it, the presentation will provide complementary results from the centrifugal compressor modeling project. This application capitalizes on the fact that the centrifugal compressor modeling project was an ongoing effort at Rolls-Royce before implementing the new V&V framework, which allows for a direct comparison between the V&V framework and the traditional process. In general, this work confirms many anticipated advantages of implementing the V&V framework. Examples include promoting greater confidence in model development through structured activities and improving decision making capability through quantification of uncertainties. The work also identifies several shortcomings of the framework in the form of difficulties to acquire certain information within large organizations or projects, unfamiliarity of engineers with concepts of uncertainty or framework activities, lack of clear termination points for some framework steps, and challenges to accurately compare time and cost commitments.

Speaker Biography:

Jakob Hartl is in the Aerospace Systems direct PhD program at Purdue University. His current research is in the development of a model verification and validation framework for high-consequence systems in industry. More specifically, Jakob is part of a Rolls-Royce Doctoral Fellowship program and his work considers the motivating industrial setting of gas turbine engine design.

Presenter Name: Helfrich, Reinhard

Presenter Company: INTES GmbH

Presentation Title: Next Generation Contact Analysis (R. Helfrich, INTES GmbH; Lvl: 3)

Session Title: Structural Analysis 1

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 12:30 PM

Type: Presentation

Intended Learning Outcome:

They will learn that contact analysis is not an obstacle any more for using very large models due to essentially reduced computation times.

Keywords: Contact analysis, method, computation time, accuracy, optimization

Abstract:

Contact is a highly nonlinear boundary condition in Finite Element Analysis (FEA), which is used in many applications. Each assembly model has joints where contact is present. An accurate representation of the actual contact has a great influence on displacements and stresses. In fact, even very small changes in the contact geometry can change the FE results drastically. Although contact is omnipresent in FEA applications, the standing of contact analysis is still rather poor due to high computational effort as well as sometimes serious convergence and accuracy problems. Such problems can also limit the possible model sizes due to increasing computing times. Users often replace true contact by other couplings and hope that the results will be acceptable. When model sizes increase due to needs for predicting durability, the situation becomes even worse. Additional computational effort will be needed, if contact is taken into account together with elastic-plastic material behavior and geometrical nonlinearities. Therefore, a contact solver is needed, which provide accurate results and very short computation times. The accuracy is achieved by two points: (1) Lagrangian multipliers are used to properly describe the contact conditions correctly, which do not allow for tensional contact forces, show no penetration of the contact surfaces, and provide contact forces only for closed gaps. (2) A flexibility approach is used as constitutive equation, because contact forces are the primary unknowns in contact analysis. The performance aspect is supported by a condensation approach, which reduces the problem size dramatically and allows for a very efficient solution based on state-of-the art solution strategies. This paper introduces a new solver for contact analysis, which opens a door to very large models (> 150 Million DOF) with contacts (> 200,000) and accomplishes top speed (overnight) without sacrificing accuracy. Various industrial examples are shown to illustrate the achievements in different application areas.

Speaker Biography:

PhD in Aerospace Engineering of Stuttgart University, Germany Co-Founder of INTES in 1984 Currently: Chief International Officer of INTES

Presenter Name: Helfrich, Reinhard

Presenter Company: INTES GmbH

Presentation Title: Maximizing Eigenfrequencies of PCB (R. Helfrich, INTES GmbH; Lvl: 3)

Session Title: Innovative Applications

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 1:30 PM

Type: Presentation

Intended Learning Outcome:

They will learn that the simultaneous optimization of shape and sizing is possible, and that only one model is needed to perform an eigenvalue analysis and the maximization of eigenfrequencies.

Keywords: Eigenvalue analysis, multi-modal optimization, positioning, sizing

Abstract:

Electrification of drive train and autonomous driving are increasing the number of electronic devices in cars and related PCB (Printed Circuit Boards). Due to the dynamic road excitation of such boards and other excitations any damages of the electronics should be avoided. To this end, an increase of the eigenfrequencies of PCB could help to overcome such vibration problems. Any other connected assembly, where bolts, rivets, spot welds, or supports to ground are subject to dynamic excitation, will be a candidate for using the same technology to maximize the eigenfrequencies. One way to increase such eigenfrequencies is to use a sufficient number of bolts to fix the board. These bolts have to be positioned in an optimal way. These tasks lead to a multi-modal optimization, which simultaneously solves both a shape optimization problem to position the supports and a sizing optimization of the support stiffnesses to assess the need of single supports. The modeling of each support consists of a spring to ground, which is connected to the PCB by an interpolation function. This allows the arbitrary positioning of a support and it is not necessary to connect supports to nodes of the PCB FE (Finite Element) mesh. In this way, the shape optimization moves the support to the optimal position. In addition, each spring stiffness is scaled by a contribution factor between zero and one, which is optimized by the sizing optimization. A contribution factor close to zero is indicating a support, which can be neglected. If no contribution factor is close to zero, then it is likely that additional supports will give additional opportunities to raise the eigenfrequencies. So, the initially selected number of supports should be on the safe side. The paper explains how the modeling of PCB supports is done and how optimization task is set up. An industrial example is used to demonstrate the process and to evaluate the results. The analysis and the multi-modal optimization is done in one single job using the industrial software PERMAS.

Speaker Biography:

PhD in Aerospace Engineering of Stuttgart University, Germany Co-Founder of INTES in 1984 Currently: Chief International Officer of INTES

Presenter Name: Herbst, Markus

Presenter Company: BETA CAE Systems SA

Presentation Title: Vehicle NVH Analysis Based on Loads from a Multi Body Simulation - An Integrated Solution (M. Herbst, BETA CAE Systems SA; Lvl: 3)

Session Title: Multibody

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 4:30 PM

Type: Presentation

Intended Learning Outcome:

Demonstration of an approach how to couple a Multibody Dynamic Simulation of a passenger car with a subsequent comprehensive analysis of the trimmed body NVH performance in frequency and time domain.

Keywords: NVH, Multibody Dynamics, Flex Body, Display Model, Non-Linear Method

Abstract:

The NVH performance of a car has always been one of the key factors affecting customer satisfaction as unwanted noise in the passenger cabin leads to an uncomfortable driving environment. As a result, a lot of research and testing is invested in NVH related topics. Classical CAE NVH analysis procedures are based on linear numerical methods and linear FE models. However, it is well known that important components of a vehicle, e.g. the chassis mounts, show a strong non-linear behavior which is not captured in a linear analysis. In order to overcome this shortcoming a 2-step approach is used: 1. A Multibody Simulation (MBS) is performed which simulates a certain driving maneuver of the full vehicle. The MBS is a non-linear method and can capture non-linear characteristics via non-linear material properties, e.g. the stiffness of chassis mounts, via contacts or via kinematic constraints. The trimmed body (TB) is included in the MBS as a flexible body represented by its Modal Neutral File (MNF) modes. 2. One outcome of the non-linear MBS is the knowledge of the forces that are acting on the trimmed body at the chassis to body interface points. Assuming that the car body itself behaves linear, classical linear NVH analyses can be performed using the forces from MBS. Typical examples are the calculation of sound pressure level (SPL) or of the tactile response at locations like the steering wheel, in time as well as in frequency regime. In this presentation a new method is introduced which reduces the files sizes of the MNF file in the same significant way as the modal base for the NVH calculation. A display model is used in both steps which is a simplified FE model consisting of a coarse shell mesh. Whereas the nodes of the display model must be a subset of the original FE, the course shell elements are just used for displaying results. Using such a display model for the MNF calculation is new feature of the BETA FEM solver EPILYSIS and a key enabler for an efficient coupled MBS-NVH process. Furthermore, the presented analysis proves a huge influence of including the TB as a flexible component instead of a rigid body in the MBS. It is shown that a flexible body representation overestimates the forces on the TB and leads to exaggerated tactile and acoustic responses. A detailed modal participation analysis reveals that the overestimation is especially pronounced at the global modes of the TB. Additionally, the proposed process was slightly changed. Instead of applying the interface forces acting on the body system the modal coordinates of the flexible body calculated in the MBS are used to determine the NVH Trimmed Body response. Results for both approaches are compared.

Speaker Biography:

Markus Herbst is working in the Customer Service Department of BETA CAE Systems, where Markus is specialized in NVH FEM applications and methods. Prior to joining BETA CAE, Markus was working for more than 15 years as a CAE engineer with Ford of Germany in the Body NVH department. He was also lecturing at RFH Cologne teaching mechanics and simulation techniques. Markus holds a PhD in Physics from the WWU Münster.

Presenter Name: Hoglund, Robert

Presenter Company: Altair Engineering, Inc.

Presentation Title: Virtual Design, Validation, and Manufacturability for Metal Powder Bed Additive Manufacturing (R. Hoglund, Altair Engineering, Inc.; Lvl: 2)

Session Title: Additive Manufacturing 1

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 11:30 AM

Type: Presentation

Intended Learning Outcome:

The audience will learn how simulation in an integrated environment can accelerate product development for laser power bed fusion additive manufacturing.

Keywords: Additive manufacturing, DFAM, thermo-mechanical modeling, topology optimization,

Abstract:

In order to achieve cost-efficient and effective design of parts for production metal power-bed additive manufacturing, a variety of simulation tools have been proven useful and continue to improve. However, it is currently quite complex to develop a product for AM by validating structural performance, preparing the build, and predicting defects that might occur in the build process, moving from initial concepts to manufacturing feasibility studies. Engineers might use one software suite for topology optimization, one if they are interested in cleaning up the model; another for support generation, and even more for simulation to predict defects. Therefore, wide-ranging skill sets are required, whereas democratization of the workflows will enable faster product development in this space. Crucial to designing for additive manufacturing (DFAM) is the ability to quickly modify CAD geometry, part orientation, and support structures early in the design phase. Efficient part design for AM involves eliminating overhanging regions where unnecessary, through optimization and other methods. Since extra support structures can add significant cost in both postprocessing and material usage, understanding the best part orientation and minimizing support structure usage is necessary to successful part design. In addition to considering the supports and build direction, physics-based thermal and thermo-mechanical simulation can be used to understand manufacturing issues such as excessive distortion, residual stress, and final spring back. Macroscale simulation of the AM process, building a part layer by layer, can identify potential issues early on within the design process before any machine time or powder is committed. In this study, an example is shown to design a part for additive manufacturing in one integrated environment, beginning with the original CAD model. Topology optimization and validation are carried out on this geometry, and the part is properly oriented and supported. Finally, thermo-mechanical simulation of the additive manufactured part is used to predict build defects and issues in the same environment and give feedback to the product designer. This methodology eliminates more potential for errors due to a higher number of data translations, reduces software licensing costs, and provides time savings. Integration of the validation and manufacturing simulation processes in the same environment can enable cost savings in the additive manufacturing product development process, as well as accelerate production timelines.

Speaker Biography:

Rob is currently a technical specialist with Altair Engineering in the technical field team and joined Altair in 2017. His roles and responsibilities include providing customer support and training in software products of expertise such as OptiStruct, Inspire, and SimSolid, and assisting the field team and customers with software methods development.

Presenter Name: Huang, Joshua

Presenter Company: Ryobi Die Casting, USA

Presentation Title: An Introduction to Manufacturing Simulation and Smart Manufacturing (J. Huang, Ryobi Die Casting, USA; Lvl: 2)

Session Title: Manufacturing Process Simulation

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 11:00 AM

Type: Presentation

Intended Learning Outcome:

Discuss the right strategy to set-up the right scale of manufacturing process simulation.

Keywords: Manufacturing Simulation, Manufacturing Process Simulation, Multi-scale Modeling, Multi-level Modeling, Uncertainty Quantification, Digital Twin/Traceablity

Abstract:

First, this presentation presents an overview of manufacturing, more specifically smart manufacturing, and explains the transformation processes of information and material in a manufacturing system from the viewpoints of both product lifecycle and enterprise system. It discusses the common physics phenomena and performance parameters that designers are interested in a manufacturing process. Then, a generic definition of manufacturing simulation is presented. The manufacturing simulation can be divided into two categories. The first category is manufacturing system simulation that aims to analyze the systematic performance of a manufacturing system that is a material flow system which usually consists of several manufacturing processes. The second category is manufacturing process simulation that is to analyze an individual manufacturing process which consists of one or more physics phenomena of the material transformation. After a brief introduction of manufacturing system simulation, the paper focuses on the requirements and challenges of manufacturing process simulation and smart manufacturing. In order to make a manufacturing system intelligent, the manufacturing system simulation and manufacturing process simulation have to be merged to provide a decentralized decision-making modeling to realize the agile production response to achieve the best overall performance of the manufacturing system. It is one of hot frontiers of manufacturing simulation, which is the core and essential work of smart manufacturing engineering in order to take full advantages of industry 4.0 revolution. The presentation further discusses the challenges of manufacturing process simulation such as the raw material property input data, process uncertainty and multiscale modeling. To address these challenges three additional hot frontiers of manufacturing simulation are introduced: Multiscale Modeling for ICME – Integrated Computational Material Engineering, Uncertainty Quantification for "the last mile" improvement of manufacturing process simulation and Digital Twin for product real time whole life monitoring and control from its birth (manufacturing process) to its decommissioning and recycling. In addition, this paper discusses the effective and efficient strategy for a CAE practitioner to set-up the "right scale" of modeling to do a productive manufacturing simulation.

Speaker Biography:

Dr. Changhua (Joshua) Huang Ryobi Die Casting (USA) Inc. Experiences: June 2018 – present Senior Technical Lead, Advanced Engineering, Ryobi Die Casting Nov. 2000 – May 2018 Senior R&D Engineer, Head of CAE and Simulations, Exco Engineering Jan. 1993 – Sept. 2000 Associated Professor, Tsinghua University ____ Current position / tasks Dr. Huang is currently Senior Technical Lead at Ryobi Die Casting, USA. He is responsible for development and implementation of new and improved manufacturing processes into operational groups to drive future profitable growth by leading inter-departmental technical projects, which includes product engineering, tooling engineering, process engineering and quality assurance engineering. His expertise includes manufacturing process simulations with CFD and FEA, die casting manufacturing and additive manufacturing. He is currently a member of NAFEMS Americas Steering Committee, one of founding members of NAFEMS Manufacturing Process Simulation Working Group and a member of the NADCA Computer Modeling Working Group.

Presenter Name: Hunter, Tim G.

Presenter Company: Wolf Star Technologies

Presentation Title: GETTING BOUNCED: Pogo Stick Loads and Durability (T. Hunter, Wolf Star Technologies; Lvl: 2)

Session Title: Structural Analysis 2

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 2:00 PM

Type: Workshop

Intended Learning Outcome:

The attendees will learn about and see a live Rubber Fatigue Analysis with Endurica using Load Reconstruction with True-Load.

Keywords: Fatigue, Rubber, Load Reconstruction, FEA, Strain Gauge, Endurica, True-Load

Abstract:

Digital Twin applications that integrate in-situ load measurements with periodically updated simulations of remaining fatigue life hold great promise for creating huge value in maintenance and logistical operations. In this work, we implement two commercially available, off-the-shelf solutions to create a closed-loop pogo stick digital twin that tracks damage accumulation due to actual loads experienced. A pogo stick was chosen because it experiences highly non-linear loading. The system records 12 strain gauges on the pogo stick frame at 1000 Hz. Strain gauges were placed using the True-Load load reconstruction. The True-Load process automatically creates strain correlation plots comparing measured strain to the strains in the FEA model simulated by the reconstructed loads. It also converts the strain gauge signals into 3 mutually perpendicular load channels that then are fed to a simulation of the pogo stick's rubber tip. After each "operating" session, load history from the pogo stick is downloaded and accumulated as fatigue damage in a digital twin that tracks the remaining life of the rubber tip of the pogo stick. In order to accelerate loads processing to real-time speeds, the Endurica EIE interpolation engine has been used. EIE uses pre-computed finite element solutions of the rubber tip of the pogo stick under a series of load cases to rapidly convert input load history into strain tensor component history for each finite element. The Endurica DT incremental fatigue solver is then used to accumulate damage in all finite elements of the model, for each operating session. The result is a continually updated account of remaining life left in the pogo stick tip due to actual loads experienced. Whether you are developing a new product, or operating a digital twin, combining real-time high-accuracy structural loads with real-time fatigue evaluation software will propel you leaps and bounds towards a digital twin for durability.

Speaker Biography:

Not Yet Provided

Presenter Name: Huston, Steven

Presenter Company: Ingersoll Rand

Presentation Title: Can You Crack the Crush Tube? A Nonlinear Deformation Challenge Problem (S. Huston, Ingersoll Rand; Lvl:)

Session Title: Structural Analysis 2

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 3:30 PM

Type: Presentation

Intended Learning Outcome:

Keywords:

Abstract:

The Computational Structural Mechanics working group would like to present NAFEMS members with a nonlinear deformation challenge problem. The problem is outlined below, and will be described in more detail in this webinar. We'd love to learn how you would tackle the problem and look forward to comparing approaches. The design department of your company are engaged in a project to design an impact limiter for a part to be moved by a crane lift. The design they want to go with is for two effectively rigid thick steel plates; the crane lifting points will be attached to the lower plate. The part that is required to be lifted will be attached to the upper plate, and the two plates must be separated by at most 350mm to provide the necessary clearance throughout the lift. The designers have determined that, for the energy content of the maximum credible drop height, a set of tubes that can each provide 100kJ of energy absorption would be sufficient, and they have found some stainless steel tubes in stores that they think will work. The tubes can be cut to the required 350mm length, and there are a large number of tubes immediately available which makes them very attractive to use. Simple hand calculations have shown that these tubes are capable of supporting the static force during the lift, including all credible dynamic loads from the crane. The tubes have been inspected by the designer using a Vernier gauge and appear to all have a 4.0mm wall thickness, are visually round with no obvious ovalisation or other imperfections, and have an outside diameter of 174mm. The material certification cannot be found, although the company metallurgist has suggested that a mean plastic flow strength of 317MPa has been used in previous work which gave reasonable correlation to crushing problems such as this for this sort of material. The metallurgist is very busy (and also quite grumpy!) and won't provide any more assistance in characterisation of the material. The designer is also very sorry, but there isn't any money in the project for testing of the tubular material, either. The designer wants to know if the tubes that have been found in stores are suitable for use and will absorb the required energy. What is your advice? What caveats, if any, do you think are necessary to be attached to your advice, noting that the project is under considerable time and cost constraints.

Speaker Biography:

Steven Huston is Lead Simulation Engineer for Ingersoll Rand / Club Car, specializing in structural and durability analyses. He has 18 years of experience in product design and validation in industries including appliances, HVAC, transport refrigeration, and golf and utility vehicles. Steven is a member of the NAFEMS Computational Structural Mechanics Working Group.

Presenter Name: Illa, Kaushik

Presenter Company: Siemens Digital Industries Software

Presentation Title: Battery Aging Prediction for a Real-World Driving Cycle (K. Illa, Siemens Digital Industries Software; Lvl: 2)

Session Title: Multiscale & Multiphysics 1

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 12:30 PM

Type: Presentation

Intended Learning Outcome:

To create a realistic Battery Pack model which consider Electrochemistry, Thermal, Stress and Aging.

Keywords: battery pack, electrochemistry , thermal , aging, empirical , simulation , modeling

Abstract:

Physically developing and performing trials on new battery compositions and cooling strategies is an expensive and resource intensive process that only large funded organizations and laboratories have the facilities to perform successfully. In this paper, we would like to address how simulation would assist in minimizing the research, analysis, and experiments to analyze the behavior of battery systems where there is a need for strongly coupled resolution of flow, heat transfer, electrochemistry and stress due to expansion and contraction during operation to provide the best possible prediction to maintain the integrity of the system and identifying potential problems at an early stage. Now, introducing aging mechanisms into this creates a complex but realistic model which is predictive of the battery pack's performance for a real world driving cycle. This paper presents a case study for a commercial light weight sports EV which considers the multiphysics aspects of pack: electrochemistry, thermal, stress and aging mechanisms. Firstly, the cell is characterized and then the pack level cooling is developed to achieve the required range based on an aggressive drive cycle. Finally, we will demonstrate the performance of a full system level simulation to capture various interactions such as control on pack level integration. Different approaches are used for modeling of lithium-ion batteries and their aging. The most realistic cell models are physics ones which simulate mostly single aging effects such as SEI growth, lithium plating, electrolyte decomposition, and corrosion of electrodes, etc. However, these models are very slow and complex to parameterize. Therefore, they are not suitable for aging prediction on a long-time scale hence an empirical aging model would be suitable. For an aging prediction a lot of different aging factors must be accounted for - e.g. temperature, storage voltage and time for calendar aging and, in addition, cycle depth, SOC range, current rate and charge throughput for cycle aging considering both calendar and cyclic aging. This paper presents a case study for a commercial light weight sports EV. Firstly, the cell is characterized and then the pack level cooling is developed to reach the achieve the required range based on an aggressive drive cycle. In all, it is becoming more vital to analyze packs and modules through simulation to capture the complexity of the management of thermal, stress and aging of cells at the component and system level.

Speaker Biography:

Biography – Kaushik Illa Kaushik Illa is an Application Specialist for e-Powertrain at Siemens PLM . He got his EE Bachelors from JNTU, India and EE Masters from SUNY, Buffalo. He has previous worked in various consumer and global manufacturing companies since 2011 which include SunPower, Regal Beloit, QM Power before joining Siemens PLM in 2016. He has a background as a product and software development professional with expertise in Electrical Machines and Batteries. He is the Technical Lead for all e-Powertrain related technology. He is responsible for defining future strategy, anticipating market simulation needs and disseminate the best usage of Simcenter Solution Portfolio for e-Powertrain.

Presenter Name: Illa, Kaushik

Presenter Company: Siemens Digital Industries Software

Presentation Title: Multiphysics Modeling: Electro-Thermal Analysis of a Permanent Magnet Synchronous Machine for Electrical Vehicles (K. Illa, Siemens Digital Industries Software; Lvl: 2)

Session Title: Electromagnetics & Electrostatics

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 4:30 PM

Type: Presentation

Intended Learning Outcome:

How to create a realistic eMachine easy coupled Electromagnetic- Thermal model.

Keywords: electromagnetics, simpleUI, coupled, simulation, thermal, 3D EMAG, 3D Thermal

Abstract:

With the emergence of electric vehicles (PHEV, MEV, BEV and FEC) and the significant reductions of permanent magnet material and its related cost, new challenges arise. In particular, the design of electric machines smaller in size and weight along with higher torque and power density needs better cooling to not overheat. This implies a strong need of multi-physic analysis, namely electro-magnetic in combination with thermal. The loss and temperature distribution in an electric machine in operation can be assessed early on in the design process using simulation methods (virtual prototyping). In this paper, we present a multi-physics modelling of the electromagnetics together with conjugate heat transfer and flow thermal outputs in one environment, running in parallel. A loosely coupled electromagnetic and thermal analysis is performed to obtain the overall machine performance. An interior permanent magnet (IPM) synchronous machine was selected, as they take advantage of the reluctance torque lowering the need of permanent magnet material. This is applied to xEV application. The design process of the machine usually begins with the geometry creation. This is done in Simcenter SPEED. This is where the control parameters are defined for example, the current, the voltage, the circuit regulation topology, phase advance angles for the electromagnetic characteristics and density, specific heat, conductivity of active materials for thermal characteristics and other parameters which are essential in defining the machine. The SPEED model is then imported into STAR-CCM+ where the objective is to calculate the over an electric cycle averaged iron loss distribution which is also temperature and load dependent. In this paper we present a novel approach using a finite element discretization technique for a 3D section of an electric machine and obtain the magnetic field and loss distribution and exchange the data with the full 3D CFD thermal model in one environment of STAR-CCM+ linked by the new feature Simulation Operations, which eases the linking of multi-physics simulations significantly. Additionally, with a new approach in driving SPEED from STAR-CCM+ we are able to work from a sole environment – no need to switch between different tools.

Speaker Biography:

Not Yet Provided

Presenter Name: Iti, Anup

Presenter Company: Dassault Systemes CATIA

Presentation Title: Concept Structure Engineering and Optimization (A. Iti, Dassault Systemes CATIA; Lvl: 1)

Session Title: Optimization 1

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 1:30 PM

Type: Presentation

Intended Learning Outcome:

Innovative engineering workflow to generate structural concepts, concurrent validation for multi-physics attributes and seamlessly handover to detailed design phase.

Keywords: Concept, Simulation, Structural, Multi-physics, Multi-attribute, digital continuity, optimization

Abstract:

The future of conceptual engineering across multiple industries necessitates use of tools which effectively capture the requirements at a fundamental level and provide an efficient platform not only to convert these to 3D geometry, but also allow concurrent optimization and validation across multi-physics & multi-scale attributes of these concepts. Additionally, a digital continuity is aspired to connect the selected candidate to downstream detailed design. Concept Structure Engineering, is the latest application being delivered by DASSAULT SYSTEMES under the Modeling and Simulation initiative. It is based on the successful principle of SFE CONCEPT, of generating multiple concepts, which includes continuous and discrete design variables, and can be readily converted into simulation models. These simulation models are further seamlessly connected to entire simulation and optimization applications within the SIMULIA portfolio, facilitating the con-current validation across multi-physics & multi-scale attributes. This could be further extended to include a multi-material scenarios including the use of composites. The user can select the most efficient concept, based on Result Analysis and Performance study, which are leveraged to filter through the various alternatives and rate them based on the key performance indicators(KPI's). Currently there is a huge bottleneck within the industry to efficiently convert concept models to detailed design. This is related to uses multiple tools which require different file formats. The common data model approach of the 3DExperience Platform, enables digital continuity which empowers the designer using CATIA to readily to access the concept models and enhance them further by including the manufacturing details which are crucial during the detailed design phase. The model based approach of DASSAULT SYSTEMES 3DExperience Platform enables this engineering innovation, and the work presented in this paper will capture the model based approach, digital continuity of 3DExperience Platform being leveraged to generate structural concept and enhance its performance through simulation and handover to downstream detailed design.

Speaker Biography:

Not Yet Provided

Presenter Name: Jackson, Chad

Presenter Company: Lifecycle Insights

Presentation Title: Most Effective ROI Models for Simulation Applications: Answers from Research (C. Jackson, Lifecycle Insights; Lvl: 2)

Session Title: Simulation Governance 1

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 12:00 PM

Type: Presentation

Intended Learning Outcome:

Attendees will learn which return-on-investment models are most effective for different applications of simulation.

Keywords: ROI, cost justification, executive

Abstract:

Today, simulation is being applied in new and innovative ways in product development and beyond. It is a key part of verification and validation. It offers promise for engineering-led design decisions. It can drive the selection of system architectures. It is the key to running accurate digital twins at the edge of IoT. Simulation has found new life inside and outside engineering. Making such efforts real, however, is no easy task. Champions of simulation initiatives must convince financial stakeholders that these investments are worth the company's hard earned cash. ROI models based on soft costs are often squashed due to the difficulty of monetizing the benefits. Calculations based on hard costs are far more attractive. Yet, getting buy-in from other leaders is challenging. For these reasons and more, Lifecycle Insights is conducting a survey-based research study called the Engineering Executive's Strategic Agenda. This effort will measure what initiatives engineering organizations are pursuing, what benefits they are realizing, and the importance of key technology enablers. During this presentation, Lifecycle Insights' Chief Analyst, Chad Jackson, will present a simulation-specific view of these findings. These findings will offer difficult-to-gain insight into how engineering executives view simulation as an enabler, their relative contribution to success, and what measurable goals they intend to achieve. Lifecycle Insights' mission is to help executives realize value from tech-led initiatives without disruption. We digitally publish research and thought leadership guidance, enabling better investment and deployment decisions. As Chief Analyst, Chad Jackson leads Lifecycle Insights' research and thought leadership programs, attends and speaks at industry events, and reviews emerging technology solutions. As CEO, Chad defines Lifecycle Insights' vision and change initiatives. Chad's twenty-five-year career has focused on improving executives' ability to reap value from technology-led initiatives. He has surveyed thousands of manufacturers, produced hundreds of research and thought leadership publications, and presented dozens of times domestically and internationally. He imparts an influential, independent, and insightful voice on the industry's transition to smart, connected products.

Speaker Biography:

Not Yet Provided

Presenter Name: Jadhav, Tushar

Presenter Company: ANSYS India

Presentation Title: Adjoint for Scale Resolving Simulation (T. Jadhav, ANSYS India; Lvl: 2)

Session Title: Optimization 1

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 2:00 PM

Type: Presentation

Intended Learning Outcome:

Adjoint for scale resolving simulation

Keywords: Adjoint, SBES, LES, Optimization, Shape optimization,

Abstract:

Adjoint is an optimization method popularly used for shape optimization in Automotive industry. In most of the commercial codes it has been developed to use steady state Reynolds averaged naiver stoke (RANS) solutions as a primal solution to adjoint. However, it is also has been observed that certain regions on a vehicle may have strong transient effect which are difficult to capture using steady state calculations. For example, the modification in rear spoiler, d-pillar modification or air dam can sometime produce large transient effects and the steady state calculations may not predict right tendency in drag benefit at these locations. In aerodynamic point of view these are important region in optimization perspective. The approach discussed here will require a fast-transient stress blended eddy simulation (SBES) followed by length scale evaluation from restricted RANS calculation and then adjoint optimization. The time averaged mean velocity field obtained from SBES calculation will replace RANS field prior to running adjoint calculations. The restricted RANS calculation will only solve for turbulent length scale and flow calculations will be frozen. This will require more computational power to resolve the smaller scales as compared traditional RANS based approach however it is more reliable as the drag benefit obtained from above mentioned design changes are typically very small, mostly less than 5% altogether. In this work the process will be discussed using DrivAer car model and other simplified designs like Hyundai Simplified Mode (HSM) and SAE models for which the test data is available for initial design. The shape optimized designs will be compared for Steady and Transient scale resolving models. The DrivAer car model resembles to real car model and has aerodynamic shape. The HSM model is simplified but has sunroof window buffeting. It is quite difficult for steady state RANS to predict design change very accurately. The focus will be on optimizing the front roof region. The SAE body has a mirror which will be optimized for drag and the comparisons will be made between steady state adjoint and transient adjoint calculations. An ANSYS Fluent software will be used for Meshing, Solution and Postprocessing. The HSM and SAE body case was originally developed to study external wind noise to interior cabin. However, the work will focus only on Adjoint shape optimization and understanding the benefit of using scale resolving simulation over steady state calculation.

Speaker Biography:

Tushar Jadhav is a Senior application engineer at Ansys Inc, He is specialized in Automotive CAE simulations. His focus area includes Aerodynamics, Aeroacoustic, Heat transfer, Design Optimization, Multiphase and Fluid-Structure interaction. At Ansys, Tushar have worked with many Automotive customers and have generated many collateral and high quality papers . He provides technical excellence to ANSYS customers, interacts with product development team and provides inputs for product road map and planning. He is part of ANSYS for around 9 years. Tushar did his master degree program from Aerospace Department of Indian Institute of Technology Madras in Aerodynamics domain. He has eight publications in respected journals and conferences.

Presenter Name: Jatale, Anchal

Presenter Company: ANSYS Inc.

Presentation Title: Simulation-Based Digital Twins for Improved Asset Operation and Maintenance Management (A. Jatale, ANSYS Inc.; Lvl: 3)

Session Title: Digital Threads & Digital Twins 2

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 2:30 PM

Type: Presentation

Intended Learning Outcome:

How to use detailed simulation powered realtime model for asset monitoring and management

Keywords: Digital Twins, Predictive analysis, Real-time models

Abstract:

The insight of physics-based simulation in conjunction with advancement in collection and usage of sensor data enabled by the wireless technology and cloud computing has created great opportunities. It can drastically reduce risks associated with cost and schedule overruns resulted in less warranty cost and unexpected downtime. Simulation technology plays a central role in increasing the ROI related to IoT and digital-twin initiatives. It can provide insight from the deployment stage of the IoT platform to its operation and end of life. This includes sensor placement optimization to physics-based data interpretations and physics-based decision making. Additionally, it is being used for monitoring, diagnostics, prognostics, and prescriptive resolutions to optimize asset performance and utilization and record the digital footprint of the system. This technology also provides valuable insight for future product, system and subsystem requirements and design. Current talk will present a solution for digitalization of assets/process using the power of detailed 3D simulations. The solution will be showcased with an industrial scale shell & tube heat exchanger. The failure modes like fouling, corrosion, fatigue was modeled using 3D physics simulation models (CFD and FEA). Traditionally these models take long time to execute making them not suitable for real-time monitoring. Thus, the details of 3D models were compressed in a lightweight real-time model (Reduced order modeling) which were then hosted on an IOT platform and connected to the sensor data. This 3D detailed simulation powered twin provides insights into the equipment which was not possible with just the data. This twins augment and extend the capability to understand how and why certain failure is happening, enabling the person on the field to take informed decisions. This portable digital twins (run-times) can also be used as virtual sensors or to determine the physical sensor placement.

Speaker Biography:

Anchal Jatale, is currently serving as North America Oil & Gas Industry lead for Ansys. His background is in CFD modeling and has experience of 10+ years in modeling and simulations. For the past couple of years, he is spearheading Ansys Digital twin engagements in O&G industry. His expertise is in reduced order modeling, system modeling, reacting flow, combustion, multi-phase flow. Prior to joining Ansys, he received his doctorate in chemical engineering from the University of Utah.

Presenter Name: Jha, Pankaj

Presenter Company: VIAS

Presentation Title: Electromagnetic Simulations for Antenna Design and Its Placement, RF Interference Analysis and Lightning Strike for Aerospace Applications (P. Jha, VIAS; Lvl: 3)

Session Title: Electromagnetics & Electrostatics

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 5:30 PM

Type: Presentation

Intended Learning Outcome:

Antenna Design, Antenna Placement, RF Interference Analysis and Lightning Analysis on Aerospace Structures.

Keywords: Antenna Placement Analysis, Hybrid Solver, RF Interference Analysis, LEMP Simulation, Lightning Strike, TLM Solver, SIMULIA CST Studio Suite®

Abstract:

This work focuses on design and optimization of antenna at different frequency bands, RF interference analysis and lightning strike on aircraft and space systems. When aircraft is airborne, the pilot rely on their antenna systems to function well at any circumstances. So, the design and performance of the antenna when placed on the complex aircraft system environment becomes extremely important. The analysis of antenna in free space and its placement on aircraft and satellite is performed using bi-directional hybrid solver approach of SIMULIA CST STUDIO SUITE®. This approach allows the possibility to divide large models into small domains and solve each domain using the appropriate solver via field source coupling automatically. The mesh can be relaxed for full model containing imported source (field of antenna) and convergence can be achieved faster, thus reducing the simulation time. Radio frequency (RF) interference between co-located systems on aircraft is a key concern for system designer and must be understood at an early design phase. A dedicated RF interference task is used to find the desired and undesired coupling between all the communication and detection systems. The violation matrix is generated for clear picture of Electromagnetic Interference-Margins (EMI-Margins) for all possible TX/RX combinations and visually indicate the potential region of interference. Higher the EMI-Margin, higher the probability of interference. Almost all aircraft are struck by lightning on average once a year. The tremendous growth of lightweight composite materials such as carbon fiber reinforced (CFC) in place of metals increases the complexity of lightning-safe design, since composites are poor conductors and do not provide much electric shielding. The lightning EM Pulse Simulation (LEMP) is performed using TLM solver for two different aircraft skin Aluminum and CFC and susceptibility analysis of cables and electronics inside the aircraft is studied against the lightning stroke. TLM solver offers octree meshing, compact modelling, thin panel material and bi-directional coupling with cable solver. Lightning attachment starts with the initial attachment zones which has been analyzed with electrostatic simulation. The presentation details simulation-based approach to address the three key design and integrity aspects of communication and structure for an aircraft, satellite, Unmanned Aerial Vehicle (UAV). In particular, the antenna placement, RF interference and lightning analysis on a UAV, satellite and aircraft.

Speaker Biography:

Pankaj Jha, M.Tech., is a Senior EMAG Solution consultant at VIAS. He has 7 years of academic and industrial experience in modelling and simulation of different types of Electromagnetics problems. He has worked in areas of Antenna, Antenna Array, Filter Design, Microwave and RF circuits from GHz to THz, Bio-Electromagnetics, EMI/EMC ,EDA/Electronics and Low Frequency. He provides technical support and engineering services to customers and helps drive growth of VIAS electromagnetics Solutions. He worked with Dassault Systemes SIMULIA as Solution Consultant and was responsible for Aerospace & Defense, High-Tech and Automotive industry technical portfolios for CST. He is a graduate from Indian Institute of Technology, Delhi (IIT-D), where he studied Radio Frequency Design and Technology.

Presenter Name: Johar, Chait

Presenter Company: AAON Inc

Presentation Title: Making Believers out of Non-Believers: Psychology behind Transformation (C. Johar, AAON Inc; Lvl: 2)

Session Title: Cultural Challenges

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 11:30 AM

Type: Presentation

Intended Learning Outcome:

How to champion a change that leverages the power of simulation to an industry traditionally following expensive build and test methods.

Keywords: HVAC, FEA, Training, Psychology, CFD, Simulation, Transformation, Payoff

Abstract:

While simulation is inundating many engineering fields, the Heating, Ventilation and Air-Conditioning (HVAC) industry has not reached the stage where simulation is as ubiquitous as it could (or should) be. It is still very common to implement the "build and test" process that is often extremely expensive. Over the last 5 years, I have championed the comprehensive usage of CFD and FEA at an HVAC firm that has not done much with simulation for decades. The transformation at a "traditional" firm from "build and test" to leveraging simulation can be divided into certain "regions" that can be followed by Influencers to boost the change: 1) Introducing the concept of simulation to the most technical group within the firm (usually the Research and Development group). This first step is to offer a bird's eye view without much in-depth detail so the group can ease their mind into looking towards these technologies. Providing too much information here can be overwhelming and can cause the subjects to "turn off" before even attempting to work with these technologies. 2) After the subjects are beyond the stage of acknowledging the existence of simulation technologies, we can move toward demonstrating the simulation for a current application. It is beneficial to ask the subjects for an engineering problem they are experiencing themselves. After the problem is presented, at this stage all the technical "back-end" work should be done privately from the Influencer. Only the results (with postprocessor graphics) need to be shown to the subjects. 3) At this point, the subjects should be intrigued and interested enough to invest their own time in simulation. This is the time to have the subjects attend training sessions with beginner FEA and CFD application courses. Upon a certain degree of competence shown by at least a few of the subjects, it is proposed to juxtapose a few different types of simulation packages to invest in. 4) After this stage is reached, there will be a chosen person or two that will invest either nearly all their time in learning to use the simulation tool effectively. Initially they might need physical testing to support their simulation results. Over time, they will gain enough confidence in the simulation package and their abilities to not require physical validation for each and every simulation. This is when the payoff of using simulation seriously begins. 5) After reasonable experience, both the user and the firm will reap the benefits of simulation. They will be able to design products faster with better quality. It will also become easier to train newcomers to the team as there will be existing members with experience. The company culture will have fully changed to imbibe the benefits of simulation. This presentation will go in detail regarding the transformation outlined above. As someone who has gone through this process first hand, I am aware of the ins and outs of company culture transitioning from physical prototyping to benefiting from simulation. I would like to talk about this at the NAFEMS Conference as I think others will benefit from this knowledge as well.

Speaker Biography:

Chait Johar, R&D Project Engineer - AAON - Chait graduated Summa Cum Laude with a Bachelor of Science in Mechanical Engineering from Montana State University and with a Master of Science in Engineering from the University of Arkansas. Chait has been working at AAON since 2014 – he started working at AAON as a Line Engineer and is working as a R&D Project Engineer since 2015. Chait is a member of ASHRAE, IBPSA and AMCA. Chait is a licensed Professional Engineer in the state of Oklahoma.

Presenter Name: Jones, Gavin

Presenter Company: SmartUQ

Presentation Title: Predictive Analytics and Uncertainty Quantification of a Microwave Ablation Simulation with Spatial and Transient Responses (G. Jones, SmartUQ; Lvl: 1)

Session Title: Verification & Validation 2

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 11:00 AM

Type: Presentation

Intended Learning Outcome:

How predictive analytics and uncertainty quantification techniques can be applied to simulation cases with a functionally varying response, as in the case of a simulation which outputs a spatial field.

Keywords: uncertainty quantification, analytics, predictive analytics, emulation, surrogate modeling

Abstract:

This study presents a statistical approach for prediction and uncertainty quantification of a hepatic tumor Microwave Ablation treatment simulation with a spatial and transient response. The study examines the variation in the volume of necrotic tissue in a human liver tissue model during Microwave Ablation/Coagulation therapy due to tissue property variation as a function of wattage and treatment time. The analysis also assesses the effects of tissue variation on the size, shape, and percentage of necrotic tissue as a spatially distributed field rather than as a single-value parameter like cross-sectional area or volume. Data with spatial and functional correlations can often be modeled with fewer training data points using machine learning techniques. This approach also has the advantage of representing the entire spatial-transient field, which allows analysis on a greater range of results such as the percentage of necrotic tissue around an ablation region or areas in which tissue was unaffected. The surrogate models developed in this study are used to perform sensitivity analysis and uncertainty quantification studies to assess the variation in volume and shape of necrotic tissues due to variations in human tissue properties and treatment procedures. The microwave heating of a cancer tumor was used to simulate a region of hepatic cancer tissue. A commonly used coaxial microwave ablation antenna, with the corresponding slotted catheter, is positioned in the center of the cylindrical tissue section. The antenna operates at 2.45 GHz, a frequency widely used in microwave ablation therapy. A Design of Experiments (DOE) containing both biological and treatment factors was used to generate proper training data for the surrogate model. The biological factors included temperature, conductivity, permittivity, and specific heat of cancerous hepatic tissue. The surrogate models developed in this study accurately mimic the behavior of the underlying simulation model. These surrogate models were then used to produce sensitivity results and uncertainty margins due to expected variation in human tissue properties corresponding to a mock set of liver tumor scenarios. This study presents a novel methodology for both transient and spatial-transient simulation of tumor ablation treatment using surrogate modeling. This surrogate model will help ensure a microwave ablation device is able to produce predictable ablation zones while keeping ablation time to a minimum. The techniques presented with this case study can be implemented to a wide variety of other medical devices to deliver similar results and improve treatment predictions on a case-by-case basis for patients.

Speaker Biography:

Gavin Jones, SmartUQ Sr. Application Engineer, is responsible for performing simulation and statistical work for clients in aerospace, defense, automotive, medical device, gas turbine, and other industries. He is also a key contributor in SmartUQ's Digital Twin/Digital Thread initiative. Mr. Jones received a B.S. in Engineering Mechanics and a B.S. in Mathematics from the University of Wisconsin-Madison.

Presenter Name: Jones, Gavin

Presenter Company: SmartUQ

Presentation Title: Uncertainty Quantification and Digital Engineering Applications in Design and Life Cycle Management (G. Jones, SmartUQ; Lvl: 1)

Session Title: Uncertainty Quantification 1

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 4:30 PM

Type: Presentation

Intended Learning Outcome:

Understand the use of uncertainty quantification and probabilistic analysis over all stages of the product life cycle.

Keywords: life cycle management, digital engineering, uncertainty quantification, probabilistic analysis

Abstract:

Essentially every government and industry entity in the US Aerospace and Defense Industry, as well as numerous global industries, already have some form of ongoing digital engineering activity. The vision for implementation of digital engineering is to connect research, development, production, operations, and sustainment to improve the efficiencies, effectiveness, and affordability of processes over the life cycle of systems. Basic capabilities required of a model-based digital engineering approach to successfully achieve this vision are: • An end-to-end system model – ability to transfer knowledge upstream and downstream and from program to program • Application of reduced order response surfaces and probabilistic analyses to quantify uncertainty and risks in cost and performance at critical decision points • Single, authoritative digital representation of the system over the life cycle – the authoritative digital surrogate “truth source” This presentation will illustrate both conceptual and practical applications of using Uncertainty Quantification (UQ) techniques to perform probabilistic analyses. The application of UQ techniques to the output from engineering analyses using model-based approaches is essential to providing critical decision-quality information at key decision points in a product’s life cycle. Approaches will be presented for the continued collection and application of UQ knowledge over each stage of a generalized life cycle framework covering system design, manufacture, and sustainment. The use of this approach allows engineers to quantify and reduce uncertainties systematically and provides decision makers with probabilistic assessments of performance, risk, and costs which are essential to critical decisions. As an illustration, a series of probabilistic analyses performed as part of the initial design of a turbine blade will be used to demonstrate the utility of UQ in identifying program risks and improving design quality. The application of UQ concepts to life cycle management will be addressed, highlighting the benefits to decision makers of having actionable engineering information throughout a system’s life cycle.

Speaker Biography:

Gavin Jones, SmartUQ Sr. Application Engineer, is responsible for performing simulation and statistical work for clients in aerospace, defense, automotive, medical device, gas turbine, and other industries. He is also a key contributor in SmartUQ’s Digital Twin/Digital Thread initiative. Mr. Jones received a B.S. in Engineering Mechanics and a B.S. in Mathematics from the University of Wisconsin-Madison.

Presenter Name: Jones, Gavin

Presenter Company: SmartUQ

Presentation Title: Narrowing the Simulation – Test Gap with Statistical Calibration (G. Jones, SmartUQ; Lvl: 1)

Session Title: Uncertainty Quantification 1

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 5:00 PM

Type: Presentation

Intended Learning Outcome:

Attendees should leave with an understanding of how to apply calibration to their combined simulation and testing environments and to be able to understand the fundamental value that statistical calibration brings.

Keywords: digital twin, digital engineering, calibration, Frequentist, Bayesian, validation, statistical calibration, uncertainty quantification, physical testing, simulation modeling

Abstract:

Establishing how well the numerical simulation represents reality is one way to make simulation results more trustworthy for decision makers. This assessment is usually accomplished by comparing the simulation results to physical data. However, the observed mismatch between the simulation results and the physical test results can blur an engineer's understanding of how well the simulation represents reality. This presentation will focus on statistical model calibration, a process used to quantify the uncertainties in the simulation model which provides an understanding of this mismatch and a means to narrow the simulation – physical test gap. Using a case study, the presentation will sequentially walk through model calibration process used to quantify uncertainties for simulations and physical experiments. In addition to simulations, statistical calibration has a fundamental role in the emerging field of the Digital Twin, which has applications in aerospace, automotive, manufacturing and medical device industries. For both Digital Twins and general computer simulations, statistical calibration can supply an assessment of uncertainty at critical points in the development process called the 'authoritative digital surrogate truth source'. This key information based on simulation and physical data is shared with stakeholders and used for predicting the probability of success of meeting technical requirements at these critical points as well as prescribing the next steps in order to ensure success in meeting performance metrics. The audience for this presentation would be engineers and managers involved in or overseeing simulation design and analyses and experimental analyses. This presentation aims to leave attendees with an understanding of how to apply calibration to their combined simulation and testing environments and to be able to understand the fundamental value that statistical calibration brings.

Speaker Biography:

Gavin Jones, SmartUQ Sr. Application Engineer, is responsible for performing simulation and statistical work for clients in aerospace, defense, automotive, medical device, gas turbine, and other industries. He is also a key contributor in SmartUQ's Digital Twin/Digital Thread initiative. Mr. Jones received a B.S. in Engineering Mechanics and a B.S. in Mathematics from the University of Wisconsin-Madison.

Presenter Name: Jones, Gavin

Presenter Company: SmartUQ

Presentation Title: The Role of Analytics in the Digital Twin (G. Jones, SmartUQ; Lvl: 1)

Session Title: Digital Threads & Digital Twins 1

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 11:00 AM

Type: Presentation

Intended Learning Outcome:

What are a digital twins and statistical calibration and how does calibration play an important role in an digital twin workflow.

Keywords: Analytics, Digital Twin, statistical calibration, uncertainty quantification

Abstract:

The digital revolution has forever changed the way analytics is conducted. It has modernized the field of metrology with responsive digital measurement devices, yielding a “data rich” environment. Moreover, advancements in simulation software coupled with high-performance computing provide a venue for analyzing complex multi-physics systems never thought possible a decade ago. Evidence of this evolution is the emergence of the Digital Thread/Digital Twin, methodologies which bring together multidiscipline simulations and physical data into a functional group for conducting analytics. Through the use of uncertainty quantification (UQ) and other analytics techniques, this presentation will introduce attendees to the digital twin process workflow. The presentation will first discuss the role of analytics in the Digital Twin and the industrial challenges and benefits that come from it. Then it will present how Uncertainty Quantification and other analytics are the solution to building and running an efficient and accurate Digital Twin. For a specific part an authoritative digital truth source can be created. This is a digital, interrogatable repository of all the accumulated data and knowledge concerning that part. Using efficiently sampled data from the trade space of a simulation model for the part as well as from physical tests or experimental data an emulator (or surrogate model) of the simulation may be created and calibrated to match real world performance. Statistical calibration is one technique that may be used in this process. Statistical calibration has the advantage over other techniques of accounting for the imperfect nature of all models by assuming discrepancy between the model being calibrated and the physical data set exists. Understanding the discrepancy between the simulation model and physical tests or experiments can help identify model form errors and aid in verification and validation of the simulation. To illustrate the importance of statistical calibration to creating and running an efficient and accurate digital twin, an example of a statistical calibration using an emulator of a physics-based simulation model will be presented.

Speaker Biography:

Gavin Jones, SmartUQ Sr. Application Engineer, is responsible for performing simulation and statistical work for clients in aerospace, defense, automotive, medical device, gas turbine, and other industries. He is also a key contributor in SmartUQ’s Digital Twin/Digital Thread initiative. Mr. Jones received a B.S. in Engineering Mechanics and a B.S. in Mathematics from the University of Wisconsin-Madison.

Presenter Name: Jones, Gavin

Presenter Company: SmartUQ

Presentation Title: Introduction to Probabilistic Analysis and Uncertainty Quantification (G. Jones, SmartUQ; Lvl: 1)

Session Title: Uncertainty Quantification 3

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 1:30 PM

Type: Training

Intended Learning Outcome:

Attendees will leave with an understanding of Uncertainty Quantification (UQ) and probabilistic methods, how to apply them to a simulation and interpret the results, and the benefits of applying UQ and probabilistic methods.

Keywords: uncertainty quantification, simulation, sensitivity analysis, Latin hypercube design, model calibration, model validation, uncertainty propagation, polynomial chaos expansion, aleatory and epistemic uncertainty

Abstract:

Experienced practitioners who construct complex simulation models of critical systems know that replicating real-world performance is challenging due to uncertainties in found in simulation and physical tests. Uncertainty arises from sources like measurement inaccuracies, material properties, boundary and initial conditions, and modeling approximations. Using case studies, this training will introduce probabilistic and Uncertainty Quantification (UQ) methods, benefits, and tools. UQ is a systematic process that puts error bands on the results by incorporating real world variability and probabilistic behavior into engineering and systems analysis. UQ answers the question: what is likely to happen when the system is subjected to uncertain and variable inputs. Answering this question facilitates significant risk reduction, robust design, and greater confidence in engineering decisions. Modern UQ techniques use powerful statistical models to map the input-output relationships of the system, significantly reducing the number of simulations or tests required to get statistically defensible answers. The training will discuss the basic UQ and probabilistic methods, such as Gaussian processes, polynomial chaos expansion, sparse grids, Latin hypercube designs, model calibration, model validation, sensitivity analysis, and how to account for aleatoric and epistemic uncertainties. This training will also discuss the broad applications these probabilistic techniques have in analyzing numerous forms of engineering systems including Digital Thread/Digital Twins. Key Learning Objectives: — Basics of common UQ and probabilistic methods — How to apply UQ methods to an engineering system — How to use UQ techniques to save design cycle time and computational resources — How to develop a robust and reliable design with UQ techniques — How to interpret UQ results when making decisions The attendees for this training would be engineers, program managers, and data scientists who are interested in investigating probabilistic analytics and how Uncertainty Quantification can maximize insight, improve design, and reduce time and resources. This is purely an educational training and will focus on the concepts, methods and applications of probabilistic analysis and uncertainty quantification. SmartUQ software will only be used for illustration of the methods and examples presented.

Speaker Biography:

Gavin Jones, SmartUQ Sr. Application Engineer, is responsible for performing simulation and statistical work for clients in aerospace, defense, automotive, medical device, gas turbine, and other industries. He is also a key contributor in SmartUQ’s Digital Twin/Digital Thread initiative. Mr. Jones received a B.S. in Engineering Mechanics and a B.S. in Mathematics from the University of Wisconsin-Madison.

Presenter Name: Jones, Gavin

Presenter Company: SmartUQ

Presentation Title: Uncertainty Quantification with Complex Data (G. Jones, SmartUQ; Lvl: 2)

Session Title: Uncertainty Quantification 4

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 4:00 PM

Type: Training

Intended Learning Outcome:

Attendees should leave with an understanding of how advanced uncertainty quantification methods can improve their experimental design and testing, quantify the uncertainties in their simulations and validate their simulation results

Keywords: sequential design, subsampling, spatial-temporal data, complex data, emulation, functional simulation, high-dimensional, predictive analytics, sensitivity analysis, uncertainty propagation, Bayesian calibration

Abstract:

Advancements in simulation software and high-performance computing have led to the possibility of new technologies like the Digital Twin which deliver a continuous stream of complex data from simulation models. However, analyses of these data streams using basic Uncertainty Quantification (UQ) methods does not always yield the results sought. The emergence of complex data from these technologies has spawned new analytic methods for extracting pertinent and meaningful information. This training is an introduction to the new methods being used to quantify uncertainties for complex data sets. Complex data can be a combination of many things. It can have multiple responses including spatial-temporal functional response or be high-dimensional and require a large number of simulation runs to analyze. The training will discuss the many challenges of complex data, how these new methods are applied to them and the results they yield. The benefits of using the new methods are as follows: long runtimes for complex simulations can be greatly reduced through emulator or surrogate modeling techniques. The ability to build predictive surrogate models for either spatial or temporal responses are available with the ability to gain additional knowledge through sensitivity analysis and uncertainty propagation. A sequential design can achieve an accurate emulator while reducing the computational burden of running a complex simulation. Using data sampling techniques, large historical data sets can be reduce to a smaller data set that still represents the design space well. Bayesian calibration can quantify model-form uncertainties between the simulation and tests. With these technologies, the challenges of the size and form of a complex data set can be resolved. This training will focus on the background and methods of these technologies. The audience for this training would be engineers and managers involved in or overseeing simulation design and analyses and experimental analyses. Attendees should leave with an understanding of how advanced UQ methods can improve their experimental design and testing, quantify the uncertainties in their simulations and validate their simulation results. This is purely an educational training and will focus on the concepts, methods and applications of uncertainty quantification with complex data. SmartUQ software will only be used for illustration of the methods and examples presented.

Speaker Biography:

Gavin Jones, SmartUQ Sr. Application Engineer, is responsible for performing simulation and statistical work for clients in aerospace, defense, automotive, medical device, gas turbine, and other industries. He is also a key contributor in SmartUQ's Digital Twin/Digital Thread initiative. Mr. Jones received a B.S. in Engineering Mechanics and a B.S. in Mathematics from the University of Wisconsin-Madison.

Presenter Name: Karl, Alexander

Presenter Company: Rolls-Royce Corporation

Presentation Title: What Are the Chances of the Ship Snapping? Considerations When Using Probabilistic Analysis (A. Karl, Rolls-Royce Corporation; Lvl:)

Session Title: Uncertainty Quantification 2

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 11:00 AM

Type: Presentation

Intended Learning Outcome:

Keywords:

Abstract:

In the BenchMark magazine issue April 2019 two challenge problems are presented. The first one consists of two normal distribution, producing an analytical (theoretical) solution. The second one contains several distribution (normal, uniform and lognormal), and therefore an exact solution is not available. At the NAFEMS World Congress 2019 these problems were discussed and a few solutions presented. In this presentation these solutions and additional ones are discussed in combination with the theoretical background and the pitfalls of these methods.

Speaker Biography:

Not Yet Provided

Presenter Name: Kartikeya, Kumar

Presenter Company: ANSYS India

Presentation Title: Leveraging the Equivalance of I1-J2 and p-q Space to Simulate Powder Compaction Process (K. Kartikeya, ANSYS India; Lvl: 2)

Session Title: Manufacturing Process Simulation

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 11:30 AM

Type: Presentation

Intended Learning Outcome:

Use of Extended Drucker Prager Model with Cap to predict defects in powder compaction based products used in fuel,automotive and pharmaceutical industries.

Keywords: Extended Drucker Prager with Cap, Geomechanics, Invariants, Automotive and Pharmaceurical

Abstract:

Powder compaction is an important step in pharmaceutical tableting process. It is also used in fuel, automotive and ceramics industry. Aim of compaction is to attain desired shape and enough 'green strength'. Attaining a minimum and near uniform green strength is critical for the part to successfully endure downstream handling loads till the sintering stage, where the part attains its full strength. Inhomogeneous density distribution is seen to be related to tablet failures like capping, lamination, sticking, crack, chip off, etc. If this happens in production environment, it can lead to significant losses and delays. Compaction of granular materials is performed using Extended Drucker Prager material model with cap(EDPC). Experimental data is in terms of pressure & von-Mises stress. EDPC is defined in terms of the basic invariants I1 and J2. The experimental quantities are mostly in the form of p-q (pressure and von-Mises stress) space. Many of the commercially available simulation software packages have the Extended Drucker Prager material model with cap in terms of invariants i.e. in the I1-J2 space. Thus conversion of parameters from p-q space to I1-J2 space is required. The present work demonstrates the use of equivalence of the two spaces and conversion of parameters from p-q space to I1-J2. This conversion is based on relation between the pressure and first invariant of stress tensor & von-Mises stress and second invariant of deviatoric stress tensor. Finally, the converted parameters are used in simulation and the results are compared against the published experimental data. Using this method, the Extended Drucker Prager material model is applied to compaction simulation. The results are validated against published experimental data. Further, the results from simulation output include relative density, stress, axial and radial die wall pressures (used in stick-slip condition). These parameters help in predicting goodness of compaction upfront and highlight the region prone to cracking and chipping off post compaction.

Speaker Biography:

Kumar Kartikeya is Senior Application Engineer at ANSYS Software Pvt Ltd, Pune (MH), India. He holds the degree of Master of Technology in Applied Mechanics (Indian Institute of Technology, Delhi India) and Bachelor of Technology in Mechanical Engineering (Indian Institute of Information Technology, Design & Manufacturing Jabalpur India). He works in the field of non-linear materials and fatigue primarily. He has been part of ANSYS for 4.5+ years, with an overall industrial experience of 8 years in the field of linear and non-linear finite element analysis and fatigue. Anil Kumar is a Lead Application Engineer at Ansys. After completing his M.Tech from IIT Guwahati Mechanical engineering department in 2008, he has been part of the ANSYS Structural team. Since then, he had been working globally with ANSYS customers in the adoption of CAE tools to meet their engineering needs, primarily in the area of Structural Mechanics. His recent areas of interest are Additive Manufacturing, Mechanical vibrations, Reduced order Modelling techniques.

Presenter Name: Kasarekar, Nachiket

Presenter Company: ESTECO North America, Inc.

Presentation Title: Democratization of a Simulation Process Using a Workflow Engine and a SPDM Framework (N. Kasarekar, ESTECO North America, Inc.; Lvl: 2)

Session Title: Data Management 1

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 12:00 PM

Type: Presentation

Intended Learning Outcome:

Ability to use Business Process and Engineering Workflows to Democratize Simulation Processes on the foundation of a SPDM Framework

Keywords: SPDM, Democratization, Simulation, Workflows, Business Process, Simulation Process, Data Management

Abstract:

A plethora of factors like expanding product portfolio, complexity of the products, reduction in time to market lead to companies adopting simulation as a cornerstone of their product development process. As simulation and modelling capability matures the impact of simulation is felt across the product development lifecycle from component level detailed design to subsystem and system level design. Adoption of simulation further leads to a more holistic design approach where product architects, system engineers, design engineers and simulation engineers are all involved in the decision-making process using simulation as a backbone. This presents a challenge of enabling effective use of system simulation tools and analytical decision-making methods to various stakeholders in the product development cycle. In this presentation we explore the use of a web-based collaboration and simulation data management platform to democratize virtual product development workflows. Further we explore the ability of such a system to enable decision making by using mathematical optimization and analytical decision-making techniques. This also enables traceability and knowledge management of design decisions, supporting models and workflows in an intuitive web-based interface. The process begins with creating an automated process of your simulation load cases using a graphical workflow. The workflow uses an intuitive approach to enable the automation depicting the process and data flow in graphical representation. These workflows can then be published on a web based SPDM platform to enable versioning, data management and democratized execution. The execution enables users to run and compare various single runs, but also enables mathematical design exploration techniques like design of experiments and optimization to be applied. These exploration techniques are augments with statistical data analytical methods. Such methods enable the user to apply objective decision-making techniques on generated data and also share the same with collaborators and decision makers. The web-based platform enables democratization of complex simulation processes and the tenets of SPDM framework enable knowledge management over the lifecycle of the simulation and optimization.

Speaker Biography:

Not Yet Provided

Presenter Name: Keene, Roger

Presenter Company: Consultant (Roger Keene)

Presentation Title: How to Justify Increasing the use of Engineering Simulation in Your Company during and after COVID-19 (R. Keene, Consultant (Roger Keene); Lvl:)

Session Title: Cultural Challenges

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 1:00 PM

Type: Presentation

Intended Learning Outcome:

Keywords:

Abstract:

While engineering simulation is used widely in some companies and industries, almost all companies would benefit from increasing the use of simulation and there are industries where simulation is not widely used. Also small/medium sized companies are less likely to make use of simulation than large companies. The NAFEMS Business Impact Working Group has identified a number of ways to justify increasing the use of engineering simulation. Roger Keene will go through those different methods and offer advice on how to go about convincing senior management of the value of engineering simulation.

Speaker Biography:

Roger Keene is the Chair of the Business Impact Work Group and a business consultant and facilitator. He retired from Dassault Systemes in 2018 where he was Vice President of Worldwide Sales and Operations for the SIMULIA brand, responsible for sales, customer support, training and services for all of Dassault Systemes simulation products, particularly the Abaqus finite element software. He led the integration of several simulation companies and their products into Dassault Systemes, including CST, PowerFlow, X-Flow, Simpack, Wave6, Tosca and Isight. Roger came to Dassault Systemes when it acquired ABAQUS, Inc (previously known as HKS) in 2005. He has a Masters in Engineering from Cambridge University in the UK and worked at Arup consulting engineers and MSC Software, prior to joining ABAQUS.

Presenter Name: Khan, Kajal

Presenter Company: ANSYS India

Presentation Title: Automated Workflow for Reliability Analysis of Through Silicon Vias in 3-D Interconnects (K. Khan, ANSYS India; Lvl: 2)

Session Title: Thermomechanical

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 4:30 PM

Type: Presentation

Intended Learning Outcome:

Audience will learn how simulation can be applied to study the fracture behavior of TSV in 3D IC packaging.

Keywords: Electronics reliability, TSV, fracture, Automation

Abstract:

Through silicon via interconnects (TSV) are high performance interconnect technique alternative to wirebond and flipchip for application in 2.5D and 3D IC packaging. TSVs have picked up a lot of momentum in recent years because TSV is a key enabling technology for 2.5D/3D IC stacking, silicon interposer technology, and advanced wafer level packaging (WLP). It passes through a silicon wafer vertically which not only reduces the power consumption but also give a better electrical performance with wider data width and bandwidth owning to its compact size. The product where TSVs are used include MEMS, LED packaging, Memory, Image censors etc. which has application in automotive electronics, consumer electronics, telecommunication, aerospace and defence. However, thermo-mechanical reliability is a key concern for the growth of the 3D TSV market. This is due to the coefficient of thermal expansion (CTE) mismatch between silicon and conducting material (Cu) which is more than 10 ppm/K and which generates a significant thermal stress due to the heat generated in the ICs. In this present work, a three-dimensional thermo-mechanical finite-element model has been built to analyze the stress/strain distribution in the TSV structures. A fracture mechanics analysis is also performed for the Cu/SiO2 interfacial cracks. An automated workflow is created using ANSYS ACT extension that drastically reduces human error by converting complex manual analysis into an automatic process to identify critical crack and interface delamination locations. The ACT extension also automates the submodeling analysis set up, which reduces the computational expenses for a high-fidelity simulation. The automated workflow comprises of failure location identification, submodel domain specification, material mapping, mesh refinement, loads and boundary conditions transfer, crack insertion and postprocessing. The ACT application is not limited to TSV cracking analysis and can be used in any other scenario to create submodel analysis set up for any high-fidelity solution with an optional downstream fatigue and fracture analysis. This workflow can help analyst to swiftly create highly precise models, rapidly determine the optimal solution, identify problematic parts and reduce significant overall development time.

Speaker Biography:

Kajal Khan is an Application Engineer at ANSYS Inc with 5 years of experience. He is specialized in Ansys Mechanical, additive manufacturing, and electronics reliability. Kajal works for the electronics mechanical reliability related activities for Ansys customers across Asia and has been interacting with design engineers from different industries which includes consumer electronics, automotive electronics, A&D, etc. and helping them to design reliable and robust electronics. Kajal did his Master's degree in Mechanical Design Engineering from the Indian Institute of Technology Bombay and currently undergoing his Ph.D from the same university.

Presenter Name: Kim, Sangtae

Presenter Company: FunctionBay, Inc

Presentation Title: Optimizing Dynamic Mechanisms Using CAE: Best Practices to Select the Design Variables and Objective Functions (S. Kim, FunctionBay, Inc; Lvl: 1)

Session Title: Multibody

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 4:00 PM

Type: Presentation

Intended Learning Outcome:

These presentation demonstrate the need for optimization and provide the ideas and insights about how to optimize practical mechanisms.

Keywords: System simulation, multibody simulation, system optimization, design variable, objective function, meta model

Abstract:

System optimization is a primary goal of CAE simulation. To optimize the design or performance of the system, there are many kinds of optimization methods and optimization software. However, many engineers still have difficulties in using these approaches to optimize their systems. One of the reasons which makes optimization difficult is that too many trials (simulations) are required to optimize the system. The other reason is that many engineers are not familiar with the best types of inputs that should be used to define design variables and what types of outputs should be defined as objective functions of the system. This presentation will introduce several simple but practical examples such as construction equipment (a wheel loader), deployment of a solar array for a satellite, unicycle dynamics while in operation, and a hand press. All of these models will be optimized using software that is based on the progressive meta-model method. Please note that the examples introduced here are dynamic mechanisms and that the transient behavior of the multibody system is optimized. This method optimizes the transient multibody system with a minimum number of trials. The major topic of this presentation is to introduce best practices for deciding the design variables and the objective functions of a mechanical system for optimization. Each example has a different type of goal, for example to minimize the fatigue of the operator who use the hand press or to maximize the safety of the wheel loader. To achieve these goals appropriate inputs are set to the design variables and the objective functions to be optimized are defined. Then the optimization method is applied to the multibody simulation of these examples and the optimized results will be illustrated. These examples demonstrate the need for optimization and provide the ideas and insights about how to optimize practical mechanisms.

Speaker Biography:

Title: Marketing Team Manager Name: Sangtae Kim Email: sangtae.kim@functionbay.co.kr Keywords: System simulation, multibody simulation, system optimization, design variable, objective function, meta model, MBD, MBS, Optimization, MFBD, FMBD, RecurDyn Bio: Sangtae is a Marketing team manager at FunctionBay, Inc. where he focuses on product marketing of FunctionBay, especially RecurDyn, a Multibody Dynamics software. Sangtae obtained his Bachelor's and Master's degree in Mechanical Engineering Department from Seoul National University where he concentrated on numerical methods and simulation studies. Also he obtained MBA from Seoul National University. He has been working for FunctionBay for 20 years where he was responsible for RecurDyn development, collaboration with partner companies especially co-development with other CAx companies and now he is responsible to lead the global marketing activities. • Bachelor/master's degree in Mechanical Engineering from Seoul National University (Korea) • MBA from Seoul National University (Korea) • 10 years as a software engineer at FunctionBay (RecurDyn Multi-Body Dynamics software) • 3 years as a manager of the co-development with the OEM team at FunctionBay • 7 years as a Marketing Manager at FunctionBay

Presenter Name: Knoechel, Rick

Presenter Company: Oracle

Presentation Title: Will the Cloud Ever Work for HPC? (R. Knoechel, Oracle; Lvl: 2)

Session Title: HPC & Cloud

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 4:30 PM

Type: Presentation

Intended Learning Outcome:

How and Why HPC on the Cloud has become a viable and productive means of running Product Design and Development Critical CAE Simulations that should be a major part of everyone's HPC portfolio TODAY!

Keywords: HPC, CAE, Cloud

Abstract:

The traditional paradigm of the All On-Prem HPC Infrastructure is being challenged today by HPC on the Public Cloud. With the largest IT Players on the planet like AWS, Miccorsoft Azure, Google, IBM, Oracle investing heavily in the space, the question of "Will the Cloud ever Work for HPC?" should really be changed to "Why are you waiting for Cloud HPC to Work? It already does!" In fact, Cloud based HPC has been working successfully for a number of years now, because, in reality, One person's Cloud is another person's Data Center. Cloud based HPC removes the constraints that are imposed by Fiscal Year Budgets, IT Infrastructure organizations and Physical Data Center facilities and locations in a traditional On-Prem environment. This leads to "Choke Points" in the Product Development Process (PDP) where a fixed HPC hardware core count, software license limitations and CAE software license queuing systems ultimately dictate the productivity of CAE Simulation Engineers and Analysts adversely impacting Product Development Process timelines and finally, Time to Market. The real question to be asked is "What Engineering Challenges could you tackle with Unlimited Access to Compute?" If you could perform more simulations in a given time window of the PDP could you * Improve Product performance by 10 to 20%? * Further Lightweight your product without compromise? * Improve Fuel Economy or Extend Battery Powered Vehicle Ranges? * Accelerate Product Innovation and "First Mover" Competitive Advantage? In this presentation we will cover: * A brief history of Cloud based HPC * Basic components needed to provide a viable Cloud based HPC environment * CAE Simulation workloads best suited for Cloud Based HPC * The Economics of Cloud Based HPC * A View from the Simulation ISV perspective * Cloud HPC 2.0 - The Bare Metal Elastic HPC Cloud * Some Case Studies and Success Stories * Where do we go from here? * Q&A

Speaker Biography:

Rick Knoechel is a Senior Principal Product Manager for the HPC – Discrete Mfg. Vertical within the Oracle Cloud Infrastructure (OCI) group. Rick joined OCI in October of 2019 after leading Sales and Solutions Operations for Rescale in the Great Lakes Region for 2.5 years. During this time Cloud based HPC in the Great Lakes Region doubled, year over year for Rescale. Well versed in all aspects of Cloud Based HPC, Rick has been involved with HPC with a number of the Industry leaders in IT over the past 20+ years including Dell, EMC, NetApp, Platform Computing and others. Rick also ran Sales, Marketing and Customer Service for Powerway, the Global Automotive Industry's Largest APQP/PPAP Cloud based solutions for Supply Chain Collaboration supporting the AIAG standards for the Vehicle Product Development Process (PDP). Prior to his "2nd Career" in IT, Rick was a Consulting and Sales Engineer selling numerous Engineering products and services, including CAE Simulation services, to the Global Discrete Manufacturing community. Rick has Master's Degrees in both Mechanical Engineering and Computer Science along with Undergraduate Degrees in Physics and Mathematics.

Presenter Name: Knudsen, Linda

Presenter Company: Syncroness

Presentation Title: Assessing Computational Model Credibility Using a Risk-Based Framework: Application to Tibial Tray Component Strength (L. Knudsen, Syncroness; Lvl: 2)

Session Title: Verification & Validation 2

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 11:30 AM

Type: Presentation

Intended Learning Outcome:

The intention is to provide attendees with an understanding of ASME's V&V 40 standard, published in 2018, by working through an end-to-example example. Presentation to be considered for a coordinated session on "Verification and Validation of Computationa

Keywords: verification, validation, model credibility, medical devices, ASME V&V 40, tibial tray components, ASTM F1800, ASTM F2083

Abstract:

Industry routinely uses finite element analysis (FEA) to prescribe the amount of physical testing and identify the highest risk scenarios. At the same time, regulators need to have confidence that analysts are producing valid and repeatable simulation results. The ASME V&V 40 Standard – Assessing Credibility of Computational Modeling Through Verification and Validation: Application to Medical Devices – provides a framework for establishing the credibility requirements of a computational model for a context of use (COU) based on model risk. This presentation describes a formalized process based on the ASME V&V 40 standard to allow practitioners to demonstrate the credibility of their computational models, minimize the required fatigue testing, and save time and money associated with manufacturing and testing of these devices. To provide practical insights into the credible use of computational modeling that can be adapted and applied when developing medical devices, the V&V 40 framework is presented as an end-to-end example of a tibial tray component of an artificial knee implant. This example includes a combination of computational modeling and physical nonclinical testing to assess the fatigue resistance of a new metal tibial tray design for a total knee arthroplasty. Specifically, we use the V&V 40 framework to assess the credibility of a computational model that represents an ASTM test method for tray fatigue strength to predict the peak stresses that occur in the worst-case device size(s) from a family of tibial trays. The specific role and scope of the computational model is referred to as its COU. The computational model risk is established by combining the model influence with the model's decision consequence. Next, a gradation and subsequent selection of verification and validation activities, which are driven by the risk assessment, are provided for each of the 13 credibility factors. The credibility factors allow the practitioner to determine the rigor needed for the verification, validation, and applicability activities. To illustrate how the V&V 40 may be put into practice, the results of specific plan activities are shown. Finally, the credibility of the computational model is determined The intention is to provide attendees with ideas that can be adapted and applied within their own organizations ==== Presentation developed by: • Linda Knudsen, Principal Engineer, Syncroness • Sudeep Sastry, Engineering Analyst, W.L. Gore & Associates • Brandon Lurie, Engineering Analyst, W. L. Gore & Associates • Marc Horner, Principal Engineer, Healthcare, ANSYS, Inc. • Dana Coombs, Principal Engineer, DePuy Synthes Trauma • Michael Bushelow, Group Manager, DePuy Synthes

Speaker Biography:

As principal mechanical engineer at Syncroness, Inc., a product development company certified to ISO 13485 and AS9100, Linda Knudsen leads the FEA and CFD computational simulations of medical devices and aerospace systems. She has 20 years of practical analysis application within product development, automation, and custom equipment, an M.S. in Manufacturing Systems Engineering from Stanford University, and a B.S. in Mechanical Engineering from Rutgers University. Linda is a member of ASME's V&V 40 subcommittee.

Presenter Name: Kolera-Gokula, Hemanth

Presenter Company: MSC Software

Presentation Title: Reducing Physical Prototyping Via Real-Time Compliant Vehicle Dynamics Models (H. Kolera-Gokula, MSC Software; Lvl: 3)

Session Title: Systems Thinking

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 4:00 PM

Type: Presentation

Intended Learning Outcome:

Application of High Fidelity Systems Dynamics Simulations to Hardware in the loop, Driver in the loop and Autonomous functions.

Keywords: Multi Body Simulations, Hardware in the loop, Real Time Simulations

Abstract:

Real-time compliant vehicle dynamics models for HiL and DiL integration have traditionally involved a low number of Degrees of Freedom (DOF), typically around 20. Such models are typically used to characterize the behavior of the body via lookup tables. While these Reduced Order Models (ROMs) are a valid approach for some applications, compromising on the number of DOF's is no longer a requirement for real-time computation. Readily available high-performance computing and advances in engineering simulation techniques have now made higher fidelity real-time simulations possible, providing more valuable insights. Real-time simulations now provide an opportunity to connect physical components and virtual models in Hardware in the Loop (HiL) and Driver in the Loop (DiL) automotive test environments. MSC Software has designed Adams Real-Time to preserve the topology and parametrics of the MBD-modelled system in real-time applications. This makes it possible to maintain elements such as hardpoints, joints, springs, dampers, and bushings and make modifications without the need to calibrate a new ROM for every change. As such, the model can capture higher frequency characteristics in the system responses, and different configurations can be introduced and explored with a shorter turnaround time. Adopting a one tool, one model approach for both real time and non-real time applications eliminates error-prone model translations between different tools. This approach also makes it possible to tune and optimize systems very efficiently and has the potential to remove weeks from a typical vehicle development program. The Automotive industry is under constant pressure to address market demands in resource-constrained engineering environments. Stiff development timelines are compounded by shrinking physical prototyping budgets. The Ford Motor Company is focused on providing its customers with a world-class vehicle drivability and the ride comfort experience, which are critical attributes that drive a customer's perception of vehicle quality. These critical attributes are in turn impacted by the transmission shift strategy. The traditional approach to transmission calibration at Ford involved physical testing of full vehicle prototypes with extensive test schedules. This approach was both time consuming and expensive. In collaboration with MSC software and its services group, Ford developed a Hardware-in-the-loop testing process to reduce the need for physical prototyping. The HiL testing process has helped Ford meet its test objectives with fewer physical prototypes and in a lab environment that facilitates the tuning process. The same engine and transmission prototypes can be tested with multiple vehicles under multiple loading scenarios. In this presentation the Adams Real time modeling paradigm will be presented and benefits from the approach will be detailed via the Ford case study.

Speaker Biography:

Hemanth Kolera-Gokula has a Ph. D. in Mechanical Engineering from North Carolina State University with a focus on CFD. Since October 2018 he has served as the Product Marketing Manager for Systems Dynamics Solutions at MSC Software, a part of Hexagon Manufacturing Intelligence. Hemanth's focus in his current role is to drive adoptions of MSC's system simulation portfolio, Adams and Easy5. Hemanth has over 13 years of experience in the various areas of Engineering Simulation, including Computational Fluid Dynamics, Multi-Body Dynamics, and 0D/1-D Systems modeling. He has also served in engineering development, applications engineering, and product management roles at ANSYS, AVL, and Cummins in the past.

Presenter Name: Korbetis, George

Presenter Company: BETA CAE Systems SA

Presentation Title: Late Design Stage Optimization as an Important Task of the Product Development (G. Korbetis, BETA CAE Systems SA; Lvl: 2)

Session Title: Optimization 1

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 2:30 PM

Type: Presentation

Intended Learning Outcome:

An efficient optimization process at a late design stage

Keywords: Crash, CAE analysis, Optimization, Side impact, Design change

Abstract:

During product development, many analyses including optimization, take place at different stages of the product design. Although optimization at early stages is a very important task, as it provides solid directions for the final design, late stage optimization has significant presence in product development. Late stage optimization can act as models' fine tuning and as a process that can fix deficiencies without the need to go back in a previous design stage. The aforementioned ability is even more valuable when manufacturing methods have been decided, acting as important constraints to the design change flexibility. This paper investigates the case in which the performance of a BiW model must be improved at a latest stage of the design process. The aim of the optimization is to reduce the intrusion of the door and B-pillar during a side impact analysis to avoid passenger's injury. However, special considerations and constraints such as, the constraint of the stumping and punching manufacturing processes must be taken into consideration. The success of this process depends on the minimum number of design changes. Therefore the design changes that are used could be the definition and parameterization of small features like holes, beads, etc. Additionally, small parts can be added as reinforcements in weak areas of the model. The dimensions of these parts are also taken into account as parameters of the optimization process. Finally, all actions that are considered to act as design changes (feature definition, feature modification, parts creation) should be applied on an FE representation of the BiW since the model geometry could be possibly obsolete at the latest design stage. In this paper, an example of a BiW model subjected in side impact test will be demonstrated. The optimization process will start with a Design of Experiments run which will evaluate the most important input variables of the optimization problem. In a second step, an optimization algorithm will drive a pre- processor, solver, post- processor sequence, finding the optimum design.

Speaker Biography:

BIOGRAPHY of George Korbetis Education: Graduate Mechanical Engineer from the Aristotle University of Thessaloniki Diploma thesis in Machine Design. Work History: He worked for several years in Machine Design field. He joined BETA CAE Systems S.A. Customers Service department in 2001. Now he is Manager, responsible for the Morphing, Optimization and EPILYSIS customer service.

Presenter Name: Lauterbach, Beate

Presenter Company: Volume Graphics GmbH

Presentation Title: Taking into Account Defects in Structural Simulation of Additively Manufactured or Casted Components (B. Lauterbach, Volume Graphics GmbH; Lvl: 3)

Session Title: Additive Manufacturing 3

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 5:00 PM

Type: Presentation

Intended Learning Outcome:

The audience will learn how to preselect defects in additively manufactured or casted parts detected by computed tomography and efficiently build an FE Model by only including the relevant defects.

Keywords: computed tomography, porosity, casting, additive manufacturing; microstructural simulation, immersed boundary methods

Abstract:

Microstructural defects are inherent in additively manufactured or casted components. By optimizing the manufacturing processes, porosity might be reduced or shifted to non-critical regions, but avoiding porosity completely most often is not possible or leads to inefficient manufacturing processes. Therefore, to be cost-effective a certain amount of porosity has to be accepted. By means of non-destructive testing, e.g. computed tomography (CT), pores in a structural component can be detected and quantified. Depending on their geometrical characteristics (e.g. shape and size) but also on their location within the component and the subjected loading, these pores might act as a source of stress concentration and reduce the load bearing capacity of the manufactured part. Therefore, it is desirable to include theses defects into a structural simulation. As there is very often a huge amount of microstructural defects, including them all in a structural simulation with FEM will create an enormous effort in FE mesh generation. It will result in a very large simulation models to resolve stress concentrations in the vicinity of each defect. While most of the defects will not affect the structural behavior of the component significantly, it would be sufficient to only include the critical defects in the FEM simulation. Thus, the simulation effort can be reduced significantly. To sort the defects according to their severity, an accurate pre-simulation including all detected pores is necessary. This can be done efficiently with immersed-boundary finite element methods that do not work on geometry conform meshes. This approach is implemented in the Structural Mechanics Simulation module of VGSTUDIO MAX by Volume Graphics. It simulates local stress distributions for linear elastic material properties directly on computed tomography (CT) scans which accurately represent complex material structures and internal discontinuities. From the stress fields calculated by the immersed boundary finite element simulation, the critical pores can be identified. Using the volume meshing module in VGSTUDIO MAX efficient creation of a tetrahedral mesh on the CT scan taking into account only the critical pores can be done. Thus, the porosity information can be made accessible for classical FEM simulations making use of the wide range of functionalities that are offered by a fully capable finite element software (e.g. non-linear material models). A workflow from CT scanning, analyzing most critical defects and efficient meshing to structural simulation with ANSYS maintaining the relevant features of the scanned object will be presented. It enables to evaluate deviations in the mechanical performance of the manufactured towards the designed component by simulation.

Speaker Biography:

Dr.-Ing. Beate Lauterbach, Volume Graphics Gmbh 2001 PhD in Mechanics TU Darmstadt, Germany 2001-2004 Simulation Engineer for Durability and Stiffness at Ford, Germany 2004-2016 CAE Development Engineer Vehicle Safety at GM Europe (Opel), Germany 2016-2017 Supervisor Crashworthiness CAE at GM Europe (Opel), Germany 2017-2019 Supervisor Crashworthiness CAE at Groupe PSA (Opel), Germany 2019-now Product Manager Simulation at Volume Graphics GmbH, Germany

Presenter Name: Liu, Jian

Presenter Company: Cadence Design Systems, Inc.

Presentation Title: System Level Electromagnetic and Thermal Co-Optimization for ECU Design (J. Liu, Cadence Design Systems, Inc.; Lvl: 2)

Session Title: Multiscale & Multiphysics 1

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 12:00 PM

Type: Presentation

Intended Learning Outcome:

System level multiple physics optimization for ECU designs

Keywords: EMI, CFD, ECU

Abstract:

With the fast development and deployment of autonomous cars, the design of electronic components is becoming more challenging due to increased power consumption, strong electromagnetic radiation and interference, and demanding thermal dissipation. The traditional bottom up design flow, which starts from IC to PCB, and then from PCB to the metal enclosure box, may not be sufficient if any EMI and thermal violations are found in the late design stages. Any detected failure means a design re-spin, a longer design cycle, increased NRE and possible higher product cost that may render the product non-competitive This paper proposes a system level EMI-thermal co-simulation and optimization method. It will provide guidance in system-level design through simulation with a digital twin. With the given physical model, an EMI model and a thermal model will be created and simulated efficiently. More specifically, the high power components on the PCB, which contribute the most to both the EMI and thermal, are placed in various locations to create the contour graphs for both electromagnetic radiation and temperature distribution. The overlap of these graphs will give the optimized location which satisfy both EMI and thermal constraints. Solid and fluid system level thermal analysis enables component level accuracy to create detailed thermal contour models efficiently. Massive parallel computation engines are used to support speed and capacity. As for the electromagnetic analysis, a 3D FDTD solver is employed. Again, massive parallel computation engines are employed to solve for large physical spaces in a short time period. The distributed computation architecture enables the analysis of much larger and complicated structures which are difficult for non-structured mesh based EM solvers. We will demonstrate how using the same mechanical CAD GUI interface, enables multiple physics analysis and optimization to take place on a single desktop in a single canvas. We will then discuss future projects where more physical constraints may be incorporated into the pre-design optimization process.

Speaker Biography:

Jian Liu currently holds the position of Sr. software engineering group director of Cadence Design System. He received a Ph.D. degree from the University of Illinois at Urbana-Champaign in 2002, a master's degree, and a bachelor's degree from the University of Science and Technology of China in 1998 and 1995, respectively. He has been working on the area of signal integrity, power integrity, and computational electromagnetics for 18 years.

Presenter Name: Locci, Carlo

Presenter Company: Siemens Digital Industries Software

Presentation Title: 3D Modeling of Fuel Cells with a Complex Multi-Phase Approach: A Study on Geometry Influence. (C. Locci, Siemens Digital Industries Software; Lvl: 3)

Session Title: CFD 2

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 2:30 PM

Type: Presentation

Intended Learning Outcome:

I want them to be amazed by the advancement of CFD and the level of details that modeling can provide for very complex systems such as hydrogen fuel cells.

Keywords: Hydrogen; Fuel Cells; CFD; Water Management

Abstract:

Hydrogen technologies are considered as a valid alternative to decarbonize the transportation sector, especially for trucks and trains. Energy capacity and fast-refueling represent fuel cells most attractive aspects when compared to lithium batteries. However, several challenges still need further research and development. Internal reactions in fuel cells are promoted by Platinum (Pt), which increases the final cost of the system. PEMFC working at high current densities need less platinum, but face performance issues. In particular, the reassociation reaction of hydrogen-electrons-oxygen at the cathode side produces liquid water, which prevents reactants to effectively reach the membrane. In addition, the membrane needs to work at an ideal water content. Membrane drying-out impacts the overall efficiency and reduces the lifetime of the system. Understanding such phenomena through experimental test cases is costly and cumbersome as measurement of two-phase flows are needed in a very narrow environment. For instance, neutron radiography is able to provide insights on the water production among the several fuel cells layers whilst gas chromatography can be used to for water saturation measurement. Both techniques are though expensive. In this work, advanced CFD techniques are used to study the formation of liquid water inside the fuel cells component and understanding the impact of geometry on such physics. A portion of a single cell layer with five channels is simulated in Simcenter STAR-CCM+. The channels follow a wavy pattern, which allow for a more homogeneous temperature distribution. The equations of flow are solved for the channels and the gas diffusion layers (GDL), the latter being considered as porous media. Bipolar plates are modelled as a solid able to conduct electricity and ohmic heat. The membrane is modelled as a solid including water transport and proton with electro-osmotic drag as well as ohmic heating from the electrochemistry reactions, calculated at the infinitely thin layer between the GDL and the membrane itself. A two-phase approach is included to model the gas mixture and liquid water transport in the GDL and channels. The two geometries present very similar polarization curves but significant differences in terms of water production and electric density gradients are shown. A study on the way hydrogen is consumed and reacts on the anode side is also included, providing insights on the complex physics of fuel cells.

Speaker Biography:

Carlo graduated in Italy in mechanical engineering. He then received his Ph.D at the IFPEN in Paris after working on a thesis on combustion numerical modeling. He then spent another year at the French national center of research for a post-doc. He also holds an MBA from Mannheim Business School. Since October 2015 he works for Siemens Digital Industries Software as Powertrain and Fuel Cells Application Specialist and is based in Nurnberg.

Presenter Name: Loghin, Adrian

Presenter Company: Simmetrix Inc.

Presentation Title: V&V 3D Fatigue Crack Growth Modeling: From Deterministic to Uncertainty Quantification Assessment (A. Loghin, Simmetrix Inc.; Lvl: 2)

Session Title: Verification & Validation 3

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 2:30 PM

Type: Presentation

Intended Learning Outcome:

How to perform uncertainty quantification fatigue crack growth assessment using 3D FEM simulations.

Keywords: life prediction, crack propagation simulation, finite element analysis, uncertainty quantification, verification and validation

Abstract:

Validation & Verification (V&V) is a continuous effort in modeling development. As engineering software improves, cheaper computational resources become available and, technology provides higher resolution physical measurements, the V&V process needs to leverage novel capabilities to bring knowledge and benefits to the engineering design community. Different organizations (ASME, TMS) have issued documents recognizing the importance of V&V in engineering design and laying out guidelines for achieving and maintaining the V&V goals [1, 2]. An integral part of these V&V guidelines is Uncertainty Quantification (UQ), a tool designed to provide a relationship between model predictions and uncertainties related to experimental data or, uncertainties related to the model itself [3, 4]. Three-dimensional (3D) fatigue crack growth modeling is used as a case study for an uncertainty quantification V&V assessment. Different experimental measurements and 2D numerical assessments from the literature are considered as a reference for V&V purposes. 3D finite element models (FEM) representative of the specimen geometry and test procedure are used for deterministic fatigue crack growth assessment [5]. The procedure to perform crack propagation simulation is automatic and robust which allows a large number of simulations to be performed quickly. This capability is used along with the Latin Hypercube Sampling (LHS) technique to establish a predefined set of model configurations, perform independent 3D crack propagation simulations and predict crack path for each configuration. Typical parameters used in this design of experiment setup are (but not restricted to): initial crack size, crack location, and the position of geometric features. Once all simulations are available, a Radial Basis Function (RBF) response surface is used to train a model that can be efficiently used in probabilistic Monte Carlo (MC) simulations. In addition to the geometric parameters mentioned above, stochastic variability of the fatigue crack growth rate measurement is also considered in the study to evaluate remaining useful life (RUL) scatter. The probabilistic predictions are compared against experimental measurements to quantify the impact of uncertainty of different factors on the fatigue crack growth predictions. V&V development coordinated with UQ assessment is a necessary step to quantify confidence bounds related to component level performance predictions such as fatigue crack growth life assessment presented here. Component level implementations of Structural Health Monitoring (SHM) or more recent Digital Twin (DT) concepts can benefit from recent development of explicit 3D FEM based crack propagation simulation capabilities and readily available machine learning (ML) algorithms to reach an accuracy-efficiency compromise in performing probabilistic life assessment.

Speaker Biography:

Adrian Loghin • Ph.D Clemson University, 2001 • 2001-2017, Senior Engineer, Lifing Technologies Laboratory, General Electric Global Research Center, Niskayuna NY. Co-developed GE's proprietary tool for fracture mechanics applications and damage assessment (3DFAS) and used it for life assessment of various components • 2017-Present, Senior Application Engineer at Simmetrix Inc. responsible with Fracture Mechanics development

Presenter Name: Mach, Rod

Presenter Company: TotalCAE

Presentation Title: Choosing Between Managed HPC Clusters and Cloud for CAE - Challenges and Opportunities (R. Mach, TotalCAE; Lvl: 2)

Session Title: HPC & Cloud

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 4:00 PM

Type: Presentation

Intended Learning Outcome:

The audience will have a good understanding of the pros and cons of on-premise HPC vs. cloud for CAE, including considerations for choosing between various cloud and hybrid options.

Keywords: CAE, Cloud, AWS, Azure, HPC, Clusters

Abstract:

Learn how companies are adopting the latest trends High Performance Private and Public Cloud Computing to accelerate simulation and data management. Several customer case studies will be presented to show real-world solutions to customer challenges, and a roadmap to adopting simulation as a service. Topics include: 1. Types of Cloud Computing for Engineers - On-premise - Public Cloud - Hybrid - ISV Application Native 2. Pros of Cons of Each option and how to select the right strategy for your company. 3. How to choose between various major public IaaS cloud options including AWS, Azure, GCP, and OCI. 4. Build vs Buy - We will cover what is required to build a cloud or on-premise cluster vs Buy. 5. CAE licensing in the cloud - An update on licensing options including BYOL, cloud hosted, cloud forward, and other methods for purchasing CAE licensing for cloud usage. 6. Public Cloud Challenges 7. Security 8. Real world ROI 9. Benchmarks - On Premise HPC cluster vs Cloud - Cloud vs Cloud 10. Real World Customer Case Studies - Lucid Motors Hybrid Cloud - MAHLE - Cloud - O-I - HPC on Premise - ADA client - Hybrid Cloud At the end of this presentation attendees will have a good understanding of the current landscape for HPC computing for private and public cloud, and how leading companies are adopting these technologies to speed up their time to market. Speaker Bio: Rodney Mach is President of TotalCAE, a leading provider of Managed FEA/CFD Private & Public Cloud HPC solutions. Rod is a 21 year veteran in utilizing High Performance Computing for engineering simulation. Mr. Mach has a B.S.E in Electrical Engineering from the University of Michigan, and MBA from Wayne State. Prior to starting TotalCAE in 2006, he led the University of Michigan High Performance Computing center.

Speaker Biography:

Rod Mach is President of TotalCAE, a managed HPC cluster and cloud provider focused on reducing engineering simulation runtimes. Rod is a 25-year veteran in utilizing High Performance Compute (HPC) clusters and cloud for engineering. Mr. Mach has a B.S.E in Electrical Engineering from the University of Michigan.

Presenter Name: Maiti, Subhadip

Presenter Company: VIAS

Presentation Title: Wear Modeling of Brake Pad Due to Friction & Heat Generation between the Contacting Surfaces (S. Maiti, VIAS; Lvl: 2)

Session Title: Thermomechanical

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 5:30 PM

Type: Presentation

Intended Learning Outcome:

how simulation can help understand a complex interaction

Keywords: Wear Modeling, FEA, Abaqus, Friction

Abstract:

The vehicle brake system plays an important role in the safety of the occupant during the on-road driving scenario. However the braking performance gets degraded over time due the frictional heat generation which ultimately effects in numerous ways like wear and tear, thermal cracks, noise and vibration issues, etc. The friction and the relative motion between the contacting parts generate heat due to frictional sliding. Some of the heat gets dissipated in the environment, but if the rate of heat generation is higher than the dissipated energy, temperature starts to rise at the adjacent components. Large friction coefficients, Rapid changes in contact pressure, Strong material dependence on temperature, Significant plastic dissipation makes this class problem to be numerically expensive to solve. In this presentation, the brake pad reliability and the thermal behavior of the multiple small scale components of the brake rotor system are investigated using the fully coupled temperature-displacement analysis using general-purpose FEA solution ABAQUS. Further, the effect of rotor speed and friction coefficient on the thermal performance of the brake pad is been evaluated. Also, the continuous/intermittent operations of the braking system lead the brake pad to have wear and deteriorating performance in long run. The progressive damage caused by the relative motion of two contacting surfaces generates a loss of material or produce a change in geometry if allowed to progress without limit. The wear rate is assumed to be a function of hardness of the material, contact pressure and slip velocity between the contacting parts. Using the “adaptive meshing” technology in Abaqus/Standard, along with user subroutine UMESHMOTION, allows incorporation of general wear laws helps to predict wear behavior accurately. In this presentation, the results obtained from the finite element analysis and how the output solution relates to the phenomena of the wear/damage to the practical situation is been discussed.

Speaker Biography:

Mr. Maiti has a M.Tech in Mechanical Systems Design from Indian Institute of Technology, Kharagpur, and has over 7 years of experience in linear & non-linear FEA, design optimization, fatigue and fracture mechanics of multiple industry products in the domain of Automotive, Aerospace and Defense, Oil & Gas, Industrial Equipment, Medical Devices and Structural Designs etc. His Areas of expertise lies in solid mechanics & design, rotor dynamics, NVH analysis and experimental testing, manufacturing process simulation, reliability study and optimization, fatigue life calculation etc. He has provided technical training and consulting support to multiple industries users for last 5 years.

Presenter Name: Mallyala, Rachana Rao

Presenter Company: Dassault Systèmes

Presentation Title: Design and Optimization of Cooling System Component for Enhanced Airflow (R. Mallyala, Dassault Systèmes; Lvl: 2)

Session Title: Optimization 3

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 11:30 AM

Type: Presentation

Intended Learning Outcome:

leverage benefits of design and optimization approaches to help reduce total development time and cost for cooling system components

Keywords: design,optimization,lattice Boltzmann,simulation,CFD,algorithms,DOE,airflow,cooling,fan,fan shroud,increased,optimize,equipment,cooling system

Abstract:

Engine cooling is a challenge across industries, such as Automotive and Industrial Equipment. Many equipment manufacturers focus mainly on meeting engine certification at a specific ambient temperature without realizing there is potential for additional airflow. A typical combustion engine generates a significant amount of heat, of which around 35% to 40% must be dissipated by the engine cooling system. The fan and fan shroud are critical components of the engine cooling system as they provide the necessary airflow through the engine radiator required to take the heat away from the coolant. In addition, the design of fan and fan shroud must meet packaging space requirements, which can increase the complexity of the cooling system. By maximizing the performance of fan and fan shroud, the cooling system can be improved through an increase in airflow, or a better distribution of the airflow across the radiator. Both improvements can lead to a reduction in fan speed, a reduction in fan power, longer operational life and possibly lower operating cost. Through exploration of a design space, leveraging optimization analysis, the impact of fan and fan shroud design parameters on the total airflow can be investigated to achieve optimal performance without constraining the design change to simple iterations from a baseline. This is even more critical when the equipment manufacturer is utilizing molded fan shrouds, as the optimal design must be achieved before implementing the costly initial mold tooling.With a better understanding of the key shape parameters early in the development schedule, the need for multiple tests and iterations late in the development schedule can be removed, reducing the number of molds to ideally just one. In this study, a series of design of experiments and optimization of a fan and fan shroud were performed on an excavator to achieve maximum cooling airflow. The fixed design space for this engine cooling system covered design parameters such as tip clearance, fan to radiator distance, fan shroud depth and curvature and fan shroud ring depth. The performance of the system is assessed using a Lattice Boltzmann-based Method known for its best-in-class accuracy at predicting cooling performance. The final configuration of optimal design shows a 15% improvement to the initial one and illustrates how most machinery with similar configurations of fan and fan shroud can leverage such optimization approaches to help reduce total development time and cost.

Speaker Biography:

Rachana has Bachelors of Technology in Mechanical Engineering from JNTU, India and a Master of Science in Mechanical Engineering from University of Dayton, Ohio • Home country being India, and currently a Michigan Resident Rachana has been in the Midwest for the last 6 years starting school and continuing work in the region • Enjoys Problem solving and application based engineering has always been a keen interest

Presenter Name: Malusare, Kedar

Presenter Company: Siemens Digital Industries Software

Presentation Title: Performance Benchmark of Fully Coupled Multiscale Simulations Using an Adaptive Multiscale Scheme (K. Malusare, Siemens Digital Industries Software; Lvl: 2)

Session Title: Multiscale & Multiphysics 5

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 2:30 PM

Type: Presentation

Intended Learning Outcome:

The audience will learn about fully-coupled multiscale simulation and a computational cost benchmark associated with this complex finite element for structural / thermal analysis of advanced materials.

Keywords: multiscale, finite element analysis, composites, progressive failure, computational efficiency

Abstract:

The adoption of composite materials is growing rapidly to enhance structural performance across many engineering applications. However, failure and damage prediction of these advanced materials through finite element analysis (FEA) is often inaccurate and can be computationally expensive. This inaccuracy is due to the use of generalized orthotopic failure models that are based off simple uniaxial experimental tests. These material models result in long run times and high memory usage since non-linear FEA models require refined time steps and constant updating of the constitutive stiffness tensor. Through multiscale modeling, these materials can be represented more realistically and accurately since every integration point of a global finite element model (FEM) is mapped to a unique microstructural FEM. However, with this increase in accuracy comes an increase in run time and memory, due to the added degrees of freedom from the microstructural FEMs. To make this type of analysis competitive with traditional methods, an novel adaptive multiscale scheme was used to reduce the computational cost of these simulations. In this study the efficiency of this type of multiscale analysis is compared against single scale composite analysis. The global model is a 3D model of a simply supported beam. For the single scale analysis, both linear and non-linear (continuum damage) material models were used. For the multiscale analysis, four different types of microstructural models with varying mesh refinements were used: hex-pack unidirectional fiber reinforced polymer, random-pack unidirectional fiber reinforced polymer, plain weave fiber reinforced polymer, and satin weave reinforced polymer. For each global and local model, the number of elements and integrations points were documented to gauge the total number of degrees of freedom for the multiscale model. The run time and data compression efficiency for each simulation was documented and compared against the single scale simulations. The single scale simulations were unsurprisingly quicker by a factor of only 3x. As the size of the local scale model increased, so did the total run time of the multiscale model. Although the single scale simulations were still faster than the multiscale simulations, this increase in run time still allows for this type of analysis to remain feasible for commercial engineering applications, especially when considering the increase in accuracy and information received on the material’s microstructure.

Speaker Biography:

Kedar Malusare has a Bachelors and a Masters degree in Mechanical Engineering. He has a background in finite elements and failure analysis of composite materials. After graduate school, he worked in a consulting firm working on failure analysis of high performance structural glass for five years. Currently, he works on multiscale simulation of advanced materials at Siemens Digital Industries Software.

Presenter Name: Mandava, Prasad

Presenter Company: Visual Collaboration Technologies Inc

Presentation Title: New Ways to Create and Share High-Fidelity Simulation Insights Across the Product Lifecycle, to Increase Analyst Productivity and Improve Product Quality (P. Mandava, Visual Collaboration Technologies Inc; Lvl: 2)

Session Title: MBE 2

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 4:00 PM

Type: Presentation

Intended Learning Outcome:

Attendees will learn new methods of processing simulation results, creating model-based reports, and sharing enhanced simulation insights across the entire product development and manufacturing team. These new methods drive greater simulation analyst prod

Keywords: Actionable Simulation Insights, Simulation Results, Simulation Analyst, Efficiency, Productivity, Product Quality, CAE Collaboration, SPDM, Simulation Democratization

Abstract:

Manufacturers are under continuous pressure to be competitive and get the most from their investments. The promise of digital simulation is a tremendous reduction in product development costs. But are companies realizing the full benefit of simulation? This presentation explores a segment of the simulation lifecycle where much more can be gained. Simulation analyst productivity can be increased, product design collaboration can be greatly enhanced, and overall product quality can be improved by changing the way simulation information is shared across design, manufacturing, and supplier teams. Ten to 15 years ago, pre-processing was the most time-consuming activity in the simulation lifecycle, but CAE vendors have made substantial improvements. In addition, solvers now run significantly faster due to an abundance of low-cost of computing power. These have resulted in a tremendous expansion in the volume of simulation results created. And companies continue to reduce test budgets in favor of simulation to qualify products. During the same time, however, post-processing and simulation report creation have remained largely manual processes. This creates challenges not only for simulation analysts but for stakeholders like designers, release engineers, chief engineers, suppliers, and others who use simulation information and the product insights it provides. Because these stakeholders cannot access simulation results directly, analysts must manually create reports of key simulation information to share with them. These reports are almost always created by cutting and pasting 2D static images or videos into PowerPoint or PDFs. Rather than providing interactive, model-based reports which stakeholders can query as needed, analysts must make educated guesses about which “snapshots” of information are needed by engineers and others. This manual process becomes particularly challenging when analysts need to share design comparisons such as multiple iterations of a design, or comparing a slice against the full product, or even comparing multiple types of stress loads in a part. Creating comparative data or identifying design issues like hotspots is not only time-consuming, it introduces the potential for error. In other words, stakeholders work with less than complete information, leading to poorer design decisions, lower productivity, and reduced product quality. This paper outlines the potential for creating fully interactive, model-based, 3D simulation results reports with far less effort than is currently expended. These actionable simulation insights not only improve analyst productivity, they enable manufacturers to product higher quality products.

Speaker Biography:

Prasad Mandava CEO & Co-Founder, Visual Collaboration Technologies Inspired by his experience as a project director for India’s Aircraft Development Program, where he led the development of software for Finite Element Analysis, along with experience as a CAE analyst for the Space Research Organization, Prasad founded Visual Collaboration Technologies with the goal of improving the way simulation information is processed and shared. As CEO and co-founder of Visual Collaboration Technologies (VCollab), Prasad leads a highly respected team of developers who have solved a wide range of challenges related to simulation information analysis and communication. The team has been developing game-changing CAE visual collaboration tools and helping many global auto & aero companies in improving the way the simulation insights are created and communicated. Prasad holds a master's degree in Structural Engineering from Bharathiar University and a Bachelor's in Civil Engineering from VRSE College. He won Sir CV Raman award in 1998 for his contributions to computer science in INDIA. He's a member of the Simulation Data Management Working Group at NAFEMS.

Presenter Name: Mars, William V.

Presenter Company: Endurica

Presentation Title: Durability Analysis of Tires at High Speed (W. Mars, Endurica; Lvl: 2)

Session Title: Structural Analysis 1

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 11:00 AM

Type: Presentation

Intended Learning Outcome:

how to use incremental fatigue analysis to solve elastomer durability problems that involve multiple steps, complex loading and high temperatures.

Keywords: tires, elastomers, fatigue analysis, standing waves

Abstract:

The durability of a tire at high speed is strongly limited by the development of standing waves, due to effects on strain history, on viscoelastic self-heating, and on the temperature dependence of tire materials. In this work, we simulate a typical multi-step qualification test, including both the self-heating and damage development phenomena. The analysis is made using Abaqus to compute steady state structural and thermal solutions for each step of the test, and using the Endurica DT incremental fatigue solver to accumulate damage across all steps. Due to large temperature increases, material models were given as tabular functions of temperature. The fatigue law of the rubber compounds is particularly sensitive to temperature, with crack growth accelerating strongly at higher temperatures. The fatigue simulation utilizes critical plane analysis at each element centroid of the tire cross section. Strain history at each element centroid is obtained by following the material point streamlines defined in the steady state rolling structural analysis. Thermal transients during the testing procedure are treated approximately by breaking each test step into two sub-steps - a first substep using the thermal field from the immediately prior time step, and a second substep using the steady state thermal field from the current time step. The simulation shows that standing waves are very damaging to a tire. Standing waves result in multiple fatigue cycles per tire revolution, which are addressed in the fatigue simulation by rainflow counting. Standing waves also lead to order of magnitude increases in self-heating and damage accumulation. They are indeed the major factor limiting the tire's ultimate speed rating. Solutions are compared for a tire rolling on both flat and curved test surfaces, and for tires with and without a nylon overwrap layer. The trends in the solutions produced match expectation: durability on a flat surface is great than durability on a curve surface by approximately one letter grade, and nylon overwrap is shown to have a beneficial effect on the tire speed rating also.

Speaker Biography:

Dr. Will Mars is an international leader in the failure mechanics of rubber. The comprehensive testing and simulation tools Endurica has developed under his direction help companies across the world to speed their product development process and compete on durability. He has received several awards for his scientific contributions and innovations, including the 2017 Rubber Division ACS Arnold Smith Special Service Award, the 2007 Sparks Thomas award of ACS Rubber Division, and the 1999 Henry Fuchs award of the SAE Fatigue Design & Evaluation committee. Dr. Mars is the editor of the journal Rubber Chemistry & Technology, and past editor of Tire Science & Technology with 50+ peer-reviewed publications and four patents. His experiences and contributions span a topic range including material characterization, product evaluation, constitutive modeling, crack nucleation, fracture mechanics and fatigue life prediction methods.

Presenter Name: McCary, Dulce

Presenter Company: SAIC

Presentation Title: Mission Focused MBSE (D. McCary, SAIC; Lvl: 1)

Session Title: MBE 1

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 1:30 PM

Type: Presentation

Intended Learning Outcome:

MBSE connects physics based mission models with architectural for a holistic systems view

Keywords: Mission Engineering. AFSIM

Abstract:

With Digital transformation at a rise leveraging models is used to scope out requirements focused on key gaps related to mission success. Model based capabilities are linked to the evaluation of key requirements through various reference missions in conjunction with adversary models, mission assurance models. SAIC is at the forefront of applying Digital Engineering in helping to scope out requirements that help bridge gaps in analyzing the effect of design choices on mission success. We use end user reference missions, along with Model Based Engineering techniques, to help evaluate key requirements in terms of reference missions. We do the same evaluations with adversary and mission assurance models. We need a user-friendly and easy-to-learn method so that engineers can use modeling software. The modeling software should permit traceability and interoperability between mission models, system-of-systems engineering models, and all the subsets of engineering models. We believe a tool used for mission engineering can achieve the required traceability and interoperability. The tool is the Advance Framework for Simulation, Integration, and Modeling (AFSIM). Current engineering processes for AFSIM requires not only a deep knowledge of the system architecture, but also a technical know-how of the AFSIM syntax. As a result, a specific niche of skills is required for individuals to create models and scenarios for mission engineering using AFSIM. A steep there is a steep learning curve is an issue for new users. SAIC has develop a tool called Resilient Architecture Validation Environment (RAVE), to resolve this issue. At the mission engineering level, RAVE has the ability to create scenarios without being an expert in AFSIM syntax. We achieve the ease of use by using a single source AFSIM library built within an organization. RAVE allows for faster scenario development time and optimization, applying the ModelCenter software for evaluating mission success. Our methodology links requirements to mission success to identify key gaps. Additionally, it provides an interaction with external scripts or programs, such as Python and java, to aid in calculating mission metrics and data visualization. At the engineering process level, RAVE can connect to ModelCenter® by Phoenix Integration and Cameo Systems Modeler™ by No Magic, Inc. This creates a feedback mechanism for design optimization connecting MBSE, MBE, and Mission Engineering.

Speaker Biography:

•Dulce Maria McCary is a first generation American in her family to complete an engineering degree. •She holds a graduate degree in Electrical and Computer Engineering from the University of Florida – Go Gators! •Not only does she bring great technical experience to her MBSE projects but she also enjoys bringing folks out of the excel age into the digital engineering age. •She loves being the Local chair of the Multicultural Business Resource Group. She enjoys directing and creating events to champion employees of different cultural backgrounds. She believes strength lies in diversity •She is a fan of doing things differently – thinking out of the box is one of her strength •Dulce is a true east coaster at heart but moved out west to Los Angeles where she enjoys being a newlywed to Jon McCary and really good Korean BBQ !

Presenter Name: McConnell, Raymond

Presenter Company: SmartUQ

Presentation Title: Using Statistical Calibration for Model Verification and Validation, Diagnosis of Model Inadequacy and Improving Simulation Accuracy (R. McConnell, SmartUQ; Lvl: 1)

Session Title: Verification & Validation 1

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 4:30 PM

Type: Presentation

Intended Learning Outcome:

What is statistical calibration and how can it be used for model validation.

Keywords: calibration, statistical calibration, uncertainty quantification, validation, analytics

Abstract:

The use of simulation models to displace physical tests has become essential in accelerating analysis and reducing the cost of research and design. However, as mathematician and statistician George E. P. Box said, “Essentially, all models are wrong, but some are useful.” Simulation results may be substantially different from reality, making accurate model calibration and validation critical to achieving desired outcomes. Using a method like statistical calibration can characterize model inadequacy by combining aspects of calibration and validation. By using a calibrated simulation model, designs can be certified and accepted with reduced physical testing. Statistical calibration can reduce design cycle time and costs by ensuring that simulations are as close to reality as possible and by quantifying how close that really is. It optimizes tuning of model parameters to improve simulation accuracy, and estimates any remaining discrepancy which is useful for model diagnosis and validation. Because model discrepancy is assumed to exist in this framework, it enables robust calibration even for inaccurate models. The presentation will introduce the concepts and advantages of statistical calibration and model validation. Using an air foil CFD model case study, this presentation will walk through the step-by-step process of performing statistical calibration and quantification of the uncertainty of the final calibrated model. The model will be a seven-parameter k-omega CFD turbulence model simulated in COMSOL Multiphysics. The model predicts the coefficients of lift and drag for an air foil defined using a 6049-series air foil parameterization from the National Advisory Committee for Aeronautics (NACA). The model will be calibrated using publicly available wind tunnel data from the University of Illinois Urbana-Champaign’s (UIUC) database. Multiple metrics will be shown which can be used for model validation, including a discrepancy map which characterizes inadequacies in the simulation. An analysis will be performed to compare results from a calibrated model and an uncalibrated model. The analysis will include optimization and sensitivity analysis. The results will illustrate the importance of calibrating a model before drawing design conclusions.

Speaker Biography:

Ray McConnell, SmartUQ Application Engineer, is responsible for performing simulation and statistical work for clients in aerospace, defense, automotive, gas turbine, and other industries. He is also a key contributor in SmartUQ’s partnership initiative. Mr. McConnell received a B.S. in Engineering Mechanics and Astronautics from the University of Wisconsin-Madison.

Presenter Name: McConnell, Raymond

Presenter Company: SmartUQ

Presentation Title: Engineering Analytics for the Automotive Industry (R. McConnell, SmartUQ; Lvl: 1)

Session Title: Advanced Information Technologies 1

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 11:00 AM

Type: Presentation

Intended Learning Outcome:

How engineering analytics can be applied to solve challenging problems faced by the automotive industry.

Keywords: predictive analytics, statistical calibration

Abstract:

The complexity of today's automotive engineering systems increasingly requires analytics to extract useful information from simulation, testing, and recorded data. As system complexity increases and large test data sets become available, new challenges and opportunities emerge to use analytics to make more informed decisions. Engineering analytics becomes a necessity for fully realizing the benefits of creating detailed automotive models and collecting fleet wide data. For example, extremely detailed vehicle telemetry is now common and previously infeasible applications such as condition based maintenance and root cause analysis are questions of big data analysis. The process and results of using engineering analytics methods will be presented for three unique automotive applications in order to demonstrate the utility of performing advanced analytical techniques in a variety of scenarios. The engineering analytics solutions for these applications have been successfully tested on real industry challenges. The applications to be demonstrated are: 1. Analyzing Diagnostic Trouble Codes (DTCs) from On Board Diagnostics (OBDs) to characterize and build predictive models for the DTCs. Results include a predictive model for DTC as a function of mileage and a classification model to identify DTC indicator parameters. 2. Using statistical calibration to efficiently improve engine model accuracy. Results include a simulation model with improved accuracy, and a discrepancy map which predicts simulation model error for validation. 3. Creating virtual sensors which predict gas flow temperatures within engine components. The final predictive model is capable of predicting temperatures in real time. The analytics to be presented rely on several methodologies and techniques. Many of the methods rely on surrogate model based approaches which require efficiently constructing an accurate statistical model of the system. This involves sampling a model or physical system to collect training data for the surrogate model. Sampling is typically done using a Design of Experiment (DOE) or sub-selection from a large data set. Once constructed, the surrogate model is used in place of the true system to perform sampling-intensive analytics or to make real-time predictions such as for control applications.

Speaker Biography:

Ray McConnell, SmartUQ Application Engineer, is responsible for performing simulation and statistical work for clients in aerospace, defense, automotive, gas turbine, and other industries. He is also a key contributor in SmartUQ's partnership initiative. Mr. McConnell received a B.S. in Engineering Mechanics and Astronautics from the University of Wisconsin-Madison.

Presenter Name: Mclendon, Ross

Presenter Company: Dassault Systemes, SIMULIA

Presentation Title: Multiscale Characterization of the Mechanical Behavior of Metals from Finite Element Simulation of Crystal Microstructures (R. Mclendon, Dassault Systemes, SIMULIA; Lvl: 2)

Session Title: Multiscale & Multiphysics 3

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 5:00 PM

Type: Presentation

Intended Learning Outcome:

Attendees will learn about approaches for setting up models of metal crystal microstructures and using them to develop plasticity models to use in structural analyses.

Keywords: Multiscale, Crystal Plasticity, Material Calibration, Microstructure, RVE, Finite Element Analysis, Homogenization

Abstract:

The properties of metal alloys derive from the alloys' microstructure, which itself is a product of the composition of the alloy and its manufacturing history, including temperature and work hardening among other factors. In general, this history will not be uniform across a component, especially in the case of welded components and components fabricated using newer advanced manufacturing techniques such as selective laser sintering. The metallurgical variability in a component can result in considerable spatial variability in the material behavior throughout a component. Furthermore, because of the broad variety of microstructures that could potentially arise, it may not be tractable to experimentally characterize every extant microstructure in a component. Multiscale material modeling methodologies provide means to enable simulation of components with varying microstructure and capture process-structure-property relationships. First, simulation methods of manufacturing processes are able to predict the microstructure in a given region of a component based upon the time/stress/temperature history in a given region. Once the microstructure is determined, it is possible to utilize finite element simulations to predict overall material behavior of that microstructure. Based upon these microstructural simulations, nonlinear material models can be calibrated for application to longer length-scales. By varying these material models throughout the component, the effect of microstructural variability can be incorporated into the simulation of the component. The work to be presented demonstrates the microstructure simulation and material model calibration aspects of this overall workflow using assumed microstructures and commercially available tools. Microstructural geometries will be assumed (rather than obtained from simulations of the manufacturing process), starting as voxel representations of a representative volume element (RVE) of the crystal microstructure. From this data, higher-fidelity finite element models of the RVE are developed using tetrahedral elements to more accurately represent the grain shapes. Following the development of these microstructural RVE meshes, nonlinear finite element analyses are performed on the RVEs using realistic representations of the nonlinear crystal behavior, such as crystal plasticity. These simulations/analyses are used to obtain the average stress-strain response of the microstructure under various load directions and histories, which is then used in a parametric optimization workflow to calibrate nonlinear phenomenological material models such as Hill plasticity to represent the complex microstructural behavior at the length scales of engineering components.

Speaker Biography:

Ross McLendon has been with the SIMULIA brand of Dassault Systemes since 2013 and presently serves in the role of R&D Development Manager for Material Calibration applications. As part of that role, he oversees the Micromechanics Plugin for Abaqus/CAE. He has a PhD in Aerospace Engineering from Texas A&M University where his research focus was in multiscale modeling of composite materials. He lives with his family in Rhode Island.

Presenter Name: Meffert, Darrel

Presenter Company: Caterpillar Inc.

Presentation Title: Keeping a Large Enterprise Engaged in the Journey from Test-Centered Product/Process Development to Simulation-Led Product/Process Development (D. Meffert, Caterpillar Inc.; Lvl: 1)

Session Title: Simulation Governance 1

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 11:00 AM

Type: Presentation

Intended Learning Outcome:

The audience will learn some of the key actions, successes, and challenges that Caterpillar has seen over the last 7 years while dramatically changing its product development and validation culture.

Keywords: Simulation, governance, strategy, engagement, vision, imperatives, strategic intent, priorities, physics-based simulation, computer aided engineering, CAE, virtual product development, VPD

Abstract:

For over 90 years, Caterpillar Inc. has delivered successful products to our customers, primarily utilizing test-centric product development processes utilizing physical prototypes. Although Caterpillar has significant simulation capability and have steadily become more dependent upon it, we have not leveraged simulation to its fullest extent. As a result, Caterpillar launched its Enterprise Simulation Strategy in 2012. The first step in developing the Enterprise Simulation Strategy was identifying key simulation advocates across each of Caterpillar's product groups within its three business segments: Resource Industries, Construction Industries, and Energy and Transportation. Once advocates were identified, those individuals were brought together to discuss Caterpillar's strengths, weaknesses, opportunities, and threats. The group shared their ideas for how utilizing simulation to its fullest extent could enhance Caterpillar's strengths capitalizing on its opportunities, thereby reducing its threats. After the simulation advocates developed a draft version of the strategy with some key foundational elements, they wanted to solicit feedback from the broader simulation community. To get feedback efficiently, the draft strategy was introduced to the simulation community during Caterpillar's AST (analysis, simulation, & test) Forum, an internal forum focused on sharing simulation best-practices from around the enterprise. It typically occurs annually and results in the single, largest gathering of Caterpillar simulation experts at any time throughout the year. Feedback provided by this gathering was incorporated into the strategy draft to make it final. One of the significant goals of this strategy was to transition Caterpillar from a "physical prototype" centered product validation culture to a "simulation-centered" product development culture in order to secure the following benefits: increased engineering efficiency, decreased time to market, expanded understanding of our products, and the ability to fully explore design alternatives. This presentation will share some of the key actions, successes, and challenges that Caterpillar has seen over the last 7 years while dramatically changing its product development and validation culture.

Speaker Biography:

Darrel H. Meffert Enterprise Simulation Strategy Manager - Caterpillar Inc. Bachelor's Degree in Mechanical Engineering from the Indiana Institute of Technology Master's Degree in Business Administration from the Eller College of Business, University of Arizona Darrel has been employed with Caterpillar for over 22 years. He has 15 years of Physical Testing Expertise: Diesel fuel-injection systems, Diesel engine and after-treatment system validation, and full machine validation (track type tractors, hydraulic excavators, Motor Graders, Wheel Tractor Scrapers, and Large Wheel Loaders) He has 15 years developing and leading Project Management offices within Caterpillar. 2020 is his 8th year leading Caterpillar's Enterprise Simulation Strategy For 5 years Darrel was accountable for allocating research funding for the development of new physics-based simulation processes. Besides leading Caterpillar's Enterprise Simulation Strategy, Darrel also leads a "Center-of-Expertise" providing the following simulation services to the Caterpillar product organizations: 1. Immersive Visualization 2. Computational Fluid Dynamics 3. In-cylinder Combustion Analysis 4. Torsional Vibration Analysis for Drive-train systems 5. Real-time Performance & Controls Simulation for major machine systems 6. Statistical Tolerance Analysis.

Presenter Name: Megel, Anthony

Presenter Company: Southwest Research Institute

Presentation Title: Integrating Different Tools in Engine Simulation to Advance Towards a Conjugate Heat Transfer Solution (A. Megel, Southwest Research Institute; Lvl: 2)

Session Title: Multiscale & Multiphysics 3

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 5:30 PM

Type: Presentation

Intended Learning Outcome:

The challenges of and some strategies for integrating different analysis tools across simulation disciplines, even when using different vendors.

Keywords: CFD, FEA, combustion, thermal management, engine, CHT, integration, interoperability

Abstract:

Thermal management in internal combustion engines is an important factor impacting overall engine efficiency and emissions. Engine designs continue to push the capabilities of current hardware closer to their performance and durability limits. Effectively modeling heat transfer through various engine structures would give a thorough overview of engine performance and durability, which is pivotal during design and development. Therefore, more accurate and reliable analysis is necessary to ensure that designs are robust. Many CAE tools exist for various stages of analysis, including computational fluid dynamics (CFD), finite element analysis (FEA), and durability analysis. For engine design, these analyses may consist of combustion CFD, cooling CFD and thermal FEA, structural FEA, and fatigue. Even though many software vendors now offer tools to cover most of these analyses, often the integration of different tools is not straightforward, OEM's utilize tools from multiple vendors, or consultants may operate with a combination of the customer's tools and proprietary software. Transient analyses may require different time steps between systems, or in some cases transient and steady-state analyses can be leveraged together. In any case, interoperability between CAE tools must be established, validated, and standardized to achieve the improvements desired from analysis. This research integrates multiple CAE tools to evaluate a method of conjugate heat transfer (CHT) analysis for both diesel and gasoline engines, combining in-cylinder combustion CFD, cooling jacket CFD, and engine thermal FEA with the aim of obtaining more accurate heat loss predictions and a more accurate temperature distribution in the engine than with existing analysis methods. Spray combustion CFD simulations were performed for the engines and results were validated with experimental data. FEA and cooling CFD simulations were performed in a separate software platform and final temperature measurements at various locations were compared with simulation results. Data interchanges between CFD and FEA software codes were performed at specified sub-cycle engine intervals and the simulations ran for multiple engine cycles. A comprehensive CFD-FEA conjugate heat transfer (CHT) methodology is proposed and the accuracy of this method is measured against existing analysis. Delivering more accurate simulation results allows engineers to better understand the thermal and mechanical behavior of structures and prevent the failure mechanisms that can occur in components that are continuously pushed to their limits.

Speaker Biography:

Mr. Megel has 15 years of automotive and off-highway engineering experience, focusing on product development through design, analysis, and program management. He is also passionate about mentoring and training in both technical and professional development areas. Mr. Megel has spent for of his career at Southwest Research Institute, with brief stints in manufacturing and university research. As Senior Research Engineer, he leads FEA and durability analysis for engine design. He holds one patent, has published several technical papers, and serves as a journal reviewer for the Society of Automotive Engineers.

Presenter Name: Mendez, Julio

Presenter Company: Corrdesa LLC

Presentation Title: Numerical Prediction of Electrochemical Machining Processes Using Multiphysics Computational Tools (J. Mendez, Corrdesa LLC; Lvl: 2)

Session Title: Advanced Materials & Multiphysics

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 1:30 PM

Type: Presentation

Intended Learning Outcome:

From comparisons with experimental data attendees will learn how a complex combination of electrochemistry, electrodynamics ,thermal and mass transfer, can be captured accurately in a transient environment to capture work piece shape change as it is machi

Keywords: Electrochemical Machining, ECM, Mesh-morphing, Overset, Chimera

Abstract:

Computational Fluid Dynamics (CFD) and Finite Element Analysis (FEA) have become the norm in engineering design and scientific applications, whereas other areas such as electrochemistry and their applications are still in their exploratory stage. Electrochemical Machining (ECM) essentially harnesses corrosion to machine very hard metals, since the tool never needs to touch the workpiece unlike conventional cutting and milling techniques. Presently, an Edisonian approach is typically used for designing ECM tools to account for the complex flow field found in the electrolyte flow region. Flow phenomena such as turbulence, hydrogen evolution and large gradients in temperature field combine with electrodynamics and Joule heating to make the flow highly inhomogeneous. As a result, ECM tools (cathode) go through several design iterations to achieve the desired shape on the workpiece (anode). So, although ECM is a very attractive machining process the effort and cost involved in tooling design deters its widespread use. With the advent of High-Performance Computing (HPC), efficient numerical algorithms and multiphysics CFD packages ECM simulations are gaining popularity in the CFD community. Nevertheless, one of the main challenges is still unresolved “the large grid deformation required to represent the tool motion”. This work shows a novel technique where the ECM is modeled using an efficient re-meshing algorithm that allows large deformation without incurring low mesh metrics and/or numerical instabilities. This technique was tested using a primary current distribution methodology to solve the die-sinking configuration which numerical predictions agreed fairly well with the digital 3D optical profilometry data gained from ECM on test specimens. Preliminary results demonstrate this methodology is computationally more efficient than overset methods, although a certain deviation was found due to round off errors in the interpolation and reconstruction methods used in morphing techniques. This deviation was drastically reduced as the mesh was further refined in the areas where large deformation was present.

Speaker Biography:

Julio Mendez holds a BS, MS, and Ph.D. in Mechanical Engineering with more than 12 years of professional experience in thermal fluids and stress analysis; specializing in CFD software development with High Performance Computing (HPC) applications, leveraging GPU's for fast CFD computation. Dr. Mendez’s research interests vary from computer science to numerical analysis. He has worked on linear solvers, explicit techniques, numerical methods, high fidelity numerical computation, and more recently he has developed a set of tools for the Design of Experiments (DoE) and surrogate modeling to accelerate engineering designs. Since 2008, Julio has worked in CFD studying industrial related problems and during his Ph.D. he worked on turbulence with a new Spatio-Temporal framework for LES. Additionally, he developed and validated a new numerical scheme for supersonic and mildly hypersonic flows called Integro-Differential Scheme (IDS). At Corrdesa LLC, Dr. Mendez is in charge of developing new methods of computational corrosion analysis and/or simulation that advance the state of the art, as well as Quality assurance through V&V. Dr. Mendez is an active member of the American Institute of Aeronautics and Astronautics (AIAA) and currently, he collaborates in Academia as a Research Scientist at North Carolina A&T State University where he collaborates with graduate students and research staffs.

Presenter Name: Mendez, Julio

Presenter Company: Corrdesa LLC

Presentation Title: Corrosion Modeling using Multiphysics Computational Fluid Dynamics – From Ideal to Real Conditions (J. Mendez, Corrdesa LLC; Lvl: 2)

Session Title: Advanced Materials & Multiphysics

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 3:00 PM

Type: Presentation

Intended Learning Outcome:

By seeing comparisons between actual tests and simulations attendees will learn that this corrosion simulation modeling approach has the fidelity to discern the difference between corrosion environments in accelerated test chambers and those experienced i

Keywords: Corrosion modeling, galvanic corrosion, multi-physics, fluid film modeling, accelerated corrosion testing

Abstract:

Computational Fluid Dynamics has been widely applied in different branches of thermal fluids, for example, combustion, turbulence, aerodynamics and more recently on aeroacoustics simulations. In this regards Direct Numerical Simulations (DNS) datasets have served the community very well in assessing the accuracy and/or credibility of these numerical applications. Unfortunately, one area that has not shown such a growth is corrosion modeling. The reason for this is the lack of accurate and robust electrochemical data (boundary conditions). Another important challenge is the large timescales involved in corrosion. Even 'Accelerated' Corrosion Tests (ACT) such as ASTM B117, and G85 salt spray chamber test often used to rank possible materials and coatings can take over a month. Despite these challenges, Multiphysics CFD packages are gaining popularity and some corrosion modeling applications are now found in the literature. The processes involved in corrosion are many and complex, however, one key parameter is the electrolyte film thickness which will clearly be different whether inside a chamber at high humidity with a continuous supply of sprayed saltwater compared to exposure from beach test where diurnal cycles result in a very thin electrolyte, of varying salt concentrations. However, most of the work shown in the literature is constrained to ideal conditions namely constant film thickness. In this sense, this work addresses two main areas, ideal and real conditions. On one hand, ideal conditions are relatively simple to asses, for example, we have developed two main procedures 1D and 2D methods, both name 1D and 2D Djinn® respectively. The former has been widely validated and verified while the latter is still in its developmental stage, but preliminary verification results demonstrate the accuracy of the code. These two tools considerably reduce the time needed to sort or test dozens or hundreds of different material/coatings combinations. On the other hand, the film thickness is also highly dependent on the geometry of the products and indeed their orientation. To this end, we implement fully 3D time-dependent Multiphysics CFD simulations on a multi-material structure along with the appropriate boundary conditions (polarization behavior of the materials involved) lead to an accurate variable film thickness that simulates the galvanic corrosion using the Laplacian potential model. The ultimate objective of this work is to correlate numerical tests (real conditions) with the ACT under realistic conditions and to demonstrate the advantage of using 1D and 2D numerical techniques to accelerate the initial stages of material and coating selection (ideal conditions). Preliminary results show that the numerical predictions agreed with the ACT results and ideal conditions are extremely efficient to down select material and coating options.

Speaker Biography:

Julio Mendez holds a BS, MS, and Ph.D. in Mechanical Engineering with more than 12 years of professional experience in thermal fluids and stress analysis; specializing in CFD software development with High Performance Computing (HPC) applications, leveraging GPU's for fast CFD computation. Dr. Mendez's research interests vary from computer science to numerical analysis. He has worked on linear solvers, explicit techniques, numerical methods, high fidelity numerical computation, and more recently he has developed a set of tools for the Design of Experiments (DoE) and surrogate modeling to accelerate engineering designs. Since 2008, Julio has worked in CFD studying industrial related problems and during his Ph.D. he worked on turbulence with a new Spatio-Temporal framework for LES. Additionally, he developed and validated a new numerical scheme for supersonic and mildly hypersonic flows called Integro-Differential Scheme (IDS). At Corrdesa LLC, Dr. Mendez is in charge of developing new methods of computational corrosion analysis and/or simulation that advance the state of the art, as well as Quality assurance through V&V. Dr. Mendez is an active member of the American Institute of Aeronautics and Astronautics (AIAA) and currently, he collaborates in Academia as a Research Scientist at North Carolina A&T State University where he collaborates with graduate students and research staffs.

Presenter Name: Mendoza Vazquez, Moises

Presenter Company: Autoliv Mexico

Presentation Title: Improving PDC times: Virtual validation using rapid prototyping, FEA & 3D scan (M. Mendoza Vazquez, Autoliv Mexico; Lvl: 1)

Session Title: Verification & Validation 1

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 4:00 PM

Type: Presentation

Intended Learning Outcome:

The use of new technologies of validation and prototype manufacturing allow the reduction of Product Development Cycle time.

Keywords: 3D scan,FEA, prototype,product development, validation

Abstract:

Traditional methods to shorten Product Development Cycle (PDC) times have shown an inverse relation between development time and cost, and that shorter development times tend to increase the overall cost. Furthermore, the development time topic is often distorted by the erroneous assumption that development time and design quality are positively related: the longer time spent on design, the better the design of the final product will be. This assumption makes difficult to explore new options to successfully complete the PDC, resulting in less innovation and blocking possibilities for market expansion as current development resources are allocated to non-value adding activities. However, current PDC show a tendency to get shortened triggered by customer needs and high demand for new products. Consequently, exploring and applying new product development options that can shorten PDC times without giving in quality, costs and customer needs has become an important goal of management and is no longer an option, but a necessity. In order to optimize PDC times, it is important to identify the stagnation points and their causes. A major development phase, where resources add no value and often cause delays on the overall planning, is the waiting times for validation of new and redesigned products. Physical resources such as transportation of samples, creation of prototypes, use of specialized machines and testing rigs, as well as human resources to execute and analyze test data are used, which make the whole process extremely complex and expensive. The continuous change of customer needs and high demand for new products require that validation process is completed as soon as possible, in order to advance to further development stages, reducing the overall PDC time. In this work, the success story of three cases using rapid prototyping, FEA and reverse engineering with 3D scanning technologies, where physical validation of products was replaced by means of digitalization of physical parts, virtual validation and standardization for future developments, are presented. Additionally, the benefits and challenges of migrating from the traditional physical validation process to consistent and easily repeatable virtual tests are explored. To achieve this, current physical validation experiments which account the main stagnation points were identified and categorized by the impact level to the development time and cost. Moreover, the feasibility and likelihood of the test to be used in future developments were analyzed to select the most suitable ones for the virtualization of the process. The virtual models for testing were compared with existing test data showing the results correlation, and the viability of the migration of more validation tests. The use of virtual validation models, which are available almost instantly, from anywhere and with great accuracy are a big leap to shorten PDC times while still reducing development costs.

Speaker Biography:

Moises Mendoza is currently a CAD/CAE Engineer at Autoliv Mexico developing seat belt systems and supporting the global development of better solutions for vehicle safety. His career has been focused in automotive engineering and taking an approach of active innovation driven product development. Graduate from Nagoya University (Japan) as Master of Automotive Engineer in the field of vehicle safety and Mechanical Engineer from National Autonomous University of Mexico.

Presenter Name: Mishra, Suman

Presenter Company: Ford Motor Company

Presentation Title: A Computational Approach to Designing an Optimal Urea Mixer in a Diesel Exhaust System (S. Mishra, Ford Motor Company; Lvl: 3)

Session Title: CFD 1

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 11:00 AM

Type: Presentation

Intended Learning Outcome:

Optimal design of a mixer to achieve a uniform NH3 concentration at the substrate interface.

Keywords: SCR, Urea Injection

Abstract:

Selective catalytic reduction (SCR) has been widely employed in diesel exhaust systems to reduce NOx emissions. In this process, an aqueous solution of urea is injected into the exhaust flow which produces NH3 gas upon going through the process of thermolysis and hydrolysis. NH3 gas further goes through a reduction reaction in presence of the SCR catalyst to reduce NOx content into pure N2. Since a calibrated amount of aqueous urea solution is injected for certain content of NOx, it is essential that all urea solution is vaporized and converted to NH3. It is also important that the NH3 gas is thoroughly mixed with the exhaust gases. An uneven mixing of NH3 gas and exhaust flow might cause the vehicle to not meet the emission standards by letting the NOx escape where local NH3 concentration is insufficient for the reduction process of NOx. It also leads to slippage of NH3 into the atmosphere where local concentration of NH3 is underutilized. Due to increasingly tighter emission requirement for NOx, a higher amount urea is dosed for increased NOx conversion. A lack of uniform mixing in this scenario creates higher localized concentration of NH3 which may lead to NH3 slippage and cause miss the emission requirement for NH3. In the current CFD study, different mixer designs have been created and evaluated to attain higher mixing. Uniformity Index at the catalyst interface is used as a metric to quantify the amount of mixing. Cold solid skin temperature often creates film on the surface which has a significant effect on the uniformity. The CFD study uses conjugate heat transfer approach to model the heat loss from the solid casing to the ambience and predict the skin temperature. It also models film formation on the walls and subsequent film stripping. The time scales of the solid and the fluid are very different. For this reason, a super-cycling approach is used to model the solid skin temperature where the solid temperature attains quasi-steady temperature quickly. The software used for this study is CONVERGE.

Speaker Biography:

Not Yet Provided

Presenter Name: Mittal, Shubhang

Presenter Company: ANSYS, Inc.

Presentation Title: Simulation for Developing Autonomous Vehicles in Context of the Indy Autonomous Challenge (S. Mittal, ANSYS, Inc.; Lvl: 2)

Session Title: Innovative Applications

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 2:00 PM

Type: Presentation

Intended Learning Outcome:

Attendees will learn about the Indy Autonomous Challenge which will take place in October 2021 at the Indianapolis Motor Speedway, as well as the preceeding simulated race in February 2021

Keywords: ANSYS, Autonomy, Simulation, Indy, AV, Race, Competition

Abstract:

The Indianapolis Motor Speedway (IMS) and Energy Systems Network (ESN) are conducting the Indy Autonomous Challenge which is a two-year $1 million prize autonomous vehicles (AV) competition that will culminate in a head-tohead, high-speed autonomous vehicle race Oct. 23, 2021 around the Speedway's famed 2.5-mile oval. The Challenge builds upon the success and impact of the DARPA Grand Challenge – the 2004-05 defense research initiative that helped create the modern autonomous vehicle industry. Since simulation is crucial to the development of autonomous vehicles, a simulation race will be conducted in February 2021 prior to the speedway race. The simulation race will be held on a virtual model of the Indianapolis Motor Speedway. Each race team will pilot a virtual car around the virtual racetrack, with the autonomous driving software developed by their team, in a head-tohead race with several competing cars running in the simulation simultaneously. This presentation will discuss details of simulation as used in the development of autonomous vehicles, considering the autonomous vehicles to be used in the Indy Autonomous Challenge as a case study. The purpose of AV simulation is to serve as a virtual proving ground for testing, refining and validating the vehicle’s automated driving software algorithms. Toward this purpose, the first step in AV simulation is to construct a virtual world model in which the test autonomous vehicle – referred to as ego vehicle – will be virtually driven by the automated driving software. In this case the virtual world is a model of the Indianapolis Motor Speedway. We will discuss the intricacies of developing such a model highlighting modeling considerations that are important in AV simulation such as road topology. The second step is constructing a virtual model of the autonomous vehicle to be driven in the virtual world. In the case of the Indy Autonomous Challenge, the race vehicles will be based on the Indy Lights chassis developed by Dallara. Considerations for a creating a virtual model of such a vehicle that accurately represents the physical behavior of the vehicle will be discussed. Of particular importance is developing a vehicle dynamics model and a powertrain model. The next step is modeling sensors mounted on the vehicle. Various techniques of sensor modeling will be discussed. Next, the approach used to interface the automated driving software with the simulator will be discussed. Finally, we will discuss running simulations in the cloud at massive scale to test and validate the automated driving software over vast design spaces.

Speaker Biography:

Shubhang Mittal is an Application Engineer at Ansys, Inc. with a focus on autonomous vehicles and driver assistance systems. He leads multiple engagements with North American OEMs & Suppliers in the autonomous space. Master's Degree in Automotive Systems Engineering from Kettering University.

Presenter Name: Montañez Villamizar, Urbano

Presenter Company: PROCTEK SAS

Presentation Title: Optimized Gun Barrel Based on Numerical Simulation to Produce Oil With Low BSW Content (U. Montañez Villamizar, PROCTEK SAS; Lvl: 2)

Session Title: Optimization 3

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 11:00 AM

Type: Presentation

Intended Learning Outcome:

Real application of the simulation software/tool to an engineering problem/requirement in the Oil and Gas Industry

Keywords: Gun barrel, separation tanks, CFD, crude oil treatment, optimization, BSW, retention time, fluent, numerical simulation, DPM

Abstract:

A gun-barrel separator, also called a wash tank, is the oldest equipment used for crude oil treatment. However, still in these days is one of the most used methods to break the oil-water emulsion and obtain oil with minimum specifications of water, salts, and sediments (BSW) before it is sent to a storage tank. Due to the gun barrels have been used for a long time, commonly these equipment do not reach the oil specifications or have low efficiency, therefore, the oil treatment process needs more stages to achieve the specific BSW limit for sale. This work presents the methodology and results of the optimization of the internals (Inlet distributor, oil and water collectors) of a 20.000 barrel tank starting from an existing design. Computational fluid dynamics (CFD) was applied to simulate and evaluate the performance of various internals configurations. These simulations were conducted to determine the best configuration that ensures efficient separation of the oil-water mixture and oil with a low BSW content < 2% in the outlet. The simulations were carried out by Fluent commercial software under two-phase flow VOF model and k-ε realizable turbulence model. The optimum inlet distributor has four "fish spine" with a total of 28 perforated branches. The water collector has also a "fish spine" configuration and the oil collector is a serrated perimeter weir in the upper part of the tank. The inlet distributor was simulated alone and distribution efficiency of 84 % and 71% for the two types of branches was achieved. The tank dimensions, and the orientation and level of the nozzles were considered to design the prototypes. CFD simulations were conducted in the whole gun-barrel tank to compare the performance of the equipment with and without the distribution systems and fluid collection. For the first case, the effective retention time for the oil phase calculated through the discrete phase model (DPM) was 10.9 hours equivalent to 53% of tank utilization. On the other hand, for the tank without internal components, the effective retention time for the oil phase was 0.65 hour, which correspond to 3.2 % of the use of the tank. This result shows the importance of implementing flow distribution devices in separation tanks such as gun barrels. Further CFD simulations were performed to evaluate the behavior of the gun barrel tank under different operating conditions (Several inlet flow rate) and to determine the maximum operation flow which allows obtaining the crude-oil with a maximum BSW content of 0.5%. From the simulation results, an operational curve (operating flow vs retention time) was constructed. This curve shows that when the inlet flow rate increases, the retention time decreases, but this is not a linear relationship. Subsequently, the retention times were crossed with bottle tests of the water-oil emulsion and an operating flow vs % BSW curve was created. This information helps identify the inlet flow rate based on the desired BSW content in the separated oil.

Speaker Biography:

Urbano Montañez is a Chemical Engineer at Proctek SAS Company, where he coordinates the engineering team, including the CFD team. For the past seven years, Urbano has worked with CFD projects optimizing different equipment and processes in the industrial sector. Before working at Proctek, Urbano studied a master´s degree in Chemical Engineering at the University of Campinas, Brazil. Urbano enjoys climbing on Sundays and making good memories with his wife Ana and his son Matias. You can reach Urbano at urbano.montanez@proctek.com

Presenter Name: Mottola, Ernesto & Panthaki, Malcolm

Presenter Company: Toyota Motor Europe Technical Centre & ARAS Corporation

Presentation Title: A Coherent Digital Thread as Enabler for Systems Thinking Across the System Lifecycle - Where's the Simulation? (E. Mottola, Toyota Motor Europe Technical Centre & M. Panthaki, ARAS Corporation; Lvl: 2)

Session Title: Digital Threads & Digital Twins 2

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 1:30 PM

Type: Presentation

Intended Learning Outcome:

The audience will be introduced to the key concepts and characteristics of an enterprise digital thread to capture content and intent, and how pervasive systems thinking, enabled by the effective use of SPDM, is essential for successfully managing the ent

Keywords: Digital Thread, systems thinking, systems engineering, product requirements, MBSE, enterprise SPDM, intelligent simulation automation, multidisciplinary product, open PLM platform

Abstract:

Advanced manufacturers realize that a pervasive culture of systems thinking is required for their silo'ed engineers to successfully manage multidisciplinary products of increasing complexity, while also considering conflicting business, competitive, and operating environments – the traditional reductionist design approach is no longer adequate by itself. While systems thinking is pervasive in the space satellite and electronics market segments, other segments are considering it or investigating how to implement it in their organization and processes. Furthermore, intelligent simulation automation and effective, pervasive SPDM are essential enablers, as manually performed simulation, with its experts and data trapped in silos, becomes infeasible. We present an alternate enterprise data architecture, including the key characteristics of a digital thread spanning the product lifecycle – from requirements and conceptual design through maintenance and end-of-life, including pervasive and accessible simulation across the enterprise. It is limiting to discuss SPDM outside the context of an enterprise digital thread, one that captures "content" generated during the lifecycle (e.g., CAD models, systems models, and simulation data), and also, through meaningful relationships and metadata, links the content in a configuration-managed and versioned graph to capture "intent". Capturing intent provides answers to queries such as why the product was designed a certain way, what the accuracy of the simulation data is, why the product was architected a certain way and the related benefits, and how IoT data was used to predict maintenance and improve designs. This elevates data to useful and actionable corporate knowledge that, when broadly accessible, becomes the fuel that drives innovation. When implemented correctly, it is the full digital record of the critical IP/DNA of an organization, across all its products, over time. This rich trove of organized data is valuable, as the readily available engineering knowledge can be leveraged in future projects and can be utilized by machine learning to more effectively and accurately train AI algorithms. The increasing product complexity would require earlier and wider use of simulation to support the product development with systems centric thinking. On the other hand, for decades, simulation experts, tools and data have lurked within organizational silos. While simulation's ability to model multiple domains and predict overall system behaviour has steadily increased, the isolated and proprietary nature of the tools and processes has limited its impact. Hence, while the potential of simulation is well-recognized, product teams have maintained strong dependency on physical testing as a reliable though expensive and time-consuming way to explore alternatives and validate designs. Moreover, with physical testing, only a very small number of designs can be evaluated, with the risk of late detection of problems. This is no longer feasible for managing today's multidisciplinary products. These products require large teams that are segregated geographically and by organizational silos. The authors present an approach to SPDM as a Service within PLM, one that overcomes many of the issues created by proprietary applications solely used by the experts and enables the proliferation of Systems Thinking across the enterprise. Using a real-world example, we demonstrate some of the needed steps to realise simulation as a pervasive service within an open, extensible PLM platform, going from requirements and systems modelling through systems analysis and mixed-fidelity simulations and system V&V. This will show the digital thread that connects these data with the system architecture at the core, including pervasive requirements

and pervasive simulation, enabling systems thinking. This reference implementation of effective SPDM within a System Lifecycle Management platform will be made available on request for review and further development to relevant parties. We encourage further collaborative work at a pre-competitive level, within a community of like-minded end-users, to accelerate the development and the adoption of these technologies, expanding from a product-centric PLM platform to a System Lifecycle Management approach and platform.

Speaker Biography:

Not Yet Provided

Presenter Name: Neiferd, David

Presenter Company: Air Force Research Laboratory

Presentation Title: MAST: Multidisciplinary-Design Adaptation and Sensitivity Toolkit (D. Neiferd, Air Force Research Laboratory; Lvl: 2)

Session Title: Optimization 2

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 4:30 PM

Type: Presentation

Intended Learning Outcome:

The capabilities of the open-source finite element framework, MAST, and the advanced capabilities it offers for high-fidelity simulation and optimization not currently found in commercial software.

Keywords: MAST, FEA, FEM, optimization, sensitivity analysis, nonlinear, design

Abstract:

Modern design processes for structural systems across a variety of industries are becoming ever more reliant on computational models and simulations. Next generation aerospace structures are subject complex multidisciplinary loading including aeroelasticity and fluid-structure interaction, conjugate heat transfer and thermoelasticity, and structural-acoustics. In addition, it is not uncommon for these combined loads to drive responses into the nonlinear regime. Due to the inherent complexity of the governing physics, the dependency between design responses and design parameters is non-intuitive, making the use of traditional design processes difficult in these cases. As a result, a simulation-driven design process can not only reduce design cycle time, but often yield improved performance as well. Commercial finite element analysis tools are capable of accurately modeling nonlinear and tightly coupled multidisciplinary responses. However, these tools have yet to rigorously incorporate analytical sensitivity analysis methods that provide gradients between design responses and design variables for coupled systems, such as CFD-based aerodynamics and nonlinear FEA-based structures. This feature is a critical component for enabling efficient use of design optimization methods in simulation-driven design. While methods have been proposed to address these issues, such as the use of surrogate models to approximate responses, obtaining an accurate surrogate for a system with a large number of design parameters can lead to prohibitive computational costs. Traditional finite difference methods prove too computationally expensive as well for a high number of design parameters. Alternatively, the equivalent static load method has been adapted to approximate sensitivities of nonlinear responses using cheaper linear analyses; however, these methods perform poorly when the loading is highly design dependent, which is common in many aerospace structures. This work presents the Multidisciplinary-design Adaptation and Sensitivity Toolkit (MAST), which addresses the need for efficient FEA-based analytical sensitivity analysis for multiphysics, optimization-driven design. MAST is an open-source, object-oriented, C++ finite element analysis framework that is jointly developed by Mississippi State University (MSU) and the Air Force Research Laboratory (AFRL). Development has focused on efficiently and reliably quantifying static and dynamic stability characteristics of nonlinear multidisciplinary systems and providing analytical sensitivity analysis to enable gradient-based design. MAST utilizes multiple open-source libraries to achieved high performance in both the assembly and solution of finite element systems on both local and distributed architectures. Both the direct and adjoint methods of sensitivity analysis are implemented to allow for efficient sensitivity analysis in either designs with a large number of parameters such as topology optimization or with a large number of constraints. MAST also interfaces to multiple optimizers to allow the design to be automatically driven towards an optimum. This work will present a discussion and demonstration of the capabilities of MAST. A built-up generic supersonic aircraft wing structure with control surfaces is modeled using industry-level modeling representations. The nonlinear static, modal, and aeroelastic maneuver responses of the wing will be analyzed using MAST. The analytical sensitivity of these responses with respect to changes in skin panel and spar/rib thicknesses are also calculated. The accuracy of the responses and sensitivities are numerically verified against commercial software and finite differences, respectively. The use of efficient sensitivities to size the thickness variables against constraints from multiple loading conditions will also be demonstrated in an optimization-based, simulation-driven design process. Distribution A. Approved for public release: distribution unlimited. (88ABW-2019-5868)

Speaker Biography:

My name is David John Neiferd. I received my Bachelor's of Science in Mechanical Engineering from Wright State University in 2014 and am currently finishing my Ph.D. in Engineering also at Wright State University. I am a research engineer at the University of Dayton Research Institute. My background is in structural design optimization, particularly with topology optimization. I am currently doing contract work with MSTC group in the Air Force Research Laboratory at Wright Patterson Air Force Base.

Presenter Name: Niu, Hui

Presenter Company: ANSYS Inc.

Presentation Title: Multiphysics Finite-Element Modeling for Vibration and Noise of Variable-Speed Permanent Magnet Brushless DC Motor (H. Niu, ANSYS Inc.; Lvl: 2)

Session Title: Multiscale & Multiphysics 2

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 2:00 PM

Type: Presentation

Intended Learning Outcome:

Utilizing Multiphysics finite element modeling process with Ansys to predict vibrational noise and sound quality due to magnetic forces within a variable-speed permanent-magnet brushless DC motor.

Keywords: Magnetic forces, Variable-speed, Vibration, Acoustics, Noise, Brushless DC motors

Abstract:

The global demand for greater power efficiency is driving electrification initiatives across industries. In automotive industry, new electric powertrain architectures have been widely developed. Complexity of electric powertrain and driveline introduces high frequency tonal noise from engine and transmission systems. Acceptable audible noise levels for transportation vehicles must meet legislation and customer satisfaction. Therefore, NVH impact is particularly significant in electric powertrain design. This work derives multiphysics finite element modeling process to predict vibration and noise due to magnetic force of a permanent-magnet brushless DC motor. The motor in study is a three-phase surface-mount permanent-magnet brushless DC motor with 4 poles, and 24 slots. Magnetic force computation in two-dimensional electromagnetic model is carried out over a variable speed range magnetic transient analysis. Using discrete Fourier transformation and electromagnetic-structural one-way coupling schemes, magnetic harmonic forces for every rotation angular speed are generated and applied on stator teeth's inner surfaces. In Mechanical pre-processing, a 3D finite element model of brushless DC motor, including housing, caps, bearings, and shaft beam, is built for comprehensive Multiphysics analysis. Vibration characteristics are calculated for the three-dimensional full finite element model of the motor in multiple-RPM (MRPM) mode-superposition (MSUP) harmonic response analysis. Waterfall diagram of equivalent radiation pressure level (ERPL) contour plotting in function of rotation angular speed and frequency is obtained in multiple RPM harmonic analysis. Further, surface vibrating velocities for every rotation angular speed are imported and applied on acoustic domain using fluid-structure interaction one-way coupling. Noise radiated from motor housing including front and end caps is evaluated. In MRPM harmonic acoustic analysis, far-field sound pressure level (SPL) waterfall diagram in function of rotation angular speed and frequencies is obtained. Waterfall data of far-field SPL is adopted to perform the sound quality analysis based on magnetic force excited acoustic noise. Finally, the comprehensive psychoacoustic analysis including loudness, loudness level and sharpness variation over time, and their maximum, is performed.

Speaker Biography:

Ms. Hui Niu is Sr. Product Engineer at Ansys Inc.. She graduated with M.S. degrees in Physics and Mechanical Engineering. She has started working in R&D teams at ANSYS focusing on Multiphysics products since 2012.

Presenter Name: Norris, Mark

Presenter Company: the SDMConsultancy

Presentation Title: How to Get Started with Simulation Process and Data Management (M. Norris, the SDMConsultancy; Lvl: 1)

Session Title: Data Management 3

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 4:30 PM

Type: Workshop

Intended Learning Outcome:

Keywords:

Abstract:

Overview Simulation Process & Data Management (SPDM) is a technology deployed by high performance industrial organisations since the year 2000 to build and maintain the Digital Thread of the data used, and the decisions taken, to predict the performance and lifetime of engineered products. The records in an SDM solution enable these companies to rapidly stand up a functional Digital Twin of an actual product to support manufacturing or operations. These organisations use SDM to assure the quality of simulations, provide traceability of results and increase engineering throughput. While the business impact of the successful adoption of SDM and SPDM within mainstream product development has been impressive, many organisations have struggled with the adoption of a variety of information systems to manage simulation data. The Simulation Data Management Working Group therefore commissioned a publication to disseminate best practice regarding the adoption of Simulation Data Management. This webinar summarises the material in the upcoming NAFEMS publication "How to get Started with Simulation Data Management". After a brief description of the key aspects of SDM and SPDM solutions and an update on the state of the art in industry after 2 decades of deployments of commercial solutions, it describes how to approach an SDM project and achieve a first successful SDM deployment. It describes how todevelop an SDM strategy and justify an SDM project, how to identify a project manager, how to prepare to engage with stakeholders within the organisation and with potential solution vendors, how to identify the capabilities your organisation will require, running a proof of concept and building a project plan for a first deployment. It also describes common pitfalls to avoid. Intended Audience: Engineeering and Simulation Managers intending to start a project to select and deploy an SDM or SPDM solution.

Speaker Biography:

Mark Norris works with industrial organisations to accelerate the deployment of SPDM and ensure project success. He is currently advising several Aerospace OEMs on SPDM solution selection and implementation. He is the author of the NAFEMS White Paper: Business Value from Simulation Data Management – A decade of production experience and 10's of papers, articles and presentations to international conferences on SPDM and SPDM deployment. He co-developed and delivers the NAFEMS Simulation Data Management training workshop. He has also developed an open-source SPDM framework to demonstrate the core concepts of SPDM and so facilitate learning and understanding, which was presented in a paper at NAFEMS World Congress 2019. He began his engineering career developing a method for the simulation of crack propagation in aircraft structures for which he received the N.E.Rowe medal of the Royal Aeronautical Society. He has 40 years of experience of consulting and implementation of information systems for industrial companies. These include Simulation, Computer Aided Design, EDM, PDM, PLM and Simulation Data Management. He has delivered projects for companies in the sectors of Aerospace, Defence, Gas Turbines, Shipbuilding, Automobile, Industrial machinery and consumer goods.

Presenter Name: Palaiokastritis, Vangelis

Presenter Company: BETA CAE Systems SA

Presentation Title: Capturing Multi-Scale Response of Composites with Homogenization Techniques (V. Palaiokastritis, BETA CAE Systems SA; Lvl: 2)

Session Title: Advanced Composites

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 11:00 AM

Type: Presentation

Intended Learning Outcome:

Learn about pre-processing tools for the manufacturing process simulation and multi-scale modelling of composite materials.

Keywords: Homogenization, Multi-scale Modelling, RVE, Molding, FEA, Composites, Micromechanics, Material Design, Advanced Material, Plastics

Abstract:

Composite materials have entered to the era of their extensive use as load bearing materials leading one step further the design of high performance structures. CAE solutions can offer to the engineer key tools for optimal and efficient design of composite materials that meet the engineering performance requirements. The scope of this work is to present a workflow for the Multi-scale modelling of components made with composite materials in the multi-disciplinary environment of ANSA pre-processor. The aim of the examined case study was to substitute the metallic (aluminium) material of a beam, subjected into three-points bending, with a multi phase composite material to reduce its weight. With known properties of the constituents, a material with equivalent response was estimated for both the linear and non linear regions, using Mean Field Homogenization formulations. The fiber orientation from the molding simulation was mapped in the structural model. Both models (metallic and composite) ran in the nonlinear regime resulting in similar flexural behavior. At the post processing level results at multiple scales can be previewed. Furthermore, the high strain area of the model was isolated and a FE-model for the RVE was generated on given microstructure information and orientation tensor from the molding analysis. The RVE model was subjected into the boundary conditions (strain) of the macro-scale analysis to examine cases of fiber-matrix interfacial damage. The beam made by the Composite Material had approximately half of the weight of the aluminum beam. Although in case of the aluminum and composite beam the material response did not exceed the plastic region, in microscale level fiber matrix debonding was observed at the end of the analysis. In this presentation, the described workflow attempts to bridge the gap between Multi-scale modeling, Manufacturing Simulation and Structural Analysis, to facilitate the composite material design process.

Speaker Biography:

CAE Engineer at BETA CAE Systems since 2017, he supports customers with the company's software suite, specializing in the fields of Composite Materials, Durability & Fatigue Analyses. Strong support professional with a Diploma Degree focused in Mechanical and Aeronautical Engineering from University of Patras (2015).

Presenter Name: Palani, Siva

Presenter Company: Corrdesa LLC

Presentation Title: Microscale Modeling of Metal Filled Coating for Corrosion Protection (S. Palani, Corrdesa LLC; Lvl: 2)

Session Title: Advanced Materials & Multiphysics

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 2:30 PM

Type: Presentation

Intended Learning Outcome:

Attendees will see how microstructure data (˜1µm) can be captured from 3D electron microscopy, numerically meshed and then used for corrosion protection predictions.

Keywords: aluminum rich primer, cathodic protection, corrosion modeling, aluminum alloy

Abstract:

Coatings are generally classified in accordance with the mechanisms by which they protect a metal against corrosion, namely barrier protection, passivation/ inhibition and sacrificial protection. Metal filled coatings/primers containing anodic materials for example are engineered to provide sacrificial protection to the underlying metal. These coatings rely on the principle of galvanic corrosion for the protection of metals against corrosion. This means that the substrate is protected by a pigment alloy that is electrochemically more active than the material to be protected. In recent years, metal filled coatings have been gaining an increasing share of the aerospace and defense market, in a large part because environmental restrictions both in the US and particularly in Europe are driving the aerospace and defense industry away from the use of legacy hexavalent chromium (Cr6+) containing primers which are found to be very toxic. One of the few viable primers without Cr6+ is metal filled primer containing anodic materials. In particular, the aluminum rich (Al-Rich) primer developed by Naval Air Systems Command (NAVAIR) has shown some very promising results and important advantages that it provides electrochemical protection to aluminum, steel, and other metallic objects to withstand the severe corrosive operating environments. However, development and optimization of these coating systems is inhibited by a lack of understanding of how the entire system behaves and protects coated components, and assemblies in which they are used. Furthermore, the technology to manufacture these primers is quite advanced with regards to particulate size, loading and a number of other parameters that can be manipulated. To support this process, we have developed a novel computational CAE model employing Discrete element method (DEM) and Computational fluid dynamics (CFD) to create a 3-D model of the metal-filled primer, incorporating both its physical microstructure and its electrochemical properties that can be used to determine how it will interact electrochemically with the substrate and adjacent materials. Consequently, these models are aimed to help to identify and understand the key parameters for coating development, such as particle loading, particle size, shape and treatments, resin/media properties, etc. on the corrosion protection performance. This paper will present corrosion models of Al-rich primer applied on an aluminum substrate. Using case studies, we will demonstrate how it is now possible to illustrate sacrificial anode based cathodic protection mechanism capabilities of the anodic particle spatially in a 3-D primer microstructure in terms of electric potential and current density distribution, and providing some insight on the depletion of the pigment particles as a function of their electrochemical properties, primer electrolyte conductivities, and their location within the primer layer.

Speaker Biography:

Siva is senior scientist for Corrdesa LLC. His expertise is in corrosion and electrochemistry with emphasis on corrosion evaluation, protection and computational corrosion prediction specializing on aerospace alloys and composites. Prior to joining Corrdesa, he was a M & P engineer for Airbus in Germany. He holds a PhD from University of Brussels, Belgium specializing on galvanic corrosion of hybrid structures in aircraft and Masters in Computational Mechanics of Materials and Structures from University of Stuttgart, Germany.

Presenter Name: Panthaki, Malcolm

Presenter Company: RevolutionInSimulation.org

Presentation Title: The Two-Year-Old Revolution at the RevolutionInSimulation.org Community – Status and Next Steps (M. Panthaki, RevolutionInSimulation.org; Lvl: 1)

Session Title: Cultural Challenges

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 12:30 PM

Type: Presentation

Intended Learning Outcome:

Keywords:

Abstract:

The democratization of simulation software has the potential to increase the number of simulation users by one or more orders of magnitude. Similar dramatic expansions of use of complex technologies have been witnessed in many other technology-driven industries such as automobiles, airplanes, and personal computers, navigation systems, music devices, and mobile phones. In each of these cases, the expansion occurs when the nascent, complex, hard-to-use technology is packaged into a form that is simple-to-use, robust, affordable and accurate, and made available to everyone. But this turning point is never simple to accomplish and is hard to predict. However, when it does happen, it has always resulted in an explosion of investment and innovation that further drives the power and use of the underlying foundational technologies to a broader and broader audience. The RevolutionInSimulation online community resource (Rev-Sim.org) was founded in 2018 – it was launched at the last NAFEMS CAASE conference in June 2018. Rev-Sim provides professional resources and a collaborative community to help increase the value of engineering simulation software (CAE) investments through the Democratization of Simulation. Here you'll have access to success stories, news, articles, whitepapers, blogs, presentations, videos, webinars, best practices and reference materials to help democratize simulation in your organization. Experts have volunteered to be Topic Moderators, curating the resources and authoring blogs on various important next-generation simulation topics such as Automation, Apps, Democratization, HPC, Business Challenges, Digital Twins, Digital Thread and SPDM, and others. You'll also have one-stop access to simulation specialists, industry organizations, special interest discussion groups, and industry media, along with software and consulting service providers to accelerate the return on your simulation investments. Rev-Sim is a free community resource that is funded by the generosity of a number of sponsor companies whose products are at the cutting edge of simulation technology and practice. These companies and their simulation experts provide many valuable resources to the Rev-Sim community. In this session, the author will present an overview of the Rev-Sim initiative and will report on progress as it hits its 2-year mark. He will provide a vision for the future of Rev-Sim and describe the priorities for the few years.

Speaker Biography:

Not Yet Provided

Presenter Name: Patel, Deepak Kumar

Presenter Company: Dassault Systemes SIMULIA Corp

Presentation Title: Tensile Loading of 3D Woven Textile Composites: A Progressive Failure Analysis (D. Patel, Dassault Systemes SIMULIA Corp; Lvl: 3)

Session Title: Advanced Composites

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 12:00 PM

Type: Presentation

Intended Learning Outcome:

A novel computational PDA tool for progressive failure analysis of textile composites.

Keywords: Textile composites, 3D Hashin, Damage evolution

Abstract:

The tensile response of hybrid 3D woven textile composites (3DWTCs) that consist of Glass, Carbon and Kevlar fiber tows, is simulated using a finite element (FE) based macroscale model. The fiber tows are embedded in an epoxy material and integrally woven into a single preform. Based on micromechanics concepts, homogenized property of the fiber tow is extracted from its fiber-matrix constituents numerically. The extracted properties are assigned to individual fiber tows, modeled discretely for different material systems. The enhanced mechanical properties of the textile composites are highly dependent on such hybrid configuration of multi-material systems and the orientations of fiber tows. 3DWTC is manufactured by laying up the warp and weft fiber layers and consequently running a Z-fiber in the thickness direction to bind the in-plane layers together. These composite structures offer a great advantage in terms of high resistance to layer delamination, which is a common problem in conventional laminated composites. They have high damage tolerance, high impact resistance and low fabrication cost, which makes them suitable for tailoring structural properties. Given these crucial benefits, these woven textile composites find widespread application in aerospace, automobile and defense industries. For simulation of these composite structures, it is necessary to accurately describe the mechanical properties of components to correctly predict their structural response under a given loading scenario. In this work, a representative volume element (RVE) unit is modeled with geometry and architecture inputs drawn from the literature. The simulation workflow is established with meshing the RVE, material modeling, and appropriate analysis procedure. To capture the progressive damage evolution in fiber tows, user defined material subroutine based on 3D Hashin's damage law is developed. The RVE and the material models together provide a unique computational framework to predict the tensile strength of 3DWTCs, and its dependence on various geometrical and material parameters. The numerical simulation result predicts the global stress-strain response and the detailed local complex failure mechanisms of the textile composites. The reported results are found to be in good agreement with experimental data available in literature.

Speaker Biography:

Deepak completed his PhD in Aerospace Engineering in 2017 from University of Michigan, Ann Arbor and was working as Post-Doc at University of Washington, Seattle, WA thereafter. Deepak's research focused on progressive damage and failure in composites, and is well-versed in finite element techniques, mechanics and programming. He joined DS Simulia team at Santa Clara, CA in 2018 and helping Bay Area HighTech/Life Science engineers to provide technical solutions.

Presenter Name: Paudel, Govind

Presenter Company: Dassault Systemes SIMULIA Corp

Presentation Title: Standing Waves in Tires at High Speed (G. Paudel, Dassault Systemes SIMULIA Corp; Lvl: 2)

Session Title: Structural Analysis 1

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 11:30 AM

Type: Presentation

Intended Learning Outcome:

that it is now possible to model standing waves in rolling structures using Abaqus

Keywords: tire, standing waves, dynamics, stability, convergence

Abstract:

Although steady state tire analysis procedures have been long established in Abaqus, it has only recently become possible to simulate the development of standing waves at high rolling speeds. When standard Galerkin methods are used to evaluate inertial forces along streamlines, the solution diverges at high rolling speeds, becoming unstable at the onset of standing waves. A recent development in Abaqus steady-state transport analysis addresses this divergence problem by introducing a weighted shape function in the Galerkin methods. This improved shape function allows a non-uniform convection of the inertial forces along the circumference: from the leading edge to the trailing edge of the tire. As a result, convergence during high speed rolling can be achieved at and beyond the point where standing waves occur in the tire. This study demonstrates the analysis workflow for a P195/75R17 tire at rolling speeds up to 300 kph. The workflow follows standard tire analysis procedures: mounting, inflation, vertical load application, symmetric model generation, symmetric results transfer. The steady state rolling procedure requires identification of the free rolling condition of the tire, which was found by scanning a series of different rolling speeds until the tire's reaction moment about the axle becomes zero - neither braking nor driving. The solution is obtained on both flat and curved road surfaces. Starting at roughly 210 kph, standing waves are developed in the solution. Visualizations of the analysis results show standing wave effects in several aspects of the solution: displacement fields, stress / strain history and free rolling radius. The solution for the curved road surface exhibits a softer vertical stiffness and thus a smaller free rolling radius, so that greater displacements occur for a given vertical load. Intertial effects at high rolling speed are shown to produce large increases in the free rolling radius with a cross over between drum and flat cases at 270 kph.

Speaker Biography:

Govind Paudel is a senior solution consultant at the Dassault Systemes Simulia Corporation. He has been working with Simulia since 2011 focusing on Abaqus finite element analysis. Before joining Simulia Govind worked as a finite element analyst for almost 10 years at various companies. He is an expert in modeling tires with Abaqus. Govind has helped Abaqus tire customers worldwide in simulations such as rolling resistance, hydroplaning, and tire-soil interaction. He has a mechanical engineering degree from the University of Akron.

Presenter Name: Pineda, Evan

Presenter Company: NASA Glenn Research Center

Presentation Title: Software Architecture and Hierarchy of the NASA Multiscale Analysis Tool (E. Pineda, NASA Glenn Research Center; Lvl: 1)

Session Title: Multiscale & Multiphysics 5

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 1:30 PM

Type: Presentation

Intended Learning Outcome:

I expect the audience to learn how the NASA Multiscale Analysis Tool (NASMAT) has been developed as massively multiscale modeling (M^3) platform and understand how NASMAT may be able to help them solve problems related to hierarchical materials and struct

Keywords: Multiscale modeling, composites, micromechanics, hierarchical materials, software design

Abstract:

The NASA Multiscale Analysis Tool (NAMSAT) serves as a state-of-the-art, “plug and play,” massively multiscale modeling (M^3) platform for hierarchical materials and structures. The development of NASMAT has focused on modularity, upgradability and maintainability, interoperability, and utility. The code has been designed such that the various functionalities are compartmentalized into a set of generic module types. Specific modules can be swapped in and out, as needed, to solve the multiscale problem of interest. Moreover, to support M^3, recursive data types and subroutines are used extensively to handle the large quantities of data associated with each length scale considered by the multiscale model. Finally, application program interfaces (APIs) have been developed to facilitate the integration of NASMAT into other programs (commercial, research, and user-defined) as well as the integration of other codes into NASMAT itself. This presentation is intended to give an overview of the design of NASMAT and how the design supports modularity, upgradability and maintainability, interoperability, and utility. First, the software architecture and hierarchy will be explored. Each of the main program modules (Pre-processing, Driver, Engine, Solution, Homogenization, Material Model, Localization) and their “plug-and-play” interoperability will be discussed. Details on the recursive data structures, used to store specific types of data associated with the input file, fields, properties, microstructure, flags, micromechanics solution, and global solution, will be presented along with the identification of the recursive program modules needed to enable M^3. Benchmark results for NASMAT will be presented and compared to legacy code. Information pertaining to the NASMAT APIs will also be presented. The MacroAPI serves to integrate NASMAT into other software; i.e., another code calls NASMAT. The most common use-case for this API is when the highest length scale structural analysis, in a multiscale model, is being performed using the finite element method. In such a case, the integration point material properties are obtained directly from NASMAT. NASMAT calculates these properties, through homogenization and localization procedures, which can include the effects of temperature dependent inelasticity, damage, and other non-linear phenomena. The MacroAPI will be demonstrated using third party FEM software to exhibit performance of the code when the FEM operations are distributed among multiple processors. The MicroAPI is intended to interface third-party micromechanics codes into NASMAT. In these instances, the user provides code that performs the homogenization and localization operations. Because of the arbitrary length scale capability within NASMAT, there are no restrictions on the number of codes that can interface with NASMAT using the MicroAPI in a single analysis. The third-party micromechanics method can include its own local constitutive and damage models, or the method can utilize the models already implemented within NASMAT.

Speaker Biography:

Not Yet Provided

Presenter Name: Popielas, Frank

Presenter Company: SMS_Thinktank

Presentation Title: Systems Modeling and Simulation Community (SMS Community) (F. Popielas, SMS_Thinktank; Lvl:)

Session Title: Systems Modeling & Simulation

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 11:00 AM

Type: Presentation

Intended Learning Outcome:

Keywords:

Abstract:

Speaker Biography:

Mr. Popielas is currently Managing Partner and Co-founder of SMS_ThinkTank. He has over 20 years of global experience in engineering and R&D product and materials development, IP management, as well as testing, with a specific focus on the development and application of simulation tools, and the establishment of the required supporting infrastructure at Dana Holding Corporation. His expertise includes technology exchange and transfer, business assessments in engineering and manufacturing focusing on the virtual aspect, as well as process development and democratization of its application in this area. In Addition, Frank is a member of the NAFEMS Americas Steering Committee since 2011 and became founding chairman of the joint System Modeling and Simulation Working Group (SMSWG) between NAFEMS and INCOSE in 2013 and continues his leading role in the SMSWG as Co-chair since August 2016. He joined the COE organization as volunteer in 2017 and is section chair within the Engineering, Analysis and Simulation Division responsible for CAE and SPDM (Simulation Process and Data Management). His activities and achievements include over 35 granted patents globally on the areas of sealing, shielding and fuel cells, over 30 publications globally covering all the mentioned areas with the focus on the past decade on virtual engineering, its tools and practices, presentations and speaking engagements at conferences and various companies, interviews, case studies and teaching engagements. Mr. Popielas received his MSc degree in Engineering, majoring in Theoretical Physics from the Technological University (MIS&A – Institute for Steels and Alloys) in Moscow, Russia. Frank is fluent in English, German and Russian.

Presenter Name: Popielas, Frank

Presenter Company: SMS_Thinktank

Presentation Title: Digital Twin – Its Maturity Levels and Related Impact on Business Maturity and Competitive Position (F. Popielas, SMS_Thinktank; Lvl: 2)

Session Title: Digital Threads & Digital Twins 2

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 3:00 PM

Type: Presentation

Intended Learning Outcome:

Listeners will gain a detailed understanding of the various maturity levels of the digital twin capability and how it will impact business maturity and competitive position

Keywords: Digital Twin, Maturity, CMMI, cognitive, predictive analytics, IoT, deep learning, AI, simulation, continuous engineering

Abstract:

Establishing sound systems engineering practices is essential in our modern fast-paced market environment, especially model-based approaches, and have become the means how businesses try to address many of their engineering challenges. Modern systems engineering thinking doesn't stop at the doorstep of an organization or company. Especially in our modern, connected and interactive world, products begin another life once they get into service. They become part of an "Experience Ecosystem". The Digital Twin plays a vital role in such an ecosystem. There are key elements that need to be considered on the part of the digital transformation journey towards enabling leadership in such "Experience-driven" ecosystems. A major capability that needs to be enabled to achieve such leadership is "cognitive" behavior and "continuous" engineering throughout the engineering process, lifecycle and the product/system in service. Some supplemental capabilities towards achieving this level include: • IoT (Internet of Things) enablement • Digital Twin capability • Deep learning • Predictive analytics • Scalable communication and compute infrastructure In this presentation we will discuss and define the capability "Digital Twin" as key with its various maturity levels and how it is linked and interacting with the other mentioned supplemental capabilities. The maturity levels will be related to the CMMI (Capability Maturity Model Integration) scale. Detailed explanation of supplemental elements, like deep learning, predictive analytics, Internet of Thing (IoT) and Industrial Internet of Things (IIoT) will be given as well as their links to the other elements of the digital twin maturity model. Those include infrastructure elements, like computing HPC and edge computing for instance) as well as communicating connectivity, like 5G. In addition, the topic of real-time capability will be discussed. We will explain how its maturity is impacting the business maturity from a digital transformation perspective and how this, in turn, is defining the competitive position for businesses.

Speaker Biography:

Mr. Popielas is currently Managing Partner and Co-founder of SMS_ThinkTank. He has over 20 years of global experience in engineering and R&D product and materials development, IP management, as well as testing, with a specific focus on the development and application of simulation tools, and the establishment of the required supporting infrastructure at Dana Holding Corporation. His expertise includes technology exchange and transfer, business assessments in engineering and manufacturing focusing on the virtual aspect, as well as process development and democratization of its application in this area. In Addition, Frank is a member of the NAFEMS Americas Steering Committee since 2011 and became founding chairman of the joint System Modeling and Simulation Working Group (SMSWG) between NAFEMS and INCOSE in 2013 and continues his leading role in the SMSWG as Co-chair since August 2016. He joined the COE organization as volunteer in 2017 and is section chair within the Engineering, Analysis and Simulation Division responsible for CAE and SPDM (Simulation Process and Data Management). His activities and achievements include over 35 granted patents globally on the areas of sealing, shielding and fuel cells, over 30 publications globally covering all the mentioned areas with the focus on the past decade on virtual engineering, its tools and practices, presentations and speaking engagements at conferences and various companies, interviews, case studies and teaching engagements. Mr. Popielas received his

MSc degree in Engineering, majoring in Theoretical Physics from the Technological University (MIS&A – Institute for Steels and Alloys) in Moscow, Russia. Frank is fluent in English, German and Russian.

Presenter Name: Popov, Dmitry

Presenter Company: Skolkovo Institute of Science and Technology

Presentation Title: Structural Optimization of FRep Models and Their Additive Manufacturing (D. Popov, Skolkovo Institute of Science and Technology; Lvl: 2)

Session Title: Additive Manufacturing 2

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 2:30 PM

Type: Presentation

Intended Learning Outcome:

How to perform structural optimization suitable for additive manufacturing with use of function representation of the geometry.

Keywords: structural optimization, topology optimization, FRep, function representation, level set, lattices, additive manufacturing

Abstract:

Modern computer aided design software usually has geometrical kernels developed for computer graphics purposes. Algorithms which could successfully produce high quality pictures met obstacles in modeling of solid objects. The wide-spread boundary representation produces cracks and holes in shapes performing set theoretical operations. One more task challenged widely used geometric kernels is the structural optimization or generative design. Well investigated optimization algorithms, e.g. SIMP, require to perform several conversions of the geometry representation for modeling, optimizing and manufacturing tasks. Most of them require a model to be divided into a number of space portions, which can be added or removed while the algorithm works. However, there is a geometric modeling technique which can be attractive for all mentioned routines. It is a function representation (FRep). First of all, FRep provides an ability to freely parametrize a model. Secondly, this representation guarantees the correctness of a shape for meaningful parameters. This paper contributes with the research on structural optimization of FRep models and authors' experience of 3D printing of optimized parts. The classical compliance minimization problem is considered. Parameters introduced by a designer can be used in the optimization process to satisfy an objective function. Several techniques for lattice modeling and hole nucleation are described. Certain approaches for optimization of FRep models are discussed. Moreover, the work includes a short description of the direct manufacturing approach for FRep. The concept of direct manufacturing is realized and presented with the developed FRep system. It uses procedures for 3D modeling written in C++ language and it is integrated with third party software for producing instructions for a machine controller in an appropriate format. Finally, the obtained results of the mechanical test of a printed part are presented. This test was performed for verifying of the finite element scheme, which was used for optimization procedure.

Speaker Biography:

Dmitry graduated from National Research Nuclear University MEPhI, Faculty of Cybernetics and Information Security, Department of System Analysis. He held a Master's degree with honors in Applied Mathematics and Informatics. He is a Ph.D. student at Skoltech now.

Presenter Name: Pura, James

Presenter Company: MSC Software

Presentation Title: Northrop Grumman Creating a 20-Node Hexahedral Element Model: An Innovative Solution to an Old Problem (J. Pura, MSC Software; Lvl: 2)

Session Title: FEA

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 4:00 PM

Type: Presentation

Intended Learning Outcome:

See how Northrop Grumman Mission Systems uses MSC Apex to speed up their Aerospace hex-meshing workflows.

Keywords: Meshing,Analysis,FEA,FEM,Aerospace

Abstract:

One of the many critical analysis tasks in aircraft design is the evaluation of structural stability, and since the invention of finite element analysis (FEA), engineers around the world have been attempting to do this with as few elements (and thus lowest amount of computational hardware) as possible. One of those “sweet spots” between mathematically accurate results and lowest elements possible is the 20-node hexahedral element. Unfortunately, from a historical perspective, the process required to develop geometry suitable for a hexahedral mesh has been complicated and timeintensive – almost to the point of negating the time saved by faster solutions due to the hexahedral mesh. With the advent of MSC Apex’s hex meshing technological advancements, engineers now have a quick and innovative solution to their structural analysis workflows. Ever since hex meshing was invented, comparisons have been made in many industries as to the accuracy of results between hexahedral elements and tetrahedral elements. Many prefer hex elements because the results are generally more accurate, but sometimes do not use them because of the extra cost (measured in engineering man-hours) needed to create them. Therefore, in certain situations, the accuracy of the simulation is sacrificed in favor of time saved. In certain circumstances, though, a high-quality hexahedral mesh is needed, and extra time is taken to develop this type of mesh in favor of the more accurate result. Northrop Grumman Mission Systems in San Diego, CA is a leading global provider, manufacturer and integrator of advanced, secure and agile software-defined systems and solutions. The analysis group responsible for conducting this comparison commonly works on electronic assemblies & subsystems used in various air and ground applications. The goal of this workflow evaluation was to conduct a 1-to-1 comparison of an already-completed workflow using Patran as the Pre-Processor and MSC Nastran as the solver. This same workflow was then completed using MSC Apex as the Pre-Processor with the same end goal – a successfully solved MSC Nastran finite element model. The comparison metric that was used during this evaluation was the time spent on each step of the pre-processing & solving workflow: 1. Geometric Defeaturing & Preparation for Meshing 2. Mesh Creation 3. Applying Loads & Boundary Conditions 4. Exporting Solver Deck to MSC Nastran (only needed during the MSC Apex comparison workflow) 5. Solving a Normal Modes Analysis using MSC Nastran 6. Solving a Linear Static Analysis using MSC Nastran In summary, this paper describes the successful benchmark and evaluation of a Legacy hex meshing workflow using MSC Apex as a pre-processor to MSC Nastran, and the time savings achieved by implementing MSC Apex into this Northrop Grumman Mission Systems workflow. The two primary goals were to: 1. Simplify the workflow by reducing the number of tools necessary to complete the workflow. 2. Reduce the total amount of time needed to achieve the desired results. Prior to this evaluation, this hex meshing workflow took approximately 18.5 hours. By utilizing the developments available in MSC Apex, this workflow was reduced to less than 8 hours, saving more than 10 hours each time this workflow is completed.

Speaker Biography:

James Pura is the Global Product Marketing Manager for the MSC Apex platform developed by MSC Software. He is a Subject Matter Expert (SME) on CAE and Aerospace simulation methods, and helps customers simulate airplane, spacecraft and launch vehicle applications from initial design, to prototype, to end of the structural lifecycle. James received his Bachelor’s Degree in Mechanical Engineering from the University of California, San Diego specializing in Aerospace Applications. Prior to coming to MSC, James worked a structural dynamics testing

& finite element analysis (FEA) engineer for a number of companies, including Boeing, Space Exploration Technologies (SpaceX), NASA Jet Propulsion Laboratory, and Altair Engineering, where he worked with the Aerospace industry to optimize their structural components for weight and structural integrity. James has been at MSC Software for 6 years now, specializing in the application of Finite Element Analysis (FEA).

Presenter Name: Qin, Yong

Presenter Company: HPC-AI Advisory Council

Presentation Title: The Effect of InfiniBand and In-Network Computing on CAE Simulations (Y. Qin, HPC-AI Advisory Council; Lvl: 3)

Session Title: HPC & Cloud

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 5:00 PM

Type: Presentation

Intended Learning Outcome:

I would like my audience to understand how InfiniBand In-Network computing and network offloads are important for CAE applications performance.

Keywords: InfiniBand, CAE, simulations, in-network, networking, architecture, ANSYS, Fluent, OpenFoam, LS-DYNA

Abstract:

High-performance computing (HPC) technologies are used in the engineering and automotive design and manufacturing industry. One of the applications is the computer-aided engineering (CAE), from component-level design to full analyses such as: crash simulations, structure integrity, thermal management, climate control, modeling, acoustics, and much more. HPC helps drive faster time-to-market, realizing significant cost reductions over laboratory testing and tremendous flexibility. HPC's strength and efficiency depend on the ability to achieve sustained top performance by driving the CPU performance toward its limits. The motivation for high-performance computing has long been its tremendous cost savings and product improvements; the cost of a high-performance compute cluster can be just a fraction of the price of a single crash test for example, and the same cluster can serve as the platform for every test simulation going forward. The recent trends in cluster environments, such as multi-core CPUs, GPUs, and advanced high speed, low latency interconnect with offloading capabilities, are changing the dynamics of cluster-based simulations. Software applications are being reshaped for higher degrees of parallelism and multi-threading, and hardware is being reconfigured to solve new emerging bottlenecks to maintain high scalability and efficiency. Applications like LS-DYNA, ANSYS Fluent, OpenFoam and others are widly used and provide better flexibility, scalability, and efficiency for such simulations, allowing for larger problem sizes and speeding up time to results. CAE Applications relies on Message Passing Interface (MPI), the de-facto messaging library for high performance clusters that is used for node-to-node inter-process communication (IPC). MPI relies on a fast, unified server and storage interconnect to provide low latency and high messaging rate. Performance demands from the cluster interconnect increase exponentially with scale due in part to all-to-all communication patterns. This demand is even more dramatic as simulations involve greater complexity to properly simulate physical model behaviors. In this paper we will focus on the value of In-Network computing for InfiniBand Networks for CAE applications.

Speaker Biography:

Yong Qin is a seasoned High-Performance Computing professional with a vast experience and knowledge on applications performance analysis and tuning, large system architecture design, operation, and cutting-edge technologies. Before joining the HPC Advisory Council, he served as an HPC Consultant at Lawrence Berkeley National Lab and University of California, Berkeley for more than 8 years. Yong Qin received his PhD in Chemical Engineering and a doctoral minor in High Performance Computing from the Pennsylvania State University in 2005, and a MS and BS in Chemical Engineering from Tsinghua University in 2000 and 1997.

Presenter Name: Rakesh, Vineet

Presenter Company: W.L. Gore & Associates

Presentation Title: Modeling Multiphase Flow in the GORE Mercury Control System (V. Rakesh, W.L. Gore & Associates; Lvl: 2)

Session Title: CFD 1

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 11:30 AM

Type: Presentation

Intended Learning Outcome:

Audience will learn about Computational Fluid Dynamics modeling and coupling of different multiphase flow models in STAR-CCM+ and the application of the model in an important industrial process

Keywords: STAR-CCM+, Computational Fluid Dynamics (CFD), Volume of Fluid (VOF), Lagrangian Multiphase Model, Fluid Film Model, mercury removal, design iteration

Abstract:

With increasingly stricter mercury emissions requirements in several countries, effective technologies are critically needed for mercury removal from industrial flue gas. The GORE (TM) Mercury Control System (GMCS) provides a unique technology for elemental and oxidized gas phase mercury removal based on a Sorbent Polymer Catalyst (SPC) composite material while also facilitating sulfur dioxide (SO_2) removal. The GMCS comprises of discrete stackable modules with an open channel structure for chemisorption of mercury from the flue gas to the SPC. SO_2 in the flue gas is converted to sulfuric acid which is expelled from the hydrophobic SPC material to the channel surface, forms droplets, and flows counter-currently to the gas stream back to the scrubber. Additionally, a water rinse system is typically installed above and below the modules to help rinse acid and dust off the module surfaces. To understand these complex multiphase transport processes which can greatly affect the performance of the modules, we developed computational fluid dynamics (CFD) models in Simcenter STAR-CCM+. Volume of Fluid (VOF) method for tracking the air-liquid interface along with the unresolved Fluid Film model was used to model liquid generation and formation and movement of droplets in the flow channel. The model was used to study the influence of operating conditions and surface properties on the liquid flow on the channel surface. To model the rinse process, the VOF and Fluid Film models were further coupled with the Lagrangian multiphase model to incorporate nozzle atomization and droplet impingement. The model was used to investigate the different design variables and estimate the rinse efficiency for different operating conditions to obtain insights for optimizing the system. Results from CFD model provided critical insights difficult to obtain from experimentation such as the prediction of droplet generation, droplet movement and coalescence, and changes in bulk flow due to the generated droplets.

Speaker Biography:

Vineet Rakesh is a Modeling and Simulation R&D Scientist in the Performance Solutions Division at W.L. Gore and Associates, Elkton, MD. He leads the CFD modeling efforts in the division providing expertise to various Gore business units, including filtration, biopharmaceuticals and venting, on new product and process development and material characterization. His current and past work has focused on fundamental physics-based CFD and finite element modeling for multiphysics simulations, including turbulent, multiphase and porous media flow, heat and mass transfer, chemical reactions, fluid-structure interactions, solid mechanics, and electromagnetics. He has published 30+ peer-reviewed journal articles, a book, and 3 patents. Dr. Rakesh received his BS degree from Indian Institute of Technology, Kharagpur, India in 2003 and PhD from Cornell University in 2009. Prior to joining Gore, Dr. Rakesh worked as a Scientist at CFD Research Corporation, Huntsville, AL and at the U.S. Army Medical Research and Materiel Command, Frederick, MD.

Presenter Name: Reimer, Thomas

Presenter Company: Dassault Systemes Deutschland GmbH

Presentation Title: The Future of Performance Design with MBSE Approach Using the Example of an Electric Powertrain (T. Reimer, Dassault Systemes Deutschland GmbH; Lvl: 2)

Session Title: MBE 1

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 2:30 PM

Type: Presentation

Intended Learning Outcome:

How the product design process will change and benefit from utilizing a model based systems engineering approach.

Keywords: MBSE, performance design, product design, electric vehicle, electric powertrain, electric drive

Abstract:

With the increasing complexity of systems, traditional engineering approaches have shown limitations. Until recently, engineers had a lot of knowledge and through their experience and working together there was a lot of interactions and communication and therefore, it resulted in many high-quality products because people knew their boundaries exactly and who to talk to. Today it is more discipline-centric where you know roughly from a previous project the new solution to be developed. The system definition is often limited to defining the system requirements from the marketing or product manager needs and then on to develop the components of the solution. The performances is typically accessed after the design has been done. Product design is becoming increasingly complex these days, we are now in a cyber-physical systems world with software intensive systems, distributed systems, cloud services environment, etc. The intelligence is now not only in the system but also in the surrounding environment with interactions between multiple systems. Model Based Systems Engineering (MBSE) is the state of the art approach to address this complexity and develop high quality products. It addresses the analysis of the problem, prior to the development of the solution, through behavior and structure analysis. One aim of the approach is to define achievable targets that drive the design instead of designing and then assessing performances. Using an electric vehicle powertrain example, we will illustrate how to achieve performance design in the context of a system architecture utilizing a systems engineering methodology called Cyber MagicGrid©. Through this framework we will cover all phases from analyzing the problem, definition of a solution by utilizing trade studies, implementation and assessment of component performance, verification of system performance and validation of the system against stakeholder requirements. This will help to understand how this framework helps to manage the complexity of a development program and thus reduces the risk cost overruns due to late phase re-designs or product recalls due to bad quality products.

Speaker Biography:

Thomas Reimer is a SIMULIA Industry Solutions Manager at Dassault Systèmes, where he works on simulation applications for electric drive engineering. Thomas has an advanced diploma in mechanical engineering and previously worked for Simpack as a Project & Support Engineer for Multi-Body Simulation (automotive, wind, aerospace industries) and as a Product Manager for NVH, User Routines, and Control. Simpack was acquired by Dassault Systèmes in 2014.

Presenter Name: Ricks, Trent

Presenter Company: NASA Glenn Research Center

Presentation Title: Application of the NASA Multiscale Analysis Tool: Multiscale Integration and Interoperability (T. Ricks, NASA Glenn Research Center; Lvl: 1)

Session Title: Multiscale & Multiphysics 5

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 2:00 PM

Type: Presentation

Intended Learning Outcome:

I expect the audience to get a practical feel for how NASA's Multiscale Analysis Tool (NASMAT) could be used to solve relevant engineering problems.

Keywords: multiscale, micromechanics, modeling, composites

Abstract:

The NASA Multiscale Analysis Tool (NASMAT) was developed recently to allow a wide variety of multiscale analysis problems to be effectively and efficiently solved. The architecture of NASMAT was established specifically to enable parallelized, “plug-and-play” functionality, to reduce the complexity associated with adding new features to the code in the future, and to allow end users to rapidly implement and evaluate user-defined capabilities. Additionally, the tool utilizes recursive data structures and subroutines to allow for an arbitrary number of length scales when performing multiscale analyses of heterogeneous materials. These features permit the rapid integration of user-defined capabilities (e.g., a material model, micromechanics approach, or failure theory) at all stages within a NASMAT calculation while leveraging built-in techniques where needed. Additionally, these features allow NASMAT to both be called from an external program as well as call an external program. This presentation will specifically focus on the multiscale integration and interoperability of NASMAT with other analysis techniques and outside analysis codes. Additional details regarding multiscale data storage and visualization are also discussed. In order to demonstrate NASMAT’s multiscale operability, a series of illustrative examples will be presented that focus on the application of NASMAT to practical problems. First, the multiscale integration and data recursion is demonstrated by performing a multiscale analysis using only built-in micromechanics methods. NASMAT’s integration is then highlighted by running a multiscale analysis where an external finite element software calls NASMAT. In this case, at each integration point within the finite element model, a local NASMAT analysis is performed to account for failure behavior at the constituent scale. In a similar example, an external program is called from within NASMAT. This case would be relevant for a user wanting to implement an outside micromechanics technique. A combination of these examples is then presented to further illustrate the code’s flexibility when interfacing with outside codes in a multiscale framework. For all examples, multiscale data is presented using a custom-developed visualization tool. Additional potential use cases are also addressed. Finally, the plan for upcoming features and added capabilities is discussed.

Speaker Biography:

Dr. Trenton M. Ricks is a Research Aerospace Engineer in the Multiscale and Multiphysics Modeling Branch within the Materials and Structures Division at the NASA Glenn Research Center (GRC) in Cleveland, Ohio. Trent joined NASA GRC in 2016 while completing his doctorate degree in Aerospace Engineering at Mississippi State University. His primary research area involves developing methods and software tools for performing multiscale analyses of heterogeneous materials.

Presenter Name: Riha, David

Presenter Company: Southwest Research Institute

Presentation Title: Uncertainty Quantification and Probabilistic Risk Assessment for a Fleet of Layered Pressure Vessels (D. Riha, Southwest Research Institute; Lvl: 2)

Session Title: Verification & Validation 3

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 3:00 PM

Type: Presentation

Intended Learning Outcome:

We expect the audience to learn how stochastic analysis can be used to solve problems in which there are considerable uncertainties and the deterministic solution is too conservative. We will showcase this using a real-world example of work that was under

Keywords: layered pressure vessel, uncertainty quantification, probabilistic risk assessment, finite element model, fracture mechanics, weld residual stress, stochastic analysis

Abstract:

A large effort is underway by the National Aeronautics and Space Administration (NASA) to assess the fitness-for-service of a diverse fleet of nearly 300 aging metallic layered pressure vessels. The vessels in the fleet are located across multiple NASA centers and range from 3-layer to 32-layer vessels. This effort involves a multi-disciplinary team of engineers performing structural analysis and modeling, materials testing, and non-destructive evaluation. The objective of this effort is to understand the relative risk of failure of a vessel due to manufacturing defects and fatigue crack growth of sub-critical flaws as a result of cyclic service loading (pressurization and depressurization of the vessels during service). For many of the vessels in the fleet, a traditional fitness-for-service evaluation is overly conservative because of uncertainties in the material properties, geometry, and stress-state in the vessels. Therefore, uncertainty and variability in the vessels are being quantified and mature models of the stress-state and fracture mechanics response at locations of interest in the vessels are being exercised in a probabilistic framework using the NESSUS® probabilistic analysis software. In the probabilistic framework, inputs to the models are treated as random variables and the models are linked together to predict the cumulative distribution function of the response, analyze the sensitivity of the response to the random variable inputs, and perform a reliability analysis. The primary locations of interest for probabilistic risk assessments of the vessels in this study were the head-to-shell and shell-to-shell circumferential welds and the longitudinal welds. Variability in the predicted stress-state in these regions of the vessels has been shown to be dominated by uncertainty in the weld residual stress field, which was simulated by a sequentially coupled thermo-mechanical finite element model with variation ascribed to the temperature-dependent stress-strain curve and coefficient of thermal expansion of the materials in the model. Another finite element model was used to predict the service stress field due to the applied pressure, and then, via the principal of superposition, the resulting stress field (service stress + weld residual stress) was provided as an input to the NASGRO® fracture mechanics software to predict the fracture mechanics response at the locations of interest. The responses predicted in this study included, the stress intensity factor, critical crack size, critical initial flaw size, and number of cycles to failure for cyclic service loading, which were primarily sensitive to uncertainty in the fracture toughness (KJc) and weld residual stress field. Since some of the ferritic steels used in vessel fabrication could experience cleavage fracture at operating temperatures, this was also accounted for in the stochastic analysis by sampling a distribution of the lowest annual temperature based on the geographic location of the vessel. The probabilistic risk assessments, such as the probability that the stress intensity factor exceeds the fracture toughness of the material for a given crack size, and the predictions of critical crack size and critical initial flaw size are being used to guide non-destructive evaluation requirements and potential development efforts. This presentation will focus on uncertainty quantification and probabilistic methods used in this effort and will provide examples of stochastic analysis that was performed for demonstration vessels in the fleet using the probabilistic framework.

Speaker Biography:

David Riha is a Staff Engineer in the Materials Engineering Department at Southwest Research Institute. He has over 30 years of experience in probabilistic analysis and design, uncertainty quantification, model verification and validation, and algorithm, model, and software development. He applies this experience to applied reliability, uncertainty quantification, and model validation problems for aerospace, automotive, biomedical, petroleum, and defense industries. Currently he is leading efforts in integrated computation materials engineering (ICME) related to aerospace composite part manufacturing, advanced processing for several metal alloys, and fitness for service of aging infrastructures. He has a B.S in aerospace engineering from the University of Texas at Austin and M.S. in mechanical engineering from the University of Texas at San Antonio.

Presenter Name: Rose, Alan

Presenter Company: Corrdesa LLC

Presentation Title: Using Electrochemical Simulation to Both Optimize Alloy Electroplating Plating and Predict the Consequent Impact on Product Corrosion Resistance (A. Rose, Corrdesa LLC; Lvl: 2)

Session Title: Advanced Materials & Multiphysics

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 2:00 PM

Type: Presentation

Intended Learning Outcome:

Attendees will learn how electrochemical simulations can benefit material choice in terms of corrosion resistance as well as being able to optimize the manufacturing processes that enables optimum coating (electroplating) to ensure consistent thickness an

Keywords: Electroplating, corrosion simulation, cathodic protection, alloy coatings, Zinc-Nickel

Abstract:

For decades the aerospace industry have employed cadmium coatings for sacrificial corrosion protection of components fabricated from high-strength steels and aluminum alloys. However, cadmium is toxic and is no longer permitted on many products. Consequently, a substantial effort has been invested in the development, testing, qualifying and implementation of alternative coatings. One alternative for cadmium is zinc-nickel (ZnNi) which is of course an alloy and presents a manufacturing/processing challenge as we now have to control, not only the thickness of the electroplated ZnNi, but also the composition of each element as this is critical to the performance of the resulting sacrificial corrosion protection. So, the electroplating of the ZnNi layer has a significant impact on the life and durability of the finished component. This is particularly important for global industries that have their components coated by many different suppliers, so it is essential for the OEMs to understand how operational differences across the supply chain can affect corrosion and safety of their products – this can now be assessed computationally. It is interesting (and fortunate) that the science of electrochemistry is relevant not only to the assessment of corrosion but also the process of electroplating. Using examples, this paper presents a workflow within a 3D framework that enables a designer to develop a corrosion risk map of a component/sub-assembly as a consequence of not only the material properties and operating environment but also the way in which it will be processed when the electroplated coating is applied. Computational simulation tools have been used for decades in the areas of structures, fluid flow, heat transfer etc. The enabling factor for the utility of these tools is data – it is relatively straight forward to find structural and thermal material data. However, the existence of robust, consistent electrochemical material data is slim, which is a major reason for the slow uptake of electrochemical process modeling such as corrosion, electroplating, etc. Consequently, over recent years protocols for the acquisition of the critical electrochemical data have also been developed, enabling the construction of an electrochemical database for corrosion simulation. Computational corrosion prediction will become a new discipline in the coming years, this paper will introduce some of the science and present initial verification & validation cases.

Speaker Biography:

Dr. Alan Rose as CEO of Corrdesa, works with commercial and military customers, developing software tools and knowledge to enable Corrosion Resistant Design. Alan has over 30 years experience transitioning computational engineering simulation tools into daily, engineering design workflow. In the 1980s, working for British Nuclear Fuels, Alan implemented CFD software as a rigorous and reliable tool for safety engineering analysis. In the 1990s, working with Rolls-Royce Inc and the USAF, Alan acquired laser diagnostic data to develop and validate CFD combustion simulation tools for NoX and soot prediction. In the early 2000s, as an expert witness Alan used CFD in the investigations of freight ship fires, demanding a very rigorous approach to the analysis process. Over the last 15 years Alan has implemented electrochemical simulation into corrosion prediction and scale-up of electrochemical processes used in manufacturing such as electrochemical machining and surface finishing operations such as plating and anodizing.

Presenter Name: Ross, Brant

Presenter Company: MotionPort

Presentation Title: Avoiding the Tipping Point: Using Quad-Physics to Optimize the Conveyance of a Fluid Product in Flexible Packaging (B. Ross, MotionPort; Lvl: 1)

Session Title: Multiscale & Multiphysics 2

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 1:30 PM

Type: Presentation

Intended Learning Outcome:

Participants will learn about the practical considerations of performing multi-physics with many types of physics as well as learn about a real manufacturing system example.

Keywords: particle-based fluid simulation, multibody dynamics, computational fluid dynamics, controls simulation, finite element analysis, system simulation, mechanical system.

Abstract:

The dynamic behavior of a fluid-filled, flexible container transported on a manufacturing line along a conveyor is simulated, with the goal of optimizing the product transport time. The simulation is at the level of quad-physics, meaning that four types of physics are simulated together. The transport of the bottle is simulated with multi-body dynamics. The container (a bottle) is modeled as a flexible structure with the ability to undergo nonlinear deformation. The simulation of the fluid within the bottle is done with a particle-based approach where the fluid momentum effects and sloshing forces on the bottle are accurately accounted for. The effects of a closed-loop, nonlinear controller is included to accomplish the transport in minimal time without approaching the tipping point for the bottle. The behavior of the nonlinear controller is tracked and can be implemented on an open-loop controller to control the actual motion of individual bottles on the transport line. Even a small improvement in the transit time of the product on a conveyor line can lead to substantial cost savings due to the large number of products that are affected. However, the benefits of faster conveyance are quickly negated if the product tips over and requires manual intervention or that the manufacturing line be stopped for a time. Therefore, an extremely high-fidelity simulation is needed (quad-physics) in order to establish that a proper margin exists before the bottle can tip over. Accurate representation of the fluid is needed because the surge during acceleration makes a big difference in the tendency of the bottle to tip. The flexible body is needed for operations where bottles may contact each other or contact guides that prepare them to be boxed. An early application of multi-physics for mechanical systems was fluid-structure interaction (FSI), that combined traditional computational fluid dynamics (CFD) with finite element analysis (FEA). The architectures of some mechanical computer-aided engineering software have evolved with multiple types of physics embedded in the software as well as an open architecture to interface to other types of physics. This enables the advanced and diligent user to include more than two types of physics in sophisticated models and thereby provide useful engineering results that could not previously be calculated. The difficulty of doing a multi-physics simulation depends on the quantity of data being communicated between the different physics engines. The communication can be trivial if a simple actuator is being controlled, but can be complex if many entities in one physics engine interact with many entities from the other physics engine. In the example presented here there are many elements of the flexible body that contact the rigid surface of the conveyor transport. Even much more complex is the interaction between all of the element faces of the inside of the flexible bottle with hundreds of thousands of particles that are used to depict the fluid behavior, including the momentum due to sloshing. Important considerations in performing a quad-physics simulation is to consider the dynamic response of the various physics being simulated and to make sure that the time step of each analysis is appropriate and that the data exchange interval for any co-simulation is frequent enough to avoid numerical instability. The robustness of the quad-physics process can be seen by evaluating the results with a different fluid viscosity, a different bottle stiffness, and different control parameters as compared to the nominal case.

Speaker Biography:

Dr. Brant Ross Company: MotionPort LLC Biography • Ph.D. degree in Mechanical Engineering from Brigham Young University • 7.5 years as an engineer at John Deere and General Motors • 9 years with Mechanical Dynamics (ADAMS multibody dynamics software) Current position / tasks • Founded MotionPort 15 years ago and enjoyed providing the RecurDyn multibody dynamics software and related services to organizations across the USA.

Presenter Name: Roth, Gregory

Presenter Company: Siemens Digital Industries Software

Presentation Title: Why Do My CAE Results Not Correlate with Test Results? (G. Roth, Siemens Digital Industries Software; Lvl: 2)

Session Title: Verification & Validation 1

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 5:00 PM

Type: Presentation

Intended Learning Outcome:

A basic understanding of what contributes to correlation issues between CAE and tests.

Keywords: CAE Correlation Test Statistical

Abstract:

This is an often perplexing issue for most CAE engineers in their career – why did my CAE result not match the test results? There must be something wrong with my model. While that is a possibility, in my career in CAE, the problem has often been attributed to testing conditions and more probable the “as manufactured” part did not represent the CAD model used for CAE. The CAD model that CAE simulations are based on represent the ideal design with no tolerance variations, homogeneous material property distribution, no defects or porosity or cracks – yes it is perfect. Unfortunately, real parts are less than ideal. Often changes are introduced just before release of a design to address manufacturing and assembly issues. Typically, they are considered minor and should have negligible effect on performance – well that is what is hoped. There are numerous examples where slight design deviations can result in substantial performance variation. In one instance, modification of a design radius a few millimeters to allow better casting flow at the foundry resulted in a product not meeting NVH requirements as simulated. When the part was laser scanned and the deviation identified, a new CAE simulation run on the reverse engineered laser scan point cloud identified that the design would not meet the NVH target. In another example, despite frame structure parts not meeting dimensional quality targets, parts were tested and failed. Follow up reverse engineering and CAE simulation indicated the part would not achieve performance objectives. The problem in these instances was not having the “as manufactured” geometry for simulation. Unfortunately, engineering departments cannot be assured the parts being tested will meet the design requirements that were originally simulated. But, the ability to quickly laser scan and reverse engineer these “as manufactured” parts and conduct CAE simulations is critical. This would significantly reduce the risk of running tests on parts that will fail. However, reverse engineering “as manufactured” parts can take a significant amount of time, and typically empirical test can be run faster. Siemens PLM Software has developed a new methodology that automates the reverse engineering of laser scan point clouds and which can be used to generate a new CAE mesh or morph an existing mesh to match the laser scan data. In case studies, this has reduced reverse engineering and CAE time from 1-2 weeks to a couple of hours. Implementing such capabilities can free up CAE resources for other critical tasks, and more importantly quickly assess an “as manufactured” design to ensure it will meet requirements and performance objectives before validation tests.

Speaker Biography:

Not Yet Provided

Presenter Name: Roth, Gregory

Presenter Company: Siemens Digital Industries Software

Presentation Title: Automating CAD to CAE Preprocessing for Parametric Optimization Iterations (G. Roth, Siemens Digital Industries Software; Lvl: 2)

Session Title: Optimization 3

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 12:00 PM

Type: Presentation

Intended Learning Outcome:

Critical automation of CAD to CAE preprocessing functionality to enable large scale parametric optimization studies.

Keywords: CAD CAE Preprocessing Automation Parametric Optimization CAD2CAE

Abstract:

In the current engineering environment, time to market is critical to develop and maintain market share. Not only do products need to be functional, they must achieve mass, cost, manufacturing and complex performance targets. This requires optimization methodologies that utilize CAE simulations extensively. Recent studies indicate that 38% of CAE simulation project time is allocated to preprocessing. This consists of CAD model repair, meshing, contact definition, material properties application, boundary condition and load assignment. Often, this presents a substantial obstacle to quick evaluation of new design proposals. But more importantly, lack of automated CAD2CAE (CAD to CAE) automation presents a substantial obstacle for parametric design optimization tools such as HEEDS. For example, automotive BiW (Body in White) CAE simulations require extensive preprocessing which can take days to weeks to develop the required finite element model (FEM). However, any changes to structure, bolts or welds, require substantial manual CAE preprocessing rework to the mesh, connectors, boundary conditions and loads. This prevents traditional parametric optimization codes from running automated DOEs to generate a response surface of different design configurations. As a result, such labor-intensive CAE models are rarely used in extensive optimization studies. In this new approach, CAD model attributes drive automation protocols in the CAE environment. Mesh density, mesh element type, mesh quality, thickness, mid-plane extraction, spot welds, contact surfaces, boundary conditions and loads are embedded in the CAD model attributes. Upon CAE automation, these attributes are extracted and trigger the necessary CAE preprocessing recipes to ready the model for solution. What would take days to weeks long to manually complete, is contained within hours. More importantly, this allows for more design iterations as the parametric CAD models can be manipulated to resolve performance problems, and quickly re-assessed. Case studies demonstrate that such a process leads to improved product performance and quality. This presentation reviews new methodologies and strategies in use at Siemens Digital Industries Software that automate many critical aspects of CAE preprocessing. Embedding critical information into the CAD model and CAE preprocessing scripts such as metadata and attributes that provide the right level of knowledge that enables automation. New advanced meshing capabilities achieving first time finite element quality targets further enables automated CAD2CAE. Other advanced features such as automated robust mid-plane surface development, spot weld joints, bolted joints, multi-point constraints, contact surface generation, automated load and boundary condition definition are critical contributors within the Siemens PLM NX CAD and Simcenter capabilities to achieve the final goal – automated CAD2CAE. These capabilities have demonstrated reductions in preprocessing time up to 97%. This represents a new frontier in democratizing CAE and enabling optimization for engineering.

Speaker Biography:

Not Yet Provided

Presenter Name: Roth, Gregory

Presenter Company: Siemens Digital Industries Software

Presentation Title: Digital Thread Based Verification Management Solution (G. Roth, Siemens Digital Industries Software; Lvl: 2)

Session Title: Digital Threads & Digital Twins 1

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 12:30 PM

Type: Presentation

Intended Learning Outcome:

How a digital thread based verification management solution can meet the challenges and complexities of new mega trends such as AV/EV/ADAS and emission controls. And streamline product development processes by reducing waste and cost overruns due to undep

Keywords: Verification Management Digital Thread CAE Test Data Traceability Auditability Traceable Auditable

Abstract:

The complexities of new automotive technologies such as AV, EV, ADAS, and emission reduction are resulting in increased regulator and criminal consequences like never seen before. Warranty and recalls are escalating as key product requirements are missed or not verified prior to release. The industry is demanding a strong, traceable, and auditable solution to ensure requirements and product performance are achieved. Siemens' digital thread-based verification management solution ensures all product development and verification processes are synchronized, traceable and auditable. This streamlines product development ensuring that up-to-date information is digitally linked to all verification processes such as CAE and physical testing. As a result, reducing cost overruns, program delays and wasted efforts due to lack of easily accessible critical program information. For example, when a CAE request is submitted, the CAE analyst needs to know the following information: • What are the requirements and targets the design needs to be evaluated against? • Where is the exact CAD model that should evaluated? • What are the corporate and customer CAE procedures, methods, standards? • Is the CAE model already available in another workflow and can be reused? The digital thread-based verification management process addresses this the workflow and related data is managed and provided. The work task is provided via email and inbox which describes the tasks and delivery dates. In the notification, the data objects are provided that when opened have all the information, models, requirements necessary to execute the CAE analysis. CAD models are specifically linked allowing the CAE analyst to download the models directly from the Engineering Bill of Materials in the CAD system. No more guessing which design level is needed. Loads, boundary conditions and requirements/targets are available directly from the central storage site – single source of truth. No more rogue or unauthorized documents to disrupt the simulation process. And after testing is completed, the CAE analyst has direct access to the testing data, as all information, data, documents, files, results are stored and connected in through the verification process. In general, this solution addresses many traditional ailments and mistakes encountered during product development such as: • A centralized point of data access eliminates "hunting" for information in different storage systems that delays programs and introduces errors due to no or missing data. • Everyone in the verification eco-system has direct access to up-to-date product information, requirements, CAD models, CAE and test data/results, etc. • Centralized data access provides a "single source of truth", eliminating uncontrolled documents and information that generate confusion and wasted time. • Ensures the correct CAD design revision is referenced for CAE simulation, part manufacturing/ordering and testing. • Provides direct access to the CAD engineering bill of material (BOM) for viewing, CAE model development, test fixture development, part manufacturing/ordering. • All verification models, files, results and raw data are stored and linked throughout the process providing easy access for all engineering and management roles. This helps address one of the traditional problems accessing physical test results for CAE correlation. • Digital thread links meet traceability requirements for audits, regulatory compliance, and legal exploratory procedures. • Requirements, CAE, and test results can be tracked down even years later to support warranty and field failure investigations. • Incorporates workflow tasks, stage gates, and checkpoints to ensure consistency and integrity throughout the verification process. This state-of-the-art web-based HTML 5 solution offers a lightweight global solution that integrates into any product development process.

Speaker Biography:

Greg Roth is the Director of Automotive and Transportation Solutions in the Industries Group at Siemens Digital Industries Software. Previously, Mr. Roth held positions at Ford Motor Company, Eaton Corporation and Amcor Packaging. More recently, he was Chief Engineer for the CAE and NVH departments at ZF-TRW Automotive North America Braking Systems in Livonia, Michigan. In his current role, he champions CAD, CAE & PLM technologies and processes for companies at a global enterprise level achieving substantial reductions in product development costs and time while improving overall quality. Mr. Roth holds an M.S. in Mechanical Engineering from the University of Michigan, an M.S. in Electronics and Computer Controls Engineering from Wayne State University and a B.S. in Mechanical Engineering from Michigan State University.

Presenter Name: Roudier, Thierry

Presenter Company: E-Sim Solutions

Presentation Title: Real-Time Structural Integrity Evaluation Combining Digital Twin, Instrumentation and Finite Element Simulation (T. Roudier, E-Sim Solutions; Lvl: 2)

Session Title: Digital Threads & Digital Twins 1

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 12:00 PM

Type: Presentation

Intended Learning Outcome:

The audience will learn how we can combine real time instrumentation with simulation to improve models design.

Keywords: digital twin, co-simulation, finite element analysis, real time, instrumentation

Abstract:

Digital twins and finite element calculations are frequently used to do predictive simulation of structural integrity and service life estimations. These simulations are based on estimated load cases that is assumed to represent the ultimate loads that the structure may be subject to. However, the real load history that a structure is subjected to, may be very different than the estimations. In some cases, a critical part whose service life is estimated by duration in service may not be solicited as often as predicted. This is a case of unnecessary early replacement of a part. The contrary would result, however, in safety issues. If a part is more solicited by an aggressive use, the service life may be a lot shorter than the predicted one. In such cases, a real-time evaluation of structural integrity with a continuous feedback to the user may prevent damages, accidents and in some cases life losses. This paper presents a technology demonstration where a digital twin is analysed real-time, using measured loads acting on a simple structure. The applied true loads are obtained using a limited number of sensors and the digital twin is continuously analyzed with recorded loads. The finite element analysis is used to compare the deformed shape to analysis results as a validation method. The stress history of the studied part is continuously fed to a simultaneous fatigue analysis where the load cycle counting using rainflow technique is updated. The user is provided with a simplified interface with two important information: Ratio of applied load to load capacity and estimated remaining service life. The approach is also innovative thanks to powerful co-simulation platforms allowing native interoperability between simulated components and real-time instrumentation. Using co-simulation through a collaborative solution provides a generic approach enabling the engineering teams to setup their own simulation environment, using different types of solvers and simulation engines. Such a platform makes easier the integration of models with different levels of maturity/complexity and promotes better integration with MBSE methodology.

Speaker Biography:

Entrepreneur, R&D manager, Thierry Roudier has a wide experience in systems engineering, modeling and simulation of systems, with in-depth knowledge of engineering domains interoperability, simulation methods and tools. He is the founder of E-Sim Solutions Inc a Canadian company providing software solutions and professional services in modeling and simulation. From its industrial experience in numerical simulation, and in software interoperability, he designed in collaboration with industrial partners the InSystemLab solution, a collaborative co-simulation platform for multi-disciplines simulation. Thierry has an engineering degree in Industrial Computing and Instrumentation with a specialty in microelectronics from Polytech'Grenoble, and a DEA (diploma of advanced studies) in Signal processing from Grenoble INP.

Presenter Name: Salman, Laila

Presenter Company: ANSYS Canada Ltd.

Presentation Title: Assembly Consolidation in Additively Manufactured Waveguides (L. Salman, ANSYS Canada Ltd.; Lvl: 2)

Session Title: Additive Manufacturing 2

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 2:00 PM

Type: Presentation

Intended Learning Outcome:

Audience will have better understanding on how to use simulation techniques to optimize their RF designs towards additive manufacturing process. This is where CAE based support generation tools can be well utilized to find the optimum build time while min

Keywords: Additive Manufacturing, microwave monolithic WR51 component, 3-D metal printing ,Assembly Consolidation

Abstract:

Recently, powder-bed fusion metal Additive Manufacturing (AM) process has matured as a breakthrough technology for the development of RF and microwave components such as waveguides, filters as well as antennas. This enabling technology has the potential and flexibility to build any shape components that conventional machining can rather be complex or not possible to use. Additive Manufacturing or 3D Printing will play key role in the future of microwave and millimeter wave applications' manufacturing processes. It will allow the exploration of unique and optimized designs of parts as well as assembly consolidation. Today, AM is highly anticipated as a standard manufacturing technology that can be widely utilized in large number of industrial applications including medical implants and disposable surgical instruments to aerospace forming equipment. As a result, AM has gained popularity offering engineers and designers the capability of building customized and optimized designs with enhanced RF, thermal and mechanical performance. The presented work illustrates the use of multi-physics simulation techniques in the design and optimization of an RF waveguide assembly that integrates three RF functionalities including bending, twisting and filtering sections operating in Ku/K-Band. The monolithic WR51 component was additively manufactured [1]. The consolidated, multi RF-functional, mechanical part was measured with respect to individual conventional waveguide components. Measurements assured the unique features that AM can offer with 3-D metal printing in the miniaturization and integration of waveguide systems as well as material mass reduction which certainly justifies the adoption of this technology in building RF space components and satellite communication systems. The demonstrated workflow can be generalized to wide variety of radio frequency applications such as phased array antennas with complex feeding networks or multi-beam active antenna array with polarizers, filters, couplers and power dividers. Moreover, the same workflow can significantly accelerate the development process of high throughput satellite communication systems with multibeam architecture and large feed chains while reducing the form-factor and the losses at the same time. The process simulation methodologies for the selective laser sintering presented in this work allows for reduced waste and build time while maintaining adequate support structure during the manufacturing of the component. Additionally, coupling with thermal-structural FEA simulation capabilities can be done to capture relative thermal losses and their effect on the high frequency performance. While the monolithic component offers significantly small form factor, flexibility of AM allows further weight reduction through topology optimization techniques. This is important in satellite communications technology where any reduction in payload weight is considered advantageous. Several optimized design approaches are shown with relevant merits. The combined twisting, filtering and bending functions in the single component creates internal surfaces at varying angles to the build direction. Internal support requirements can generate additional postprocessing challenges. This is where CAE based support generation tools can be well utilized to find the optimum build time while minimizing the distortion tendencies and the support volume. Once the optimum supports and build orientations are obtained, a coupled thermal-structural FEA simulation can be used to simulate the AM build process and estimate the residual stresses in the build for a specific build orientation and support strategy. [1] Pevereni O A, Lumia M, Paonessa F, Virone G,

Calignano F, Cattano G, Manfredi D, IEEE TRANSACTIONS ON MICROWAVE THEORY AND TECHNIQUES, VOL. 66, NO. 5, MAY 2018.

Speaker Biography:

• Dr. Laila Salman received the B.S. and M.S. degrees in electronics and communication engineering from Cairo University, Egypt, and the PhD. Degree in electromagnetic and antenna design from the University of Mississippi. • She also worked as a post-doctoral student at the Université de Quebec en Outaouais, Gatineau, Canada till 2010. Her research was on dielectric resonator antennas, wearable antennas, microwave and millimeter-wave circuits and systems, microwave imaging for early detection of breast cancer and scattering from left-handed metamaterials. • Dr. Salman joined Ansys Canada Ltd. in August 2010 as a Lead Technical Services Specialist for High Frequency Applications.

Presenter Name: Salman, Laila

Presenter Company: ANSYS Canada Ltd.

Presentation Title: Design Challenges of Millimeter-Wave Beam-Steered Phased Array Transceiver for 5G Applications (L. Salman, ANSYS Canada Ltd.; Lvl: 2)

Session Title: Electromagnetics & Electrostatics

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 5:00 PM

Type: Presentation

Intended Learning Outcome:

This talk will give a very well description of the design workflow that engineers may follow to design a complete transceiver chain for 5G applications starting from the design of steered phased array antenna @ 28GHz to full 3D implementation of the assoc

Keywords: millimeter-wave, 5G, beam-steered phased array antenna, electro-thermal analysis, linked budget analysis, circuit co-simulation

Abstract:

The 5th generation (5G) mobile networks promise a revolution in the way we connect. With faster data transfer and the capacity to support a higher density of users, 5G is expected to offer high speed internet, high definition video streaming, efficiency and real time connectivity to IoT enabled devices, thus promising ubiquitous connectivity at three times the speed of 4G. Additionally, mm-wave communication has become one of the most attractive techniques for 5G systems implementation since it has the potential to achieve these requirements and enable multi-Gbps throughput. With that in mind, beam-steerable high gain phased array antenna design is the key component for 5G cellular systems since that will directly influence the capacity of cellular networks by enhancing the signal to interference ratio (SIR) using narrow transmit beams that will offer sufficient signal power at the receiver terminal at larger distance in urban environments. Several antenna array configurations were investigated for 5G applications such as patch antennas, printed microstrip antennas as well as cylindrical conformal microstrip antennas. Recently, its been studied that 5G systems can use adaptive beamforming antenna arrays by enabling the technology of multi-user massive MIMO which can achieve more efficient usage of the radiated power. The presented work demonstrates a realistic design of 4x4 mm-wave planar phased-array antenna for 5G communication. Each element is connected to a phase shifter that build up the total array-beam which steers the antenna via constructive or destructive interference. The goal is to install the modeled array on a car and allow vehicle to everything (V2X) communication with installed street wireless infrastructure. Link budget analysis of the antennas in their installed environments using appropriate RF propagation models and standards-based radio libraries is illustrated to assess the quality of service for the system in the presence of other potentially interfering wireless systems. Design workflow for 5G phased-array transceiver implementation at 28GHz is proposed in this work where both 3D full wave implementation of the antenna array and the feeding network associated with it as well as circuit co-simulation with the rest of the transceiver chain including power amplifier (PA) , low noise amplifier (LNA), switch and phase shifters are well-presented to enable engineers and antenna designers uncover different design aspects. Several design challenges occur at this high frequency band due to the integration of physical and circuit-based models from various manufacturing technologies. It is crucial to understand the coupling between these mm-wave components and overcome any undesired interference. The resulted cross-talk, coupling and isolation plots were obtained to anticipate possible degradation in the output signal quality that results into interference and distortion of channel performance. Finally, authors will be looking into the electro-thermal design aspect for the complete design chain to explore the thermal stability of miniature wireless assemblies to ensure that the entire system conforms to its expected behavior. Such power-hungry applications with various environmental conditions can cause swings in device temperatures, leading to thermal cycling effects. Thus, its very important to assess the electronics-thermal management aspects of the overall system design. The presented multi-solution platform leverages high-performance computing that can be deployed across the enterprise, allowing designers and engineering experts to collaborate more effectively.

Speaker Biography:

• Dr. Laila Salman received the B.S. and M.S. degrees in electronics and communication engineering from Cairo University, Egypt, and the PhD. Degree in electromagnetic and antenna design from the University of Mississippi. • She also worked as a post-doctoral student at the Université de Quebec en Outaouais, Gatineau, Canada till 2010. Her research was on dielectric resonator antennas, wearable antennas, microwave and millimeter-wave circuits and systems, microwave imaging for early detection of breast cancer and scattering from left-handed metamaterials. • Dr. Salman joined Ansys Canada Ltd. in August 2010 as a Lead Technical Services Specialist for High Frequency Applications.

Presenter Name: Sami, Muhammad

Presenter Company: ANSYS Inc.

Presentation Title: On Simulating Liquid Atomization Processes with High Fidelity and Speed (M. Sami, ANSYS Inc.; Lvl: 3)

Session Title: CFD 2

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 2:00 PM

Type: Presentation

Intended Learning Outcome:

The attendees will learn the state of the art in automating the best practices in modeling physical processes that govern the formation of sprays and droplets.

Keywords: Sprays Modeling VOF DPM HPC SMD PSD Best-Practices Automation

Abstract:

Liquid atomization is a necessary technique used in several industrial processes for a variety of reasons. The atomization nozzles are designed to maximize the efficiency of the process based on the objective at hand. The shape and atomization techniques vary across the board and it has become important to bring in sophisticated analysis tools to ensure the design meets the expected performance with least cost and reduced time to market. In achieving this goal, research and development departments are turning to Computational Fluid Dynamics to model complex internal nozzle hydrodynamics that includes resolving of multiple flow scales, cavitation, liquid/gas interface instabilities and liquid and gas compressibility. The modelling of these processes has been an active area of research for many decades. Currently, with high-performance computing , we have now reached a state where simulating complex atomization models is becoming more mainstream, evident by the increasing number of researchers in academics and engineers in industry running these detailed simulations. This paper summarizes our experience with such detailed simulation of liquid atomization. ANSYS, Inc. has developed a hybrid model that combines the volume-of-fluid (VOF) model with the discrete-phase model (DPM) in Fluent 2020R1 to provide an efficient and robust tool to model primary atomization processes. This has been tested on several applications such as Simplex Nozzles, jet in cross flow (gas turbine applications) and impinging jets. There are several physical models and solver settings that make an impact on the fidelity and efficiency of the simulation. We describe the components of the integrated VOF-to-DPM model transition setup and present results from several simulations. Such simulations require robust modelling of turbulence, interface tracking, mesh adaption, model transition and parallel scalability. The purpose of this paper is to highlight key steps in the simulation and to provide guidance to others in setting up such simulations.

Speaker Biography:

Currently a Principal Application Engineer, I have been working with ANSYS (formerly Fluent Inc.) since 2001 on a variety of engineering projects in all branches of industry. Earned a PhD in Mechanical Engineering from Texas A&M University, College Station, Texas in 2000. Since 2010, focus has been on oil and gas industry. Actively working on projects in the multi-phase, chemical reactions and user-defined code development in ANSYS FLUENT in addition to regular support of enterprise level accounts. Currently working on modeling the UVC Disinfection process in relation to COVID-19. Have written more than 70 papers in journals and conferences.

Presenter Name: Sarkar, Saurabh

Presenter Company: ESSS

Presentation Title: Combined DEM and FEA Approach for Process Simulation of Granular Media (S. Sarkar, ESSS; Lvl: 2)

Session Title: FEA

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 4:30 PM

Type: Presentation

Intended Learning Outcome:

Presentation for DEM-FEM coupling for powder compaction

Keywords: multiphysics, DEM-FEA coupling, powder compaction

Abstract:

As applications of computational methods to product development and manufacturing simulations mature, the demand for more accurate modeling of nonlinear material has steadily increased. The present work shows such a solution with a multiscale modeling approach for design and manufacturing applications involving granular media. With increases in computing capabilities, there has been an exponential increase in usage of Discrete Element Method (DEM) for gaining dynamic insight for applications involving bulk solids. Fundamentally, DEM is suitable for low strain problems where the particle deformations are very small with respect to the particle size. So, while applications involving free surface flows like mixing, breakage, drying, coating, fluidized beds and etc. are very common, large strain problems like powder compaction remain a challenge for DEM. But compaction of granular media is an important process with applications to a broad spectrum of industries, namely food, chemical, geotechnical and pharmaceutical industries. Common examples include compression of multicomponent mixture of fine powders to manufacture pharmaceutical tablets, or compression of soil under varying moisture conditions. In practice, process understanding and optimization for such applications is driven by experimentation which often involves significant expenditure of time and material resources. From a modeling perspective, the existing simulation methodologies attempt to model the material behavior with continuum methods like Finite Element Analysis (FEA). These approaches rely on constitutive laws such as the Drucker Prager class of material models, and are reasonably effective in capturing the material behavior when the degree of compaction is high - typical to the finished product state. However, these simulation techniques typically assume homogeneous initial conditions for the material properties such as density and zero initial stress conditions. Also, the existing FEA methodologies are not able to simulate the manufacturing process during which the material may have low compaction granular behavior, and the continuum methods are inapplicable. The presentation will discuss a multiscale modeling technique where DEM simulates the initial stages of granular material compaction. Once the material compaction reaches a high degree as determined by the density of the material, density and the material state (stress, strain) are transferred as initial conditions to an FEA model. This continuum level simulation may address further compaction and/or operational loads on a finished product. Mapping properties from the DEM model into material properties and stress conditions are critical to the success of this approach. We discuss the challenges and practical considerations of the combined DEM+FEA approach as applied to a pharmaceutical application. The general methodology is valid for other applications in food, chemical and geotechnical industries.

Speaker Biography:

Dr. Saurabh Sarkar is an Applications Engineer for the Rocky DEM Business Unit within ESSS for past 3 years. Prior to joining ESSS, Dr. Sarkar worked at Sunovion Pharmaceuticals where he supported drug formulation and process development activities. He also held an Adjunct Faculty appointment at Rutgers University. He obtained his undergraduate degree from Delhi University, and Ph.D. from the University of Connecticut in 2015; both in Pharmaceutical Sciences. His doctoral work at UConn was focused on understanding mesoscale effects in granular flows to optimize different pharmaceutical unit operations using DEM and CFD tools in collaboration with a number of industrial and government collaborators. He has authored multiple research publications, is a Senior member at AIChE and serves as an expert reviewer for several journals.

Presenter Name: Saunders, Robert

Presenter Company: Naval Research Laboratory

Presentation Title: Towards High Throughput Simulations of Microstructure Mechanical Behavior in the AM Process (R. Saunders, Naval Research Laboratory; Lvl: 2)

Session Title: Additive Manufacturing 2

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 3:00 PM

Type: Presentation

Intended Learning Outcome:

Methods to best generate representative volume elements for using in a machine learning framework.

Keywords: crystal plasticity, high throughput, microstructure, AM, RVE

Abstract:

Metal Additive Manufacturing (AM) typically produces microstructures with a texture and columnar grain structure. This results in a mechanical behavior that is different from steels produced by conventional techniques. In a previous work, a grain size and shape dependent crystal plasticity constitutive model was developed and implemented. The model developed has the capability to predict the mechanical behavior of microstructure representative volume elements (RVEs). However, a single simulation can take on the order of hours or days even using high performance computing systems. Thus, using the developed model/method is infeasible if a large dataset is desired or needed. In this work, the number of grains in the RVE along with mesh resolution and element type will be varied to determine how simulation runtime and accuracy are effected. A baseline RVE with approximately 300 grains, 10-node tetrahedral elements, and approximately 700k degrees of freedom is first analyzed. Next, RVEs with statistically equivalent properties (e.g. grain size and shape distribution) are constructed with varying numbers of grains from 30 up to the baseline case. A sampling of the constructed RVEs will be taken and of those selected, the mesh resolution and element type will be varied. The element type will be varied between hexahedral and tetrahedral, where the hexahedral mesh will be structured and the tetrahedral, unstructured. The degrees of freedom in each mesh will be varied from 100k up to the baseline of 700k. Aspects of mesh resolution, element type, and RVE characteristics have all individually been studied but, typically, the goal is to determine the minimum requirements that yield the highest accuracy with the lowest simulation time. Additionally, it is well and understood that the unstructured mesh with the largest number of degrees of freedom will be the most accurate in assessing both the volume averaged stress in the grain and in the whole RVE. Here, we seek an RVE that has approximately the same mechanical behavior as the most accurate case but having the smallest number of grains and degrees of freedom, therefore, the lowest computational cost. By taking this approach, the accuracy of the model will be purposefully decreased in favor of lower computational times, which enables the ability to generate a larger dataset. The introduced errors will be kept relatively small and will be resolved later through statistical and machine learning techniques such as multi-fidelity surrogate modeling.

Speaker Biography:

Robert is a mechanical engineer at the U.S. Naval Research Laboratory in Washington D.C. He has interests in mechanics of materials, additive manufacturing, and machine learning.

Presenter Name: Sederberg, Matthew

Presenter Company: Coreform LLC

Presentation Title: Using Spline-Based Structural Simulation for Higher Accuracy and Faster Computation Speed (M. Sederberg, Coreform LLC; Lvl: 1)

Session Title: FEA

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 5:00 PM

Type: Presentation

Intended Learning Outcome:

Attendees at this presentation will come away with an understanding of what spline-based simulation is and an appreciation of the fundamental improvement it might make to the simulation industry. They will also understand the current maturity of the techn

Keywords: FEA, spline-based simulation, isogeometric analysis,

Abstract:

A new highly accurate and performant approach to finite element analysis (FEA) is to run simulations directly on smooth splines, the building blocks of computer-aided design (CAD) models. Thousands of academic papers have been published since 2005 investigating this new approach, and many significant advantages over traditional FEA have been reported. Recent applied research has shown that spline-based analysis promises game-changing industry benefits over traditional finite element analysis, including higher accuracy, greater robustness, and increased computational efficiency. These benefits are especially pronounced when running engineering simulations where high accuracy in the shape description is of great value, such as for contact or fatigue simulations. The implications to practical engineering design scenarios are profound. The use of smooth splines for finite element analysis is a more efficient discretization method than using traditional FEA meshes. One of the reasons for this is that spline-based analysis employs the same functions that describe the geometry of the computational domain, while traditional FEA meshes are only an approximation of the geometry. The creation of analysis-suitable geometry using smooth splines is less time consuming, while the process for creating faceted meshes is often laborious and error-prone. Additionally, spines generally can represent the same geometry as FEA with significantly fewer elements, decreasing the time required to run the simulation. This presentation will discuss the business and technical motivations for using spline-based simulation. Examples of how spline-based simulation can be integrated into commercial processes will be discussed, as well as an overview of how a number of industries are benefiting from spline-based simulation tools. We will also discuss the current research frontiers of spline-based simulation. Attendees at this presentation will come away with an understanding of what spline-based simulation is and an appreciation of the fundamental improvement it might make to the simulation industry. They will also understand the current maturity of the technology and how they can access the technology today.

Speaker Biography:

Not Yet Provided

Presenter Name: Seidensticker, David

Presenter Company: MSC Software

Presentation Title: Integrating Analysis with a Model-Based Feature Information Network (MFIN) (D. Seidensticker, MSC Software; Lvl: 1)

Session Title: MBE 1

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 2:00 PM

Type: Presentation

Intended Learning Outcome:

Significant advantages are gained by a product throughout its lifecycle by integrating analysis into a Model-Based Feature Information Network (MFIN), which enables direct sharing of data between different engineering groups.

Keywords: MFIN, Analysis Automation, Analysis Integration, Product support, MxD, DMDII

Abstract:

Analysis engineers perform Computer-Aided Analysis (CAE) within the broader context of product design, manufacturing, and support. All the actors are highly interdependent, but connecting the design model and the material properties database to the finite element model (FEM) is typically a manual process assigned to the analyst, who gathers disparate inputs from other team members and incorporates them into the FEM. Similarly, once analysis is finished and the stress report is complete, manufacturing and support engineers must seek out the results from the analyst or a library of data, whether stored physically or electronically. They must then sift out the pieces of information that are relevant to their task, such as assessing nonconformances or designing repairs. There are opportunities for disconnects on both ends of this operation, and the sharing of data is a relatively labor-intensive operation. To address this challenge, a Model-Based Feature Information Network (MFIN) was implemented by a diverse team of participants under the direction of MxD (formerly DMDII—Digital Manufacturing and Design Innovation Institute) as part of project 15-11-08. This project seeks to fill the industry need for a way to meaningfully capture and connect product information at the CAD feature level across all the various domains of manufacturing. Participating team members included end-users, technology providers, and leaders in academia, and the concept reflects the latest thinking on how MBE can be implemented effectively across multiple domains including Design, Analysis, Manufacturing, Quality, and MRO. The MFIN provides a conduit for the flow of information throughout the product lifecycle by establishing a data model and methodology for implementing Model-Based Enterprise (MBE) in a modern manufacturing environment. MFIN encourages process systematization and automation that allows manufacturers to create products faster with greater repeatable quality at lower costs. It also provides data traceability to enable meaningful advanced industrial data analytics, as well as to enable systematization and automation of business logic associated with manufacturing operations. The integration of the FEM analysis into the MFIN framework will be shown here. This includes description of the mechanisms for passing geometry and material properties into multiple CAE software platforms and automatically creating associations between model features and the materials. After analysis is complete, the generation of standard results for review and consumption by other software will be demonstrated.

Speaker Biography:

Biography for David Seidensticker (MSC Software) • M.S. in Engineering Mechanics from Penn State University in 1989 • 11 Years as a structural engineer at McDonnell Douglas and Boeing in St Louis o Assignments included National Aero-Space Plane along with other research and development programs o Provided user support for structural analysis software o Developed custom analytical software Current position / tasks • Has been working nearly 20 years as a consulting engineer in the MSC Software services group, with assignments including o Customizing software for customers to automate existing tools and processes o Consulting on advanced analysis projects using MSC FEA tools o Providing on-site software training to MSC customers

Presenter Name: Semler, Christian

Presenter Company: MAYA HTT

Presentation Title: Development of a Real-Time Engine Temperature Monitoring System, Using AI Based on Accurate and Validated Thermal Simulation Data (C. Semler, MAYA HTT; Lvl: 2)

Session Title: AI-Guided Simulation

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 4:30 PM

Type: Presentation

Intended Learning Outcome:

Understand the implementation and applicability of an approach for real-time monitoring of temperatures of engines using AI (artificial intelligence), based on accurate and validated simulation data

Keywords: Artificial Intelligence, AI, thermal, simulation, virtual sensor

Abstract:

In the context of global warming, highly competitive markets, and usage of multiple sources of energy, it becomes more and more important to optimize the operation of gas turbine power plants. This means that starts and stops of those engines become more and more frequent. On the other hand, engine manufacturers provide the operators conservative guidelines on how long to let the engine cool down before starting a new cycle, to ensure temperatures do not exceed certain thresholds. While stationary components of the engine can be monitored easily, it is very difficult and expensive, if not impossible, to monitor the temperature of some rotating parts which determine the engine conditions (cold / warm / hot). Those temperatures are critical to predict clearances, and have potentially a significant impact on the life span of the engine. The goal of this paper is to present an approach for real-time monitoring of these internal temperatures using AI, based on accurate and validated simulation data. More specifically: a) Siemens Simcenter 3D Thermal is used to build a complete representation of the whole engine through the use of thousands of separate boundary conditions that adequately represent the transient behavior of the whole engine. Those boundary conditions represent the flow conditions, in various regimes, for a range of rotational speeds and in different sections of the engine. They make use of built-in thermal correlations, of “expressions” that can automatically access specific model data (e.g., fluid temperature, material properties, solve-time computed results, rotational speed or radius), or of proprietary correlations obtained from in-house measurements, experience or CFD. b) This “digital twin” is validated against experimental data where scaling factors on the boundary conditions are used to obtain very precise thermal predictions. c) “Virtual sensors” are created at specific locations that need to be monitored in real-time during operations and that cannot be instrumented easily. d) Machine learning (ML) algorithms and reduced order techniques are used to correlate the temperature time-response of those virtual sensors against real physical sensors where temperature can be easily monitored. Since the response is encapsulated in a much reduced set, it runs very fast compared to the digital twin. e) The time response of the virtual sensors could then be implemented “on the edge” in a real-time data acquisition system that instruments the engine. The advantage of the method is that it is general enough to quickly create engine-specific virtual sensors while taking into account all of the specific physical characteristics of the engine (fluid temperatures, mass flow rates, engine operating conditions, thermal inertia, etc.). This method will be illustrated on a real engine for demonstration purposes.

Speaker Biography:

Chris Blake has worked at MAYA HTT for 12 years. As an Application Engineer and later as Manager of Engineering Services, he engaged with clients from numerous industries - aerospace, automotive, high-tech electronics, and AEC/HVAC - to define their simulation requirements, and execute thermal/CFD analyses to optimize their designs. As a Senior Solutions Architect, he managed large custom software development and PLM deployment projects, in order to make companies more efficient and effective. Now, as Director of New Product Development, he explores new technologies, such as Building Information Modelling, Cloud-Based Simulation, and Artificial Intelligence/Machine Learning – evaluating technological readiness, go-to-market strategy, and industry applicability. Chris holds a Bachelor’s degree in Systems Design Engineering from the University of Waterloo and a Master’s degree in Mechanical Engineering from McGill University (https://www.linkedin.com/in/cmblake/) Sven

Holmes has worked at Ansaldo Energia Switzerland for almost 20 years. He has held various positions: Secondary Air Flow Engineer, Seal Technology Team Leader, Project Manager Future Gas Turbine Technology, Team Leader Thermals, Group Lead Mechanical Integrity and is now the Tools & Technology Manager. He has a vast experience in gas turbine industry and in numerical simulation. Sven holds a Master's degree in Mechanical Engineering from RWTH Aachen University (https://www.linkedin.com/in/sven-olmes-15041974/) Christian Semler has joined Maya in 2018 as the Thermal-Flow product manager. He has over 25 experience in engineering and in numerical simulations. He holds a Master and a Ph.D. in Fluid-Structure Interaction and Nonlinear Dynamics from McGill University (https://www.linkedin.com/in/csemlerstg/)

Presenter Name: Shi, Yunfei

Presenter Company: Dassault Systèmes SIMULIA Corp

Presentation Title: An Integrated Workflow for Modeling Fiber-Reinforced Plastics with Multiscale Material Models (Y. Shi, Dassault Systèmes SIMULIA Corp; Lvl: 2)

Session Title: Multiscale & Multiphysics 3

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 4:00 PM

Type: Presentation

Intended Learning Outcome:

For companies that design injection molded plastics, how to use multiscale modeling and simulations to improve product quality, reduce development time and costs, increase productivity, and accelerate innovation.

Keywords: Multiscale material, plastic injection molding, fiber reinforcement, simulation-driven design, process integration, automation

Abstract:

Plastic materials are used everywhere in our daily life for many good qualities, including light weight, low cost, durability, corrosion resistance, manufacturing versatility, and aesthetics. The usage of engineered plastics in the automotive industry has been trending up, with over 50% of the car interior now made of plastics. This is an inherited requirement of modern car designs for higher fuel efficiency and less carbon footprint. On the other hand, how to reduce plastic wastes and pollutions has become a pressing global challenge, which requires simulation-driven smart designs. To increase the plastic strength and durability, chopped fibers are often added to the resin as stiffeners when plastic parts are injection molded. The mechanical properties of fiber-reinforced plastics (FRPs) often exhibit strong anisotropy and temperature-dependency, which largely depend on how fibers are oriented during thermal setting. When the injection gates and runner system are not carefully designed, manufacturing defects such as weld lines, air traps, and even short shots can be introduced and become weakness spots. If the part is not properly cooled down before being ejected out of the mold, the thermal expansion effect can give rise to significant residual stress and cause severe part warpage. These issues pose unique challenges to the design and manufacturing of FRPs. The mean-field homogenization (MFH) method has been proven an effective and computationally efficient approach for characterizing the mechanical behaviors of FRPs. By taking account of individual constituents' material properties as well as the volume fractions, shapes, and orientation of the fibers, complex nonlinear material behaviors at the macroscopic level can be accurately characterized to predict structural behaviors under thermomechanical loads and assess potential risks of fatigue and failure. Instead of costly physical testing and experiments, injection molding simulation can provide accurate predictions of the fiber orientation distribution, ejection temperature, and residual stresses used for the MFH. However, the current industry process lacks an integrated end-to-end solution. In order to complete this process, various design and simulation tools are often required with manual data management across different platforms, adding unnecessary development time and costs. To solve this industry challenge, an integrated workflow has recently been developed for modeling the FRPs with MFH method-based multiscale models. This workflow includes part and mold design, plastic injection molding simulation, and structural simulation, integrated through process automation. The plastic injection simulation results including fiber orientation distributions were used in the subsequent structural simulation for accurate characterization of material behaviors. The effects of part thickness and locations of injection gates on the structural warpage, stiffness, and strength were studied to achieve an optimal design. A simulation template was reused for the verification of design variants. This integrated workflow can help improve product quality, reduce development time and costs, and achieve more sustainable and eco-friendly plastic designs.

Speaker Biography:

Dr. Yunfei Shi is an R&D Technical Manager at Dassault Systèmes SIMULIA, responsible for managing the High-Tech Customer Strategic Partnerships in SIMULIA. He joined SIMULIA R&D in 2014. Since then, he has worked on various strategic initiatives, including Virtual Human Modeling, Super Large-scale Simulation, Electric Drive, and Multiscale

Modeling. Prior to that, he received his Ph.D. degree in Biomedical Engineering from Washington University and his M.S. and B.S. degrees in Engineering Mechanics from Tsinghua University.

Presenter Name: Shrimali, Amruta

Presenter Company: John Deere India Pvt Ltd

Presentation Title: Calculation of Rolling Resistance for Off-Road Vehicles and Its Impact on Real Time Energy Simulations (A. Shrimali, John Deere India Pvt Ltd; Lvl: 2)

Session Title: Systems Modeling & Simulation

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 11:30 AM

Type: Presentation

Intended Learning Outcome:

Vehicle system level simulations are a step towards simulation led design and optimization.

Keywords: Energy Management, System simulation, Vehicle performance, Rolling resistance

Abstract:

Vehicle Energy Management (VEM) simulations play key role in prediction of System level energy performance and energy contribution of each subsystem during any event. Tire-road interaction plays crucial role in driving the actual power consumption of vehicle. This is so, due to dynamic behavior of tire material when each tread gets loaded (comes into contact with ground) and unloaded (loses contact with ground). The rolling resistance between tire-ground also directly affects fuel consumption of vehicle. Slight change in rolling resistance significantly impacts power consumption. Also, this makes virtual simulation deviate a lot from physical world. Thus, calculation of rolling resistance is very critical for good correlation. Rolling resistance depends on various factors such as load, vehicle velocity and ambient conditions. One of the conventional approaches to estimate the rolling resistance is by trial and error method. This paper proposes a scientific approach for calculation of rolling resistance coefficient for various off-road events. It is clear that the rate of tire tread being loaded and unloaded depends on forward vehicle velocity. Also, vertical weight on the tire directly impacts on the shape and size of contact patch area. Thus, rolling resistance being offered at high load is more. A new methodology has been developed to calculate 'rolling resistance coefficient' for various duty cycles in which vehicle forward velocity and vertical load are varying. This methodology has been virtually verified for field and transport events of an off-road vehicle and excellent correlation (around 90%) has been achieved with test data. Standardization of this process is a key milestone towards predicting performance of upcoming off-road machines for various terrains and vehicle system level parameters. This study is a step towards modeling real time vehicle dynamic phenomenon accurately and making sound design decisions based upon results achieved. Further scope of this study is to optimize hydraulic subsystems based upon subsystem level performance. This will lead to performance improvement at vehicle level significantly. With this method, huge cost involved in testing and efforts will be minimized with added advantage of reusability and modular architecture. Evaluation of various technological advances at subsystem level can be appropriately compared with available options using vehicle energy management thought process. Also, optimization objectives such as better gradeability, improved traction, reduced fuel consumption and emissions can be achieved with this methodology.

Speaker Biography:

Amruta Shrimali (27) Amruta Shrimali is a Senior Engineer (Mechanical) with experience in systems simulation of hydraulic and mechanical systems for the American corporation John Deere that manufactures agricultural, construction, and forestry machinery, diesel engines, drivetrains used in heavy equipment, and lawn care equipment. The company develops and sells products and services to support those linked to the land. As a Senior Engineer, she is responsible for modelling and analyze various dynamic systems for off road vehicles. Amruta Shrimali has B. Tech in Mechanical Engineering from Walchand College of Engineering, Sangli, India (2014) and M. Tech in Mechanical Design Engineering from Indian Institute of Technology Bombay, India (2019).

Presenter Name: Sigmen, Yannick

Presenter Company: MAYA HTT

Presentation Title: Electro-Mechanical Collaboration for Board-Level Thermal Analysis: An Integrated Approach for Design Optimization (Y. Sigmen, MAYA HTT; Lvl: 1)

Session Title: Multiscale & Multiphysics 1

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 11:30 AM

Type: Presentation

Intended Learning Outcome:

Simulation driven design approach for mutli-displinary PCB design teams with the following advantages: how to exchange design accurately and how to collaborate efficiently during the design cycle.

Keywords: CAD/CAE Integration, PCB Design, Thermal Simulation, Electronics, Optimization, ECAD/MCAD collaboration

Abstract:

One of the most fundamental issues in electronics design is to properly cool the Printed Circuit Board (PCB) assembly. Miniaturization of modern electronics and ever-increasing complexity requires thermal management to improve reliability and maximize electrical performance. Combined with faster development cycle, earlier and more frequent simulation results are required to drive design decisions in order to avoid costly prototypes or respins. A simulation driven design approach requires efficient collaboration across the multi-disciplinary team and sufficient integration across the design tools for passing design information. The exchange of design information is generally initiated from the electronic domain. The PCB layout designed within the Electrical CAD software needs to be exchanged with the Mechanical CAD application, where it translates into a 3D assembly model. To get accurate results, board geometry, component geometries and positions as well as the PCB stack-up layers are required to construct a model on which different heat transfer mechanisms may need to be considered: conduction, convection or radiation. Based on the environment conditions surrounding the PCB, constraints or boundary conditions are applied to the model before solving the model solution. Although all three representations (ECAD, MCAD and CAE) must be accurate, it is common to make additional simplifications to the geometry for the simulation, like filtering passive components that have little impact on the simulation result. During this collaboration across multiple stakeholders, data synchronization between electrical and mechanical environments is often an issue as ECAD and MCAD use two sets of tools, with very different capabilities. If changes are made to the component placement or copper connections in the layout, the modifications must propagate to the 3D assembly model. The same changes must then propagate as well to the simulation model to match. If the layout changes are well identified, an update to the simulation model may be required. In a worse-case scenario, the changes are not well understood or too important, and it requires the complete recreation of the simulation model. This effort is time-consuming and error prone, considering multiple iterations can happen during the design cycle. In this session, we will evaluate different approaches of integration between electrical, mechanical and thermal engineers, using a thermal management use case from the medical industry. The objective is to provide an integrated approach in terms of modeling associativity, team collaboration as well as design synchronization for a complete typical workflow encountered in the industry for multi-disciplinary PCB design teams. We will demonstrate an efficient exchange process between ECAD/MCAD and show how PCB thermal simulations can be optimized based electrical and mechanical constraints.

Speaker Biography:

Yannick Sigmen is a Product Manager at Maya HTT and is responsible for the development of new and existing ECAD/MCAD solutions that can meet the next generation of electro-mechanical design challenges. Having experience in electronic product design in different industries (medical, automotive, space and avionics), his technical expertise extends from substrate design to advanced assembly techniques and design for manufacturing.

Presenter Name: Silva, Luis

Presenter Company: Western Michigan University

Presentation Title: Geometrical Effects On Residual Stress and Distortion In Metal AM (L. Silva, Western Michigan University; Lvl: 1)

Session Title: Additive Manufacturing 2

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 1:30 PM

Type: Presentation

Intended Learning Outcome:

Effects of evolving material porosity and geometry feature sensitivity on residual stresses and deformation in SLS additive manufacturing

Keywords: selective laser sintering simulation, multiscale mechanics, evolving material properties, geometry sensitivity

Abstract:

Advancements in metal additive manufacturing have made it a viable solution for the rapid prototyping and manufacturing of complex structures. However, the associated part deformation may cause unacceptable dimensional deviations and the accompanying residual stresses may cause premature failure or otherwise weaken the overall structure. Such stresses occur due primarily to large temperature gradients in the additive manufacturing processes such as selective laser sintering (SLS). An accurate and computationally efficient prediction of these effects is desirable for part geometry optimization that incorporates the manufacturing process. The proposed manuscript will model the particle nature and the micro-structure of the metal powder using the generalized method of cells (GMC) coupled with time-dependent thermo-mechanical finite element methods. This coupling will occur via user subroutines to a finite element software. The generalized method of cells is capable of accounting for many material constitutive relationships, including visco-elasto-plastic models (Bednarcyk, 2002). In addition, the effects of geometrical features on residual stresses and deformations will be studied. Subsequently, experimental validation studies on the simulation results will be conducted. It is expected that the discontinuities due to a geometrical feature, the particle-to-particle interaction, and the evolving micro-structure impact the overall part deformation and residual stresses. The generalized method of cells uses a repeating unit cell to represent the micro-structural domain of the heterogeneous material or composite. Each repeating unit cell can then have sub-cells that may represent different phases or materials in a composite. The computed stress and strain of each sub-cell can then be used to compute the effective homogenized response (stress/strain, thermal/mechanical material properties) of the repeating unit cell (Aboudi, 2012). These effective properties will be used as the constitutive model in the FE simulation, effectively cascading the micro-structural response onto the macro-scale. The unique contributions to be reported in the manuscript include the effects of an evolving porosity on residual stresses and deformations. In addition, this work will demonstrate how basic geometrical features affect the residual stresses in SLS 3D printing. The trends with the additional geometrical features will be studied in this manuscript. This work will be a segment in a larger project aimed at minimizing the residual stresses and deformations in additive manufacturing.

Speaker Biography:

Originally from Mexico, Luis Silva is currently working on a masters' degree in mechanical engineering at Western Michigan University. He obtained a bachelor's degree in mechanical engineering with a minor in computer science in 2017. Before attending college, Luis spent his younger years helping his father fix the family's vehicles, appliances, and the occasional broken phone along with tinkering with the family's computer. This large curiosity and interests have led him into several projects as a research assistant in areas such as electronics, internal combustion engines, biomechanics, and additive manufacturing.

Presenter Name: Stupplebeen, Rob

Presenter Company: Optimal Device

Presentation Title: Simulation is Childs Play, Broken Toys Aren't (R. Stupplebeen, Optimal Device; Lvl: 2)

Session Title: Multiscale & Multiphysics 3

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 4:30 PM

Type: Presentation

Intended Learning Outcome:

Multiphysics modeling: injection molding, FEA with contact and shape optimization.

Keywords: Multiphysics modeling, injection molding, FEA with contact, shape optimization, 3DExperience, Abaqus, Catia, Simpoe, Tosca

Abstract:

This is a case study of multiple knit line failures on the popular fidget spinner toy. This toy's geometry has been reverse engineered to create suitable geometry for a variety of simulations and redesigns. From an injection molding standpoint, the three lobed design, with 4 holes allow for a deceptively difficult molding problem. Knit lines are inevitable but where should the gates be located and where will the knit likes be located? Injection molding simulation is used to investigate a variety of gate locations and the use of multiple gates. Once the molding technique has been selected what can be done to maximize the strength of the part without deviating too far from the iconic design? Finite element analysis is performed to simulate the stresses induced through press fitting of the bearings. The simulation was carried out by having the bearings in place using contact with removing overclosures. This method is more computationally efficient than pressing the bearing in which would include sliding contact. The bearing insertion causes hoop stresses in each lobe. These stresses put the knit lines in tension which causes part failure. We will assume that the locations and sizes of the bearings are fixed and the outside diameter for ergonomic reasons. This sets the allowable design space for the redesign. Shape optimization was then used to evolve the design to maximize strength and stiffness while minimizing weight and cost. The locations of the knit lines were assigned material properties of reduced strength. Redesigning the geometry will modify the mold flow and the knit line locations causing an iterative feedback loop which can be handled with either a coupled or sequential workflow. In this study multiple simulation tools were used to reverse engineer the root causes for the product failure. These failures could have been predicted and designed around allowing for a more robust product and avoiding product failures. Most importantly broken toys could be avoided! us

Speaker Biography:

Rob Stupplebeen's LinkedIn tagline is: Redesigning the Human Body 1 Medical Device at a Time. Rob's calling is to put simulation and optimization at the heart of medical device design enabling truly customized medicine. Rob owns Optimal Device an engineering consulting/mentoring/training firm that is also a reseller for Dassault Systèms featuring products such as: Abaqus, Catia and the 3DExperience platform.

Presenter Name: Sundaresh, Keshav

Presenter Company: Altair Engineering, Inc.

Presentation Title: Integrated Multi-disciplinary System Simulation with Streamlined Coupling Between FEA, Motion, DEM and Controls (K. Sundaresh, Altair Engineering, Inc.; Lvl: 2)

Session Title: Multibody

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 5:00 PM

Type: Presentation

Intended Learning Outcome:

Attendees will learn how to create realistic system models that accurately predict vehicle motion, track & soil interactions and controller behavior for an unlimited set of maneuvers with a (virtual) system integration approach.

Keywords: Multibody Dynamics, Discreet Element

Abstract:

Optimizing performance of any electromechanical system requires the ability to accurately capture the dynamics of the interactions between different domains including Multi-body Dynamics, Discrete Element Method, Finite Element Analysis, and Controls & System Simulation. For instance, to accurately predict the mobility of off-road vehicles on soft terrains requires a combined system simulation approach between the electromechanical system, soil, tire, driveline and steering control systems as illustrated in the image below. Accurately accounting for varied soil types to understand soil-machine interactions can accelerate the development electromechanical systems and optimize in-service operation. This presentation will demonstrate a unique co-simulation approach for high-fidelity product development combining: 1. Bulk material modeling where the number of particles and contacts is not limited 2. Large-scale motion where the number of parts is not limited 3. Flexible Multi-body Dynamics model coupled with DEM for accurate loads and stresses on the equipment 4. Time domain simulation of the system that couples the Multi-body, FEA, Controls and DEM effects

Speaker Biography:

Keshav Sundaresh is the Global Director of Smart Systems, Mechatronics & Robotics with over 15 years of experience in the Multi-body Dynamics and Math & System Simulation domains. In this role, he’s responsible for technical thought leadership and driving the development of coupled software solution offerings to support the development of smart products and electromechanical systems for clients.

Presenter Name: Szarazi, Jerome

Presenter Company: Digitalweavers

Presentation Title: Using Machine Readable Physics for Simulation Governance and Democratization (J. Szarazi, Digitalweavers; Lvl: 1)

Session Title: Simulation Governance 1

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 11:30 AM

Type: Presentation

Intended Learning Outcome:

Audience will learn about machine readable physics, a graph model that captures modelling assumptions transparently and understand how this helps with simulation governance and democratisation

Keywords: simulation governance, simulation democratisation, machine readable physics, solvers

Abstract:

Space-time simulation (STS) is useful across the product lifecycle: to support iterative design processes, evaluate possible manufacturing processes and account for them in designs, and predict service life-times from sensor data recorded in digital twins. STS is cost-efficient and time-saving compared to physical prototype testing. Furthermore, STS can predict costs of material design choices, evaluate whether designs meet requirements, and determine whether safety regulatory margin constraints are satisfied. However, STS faces at least two challenges: 1. Model complexity limits broader usage across manufacturing organizations (simulation democratization) 2. Lack of reliable STS results put decisions at risk if not properly managed (simulation governance). Interoperability is key to improving simulation democratization and governance by helping determine when models from multiple vendors are equivalent based on a simplifying abstraction of simulation (interchange parts for simulation). Such an abstraction would reduce complexity of usage (democratization) and facilitate communication about simulation across organizations (governance). Mathematical equations are a simplifying abstraction, but are not as accessible to humans and machines as graph-based formalisms, e.g., as used in time-only dependent models such as power-coupled Kirchhoff network (e.g. Modelica, Simscape), signal-coupled network (e.g., Simulink), bond-graphs (e.g., 20sim). There is currently no formal and widely adopted model abstraction for STS. In this work, we apply machine-readable physics (MRP) from previous work, an approach that represents physical laws as computational graphs instead of equations, making them readable by humans as well as machines. Our methodology using MRP captures decisions in layers of models that apply physical laws to engineering problems and prepare them for numerical simulation. The objective of this model-based approach is to 1. Democratize simulation by representing these decisions in a simple and traceable way, documenting the simulation development process and making it reusable on multiple engineering projects. It also enables the same models to be translated to multiple software tools, we well as creation of domain-dependent library models by linking them to existing STS numerical solvers. 2. Aid simulation governance by enabling simulation models to be assessed for applicability to specific engineering problems (currently unreliable due to proprietary model descriptions), especially when multiple software packages are used, e.g, in OEM-suppliers relationships. We will review MRP and the methodology around it, explaining how it simplifies simulation development and management as compared to current practice. We will also describe an ongoing implementation of storing and accessing these models, and integrating them with domain-dependent solvers.

Speaker Biography:

Not Yet Provided

Presenter Name: Tabaddor, Mahmood

Presenter Company: Underwriters Laboratories Inc

Presentation Title: A New CFD Based Fire Risk Metric for Refrigerant Leakage Scenarios (M. Tabaddor, Underwriters Laboratories Inc; Lvl: 2)

Session Title: CFD 1

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 12:00 PM

Type: Presentation

Intended Learning Outcome:

How modeling can help generate safety risk insights not available from physical testing

Keywords: CFD, Fire, Refrigerant

Abstract:

An overall effort to reduce the greenhouse warming potential of refrigerants for refrigeration systems in the US has shortened the overall candidate list to a class of refrigerants that exhibit higher flammability than their predecessors. This has required investigations to ensure that the potential fire/explosion hazards associated with leakage of a flammable refrigerant are properly addressed and mitigated. The main means to gaining this understanding has been through physical testing. However, there is a challenge and a limit to using physical testing to thoroughly understand the potential risks associated with leakage of a combustible refrigerant in confined spaces. The challenge is that physical testing, especially if it could involve fire and explosion, is expensive and time consuming. Each test is a single data point and so many tests must be run which requires significant funding. Yet, it is another limit of physical testing that is most problematic. For a physical test, it is only possible to capture data at discreet points. These discrete points are usually selected to address the specific question the test was designed to answer and so the data collected may not provide sufficient overall insight into the testing conditions under consideration or allow for generalization. The intent of our research is to demonstrate two things (1) strong validation evidence for a computational fluid dynamics based simulation of refrigerant leakage in gaseous form in a confined space. We show the value of physical testing be designed to help advance the use of computational modeling tools. We also cover the key physics necessary to accurately model gaseous refrigerant leakage scenarios. And, (2) we present a new risk metric for assessing the fire/explosion hazards associated with leakage of refrigerant into a confined space. This metric can only be obtained from the rich data provided by such computer-based engineering tools such as computational fluid dynamics.

Speaker Biography:

Mahmood Tabaddor is the Manager for the Predictive Modeling and Analytics Team at UL. He is a member of ASME V&V 50 and a member of the NAFEMS Americas Steering Committee.

Presenter Name: Teller, Sean

Presenter Company: Veryst Engineering LLC

Presentation Title: Impact Testing and Constitutive Modeling of PC for Failure Modeling (S. Teller, Veryst Engineering LLC; Lvl: 3)

Session Title: Crash, Impact & Shock

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 4:30 PM

Type: Presentation

Intended Learning Outcome:

High strain rate testing methods and advanced polymer modeling techniques.

Keywords: Impact, Constitutive Modeling, explicit, Polymers, viscoplasticity

Abstract:

Thermoplastic polymers are often used in impact protection applications in consumer products, athletic protection, manufacturing, aerospace applications, and the automotive industry. Engineers select thermoplastics due to their light weight, high strength, and significant energy dissipation during loading and unloading events. Accurate design for energy dissipation and impact protection during impact events requires advanced, high strain rate testing methods, advanced constitutive models, and material modeling techniques to characterize and capture the mechanical behavior for finite element modeling. This is complicated by the complex, non-linear, viscoplastic behavior of polymers. Veryst Engineering has developed high strain rate testing techniques for advanced constitutive modeling of all polymers. We will present a study on the high strain rate testing and constitutive modeling of an impact modified polycarbonate (PC) material. We test the PC over 6 decades of strain rate in tension, compression, and shear, then calibrate the Three Network Viscoplastic (TNV) constitutive model to the data using MCalibration®. The TNV model is an advanced, viscoplastic material model that incorporates rate effects, pressure dependent yield, and damage to capture the complex behavior of thermoplastics, elastomers, and other polymers. Thermoplastics typically exhibit pressure dependent failure that is characterized by the stress triaxiality at the failure point. This pressure dependence makes accurate failure modeling of material difficult and requires extra tests at different stress triaxialities. We test the material to failure at quasi-static rates at multiple stress triaxialities to capture this pressure dependent failure behavior of the material. We use an inverse calibration method with finite element models of the tests to calibrate the failure model. We then use the calibrated constitutive model in an explicit FE simulation in an impact scenario, and discuss the consequences of the choices in testing and material modeling. An accurate pressure dependent failure model has great consequence on accurate product simulation and accurate failure predictions.

Speaker Biography:

Dr. Sean Teller is a Senior Engineer at Veryst Engineering. Dr. Teller has extensive experience in the mechanical behavior of materials at low and high strain rates, including viscoelasticity, viscoplasticity, nonlinear materials, and fracture mechanics. His interests include designing, performing, and interpreting experimental data to characterize and model materials for simulation.

Presenter Name: Topich, Jim

Presenter Company: Kinetic Vision

Presentation Title: Dynamic CT and Opportunities for Advancement of Validated Modeling & Simulation (J. Topich, Kinetic Vision; Lvl: 3)

Session Title: Innovative Applications

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 2:30 PM

Type: Presentation

Intended Learning Outcome:

This presentation will focus on showing the stochastic development of modeling & simulation, and the integration of static CT and dynamic 4D CT scanning to validate complex product performance models.

Keywords: Dynamic scanning, modeling & simulation, validated Modeling, CT, computed tomography, X-Ray, geometries, CT boundary conditions, 3-D imaging, 4-D imaging

Abstract:

Advancements in modeling & simulation have been accelerating over the past three decades and have largely focused on replicating real-world object behavior. With the integration of Industrial CT, modeling & simulation has adapted to incorporate actual object dimensionality and physics affecting a product's quality and performance. New apparatuses are being integrated to provide real-time, dynamic CT scanning yielding behavioral geometries and deformations collected during the X-Ray process. In the past, static CT Scans have provided physical specimen validation and input for modeling & simulation. Dynamic scanning allows for expanded validation and input metrics across the modeling & simulation spectrum, with the addition of time based interpretation. This presentation will focus on showing the continual development of modeling & simulation, and the integration of static CT and dynamic 4D CT scanning to validate complex product performance models. The presentation will include illustrative examples from several industries. Topics will include: 1. Development of modeling & simulation validation using CT data This will provide an overview of the previous improvements to modeling & simulation when CT data was introduced to help validate models that sought to replicate real world physics. The focus is on the efficient use of modeling & simulation to mitigate the need for large-sample physical testing. This will include a comparison of simulation results using different measurement modalities. 2. Introduction of CT scanning methodologies and their use cases This section will focus on the current state-of-the-art fixtures used in conjunction with CT scanning to provide data validation across single dimensions. Dimensions to be reviewed include: fluids, thermal, linear, rotational, and vacuum/pressure. Examples will be provided to illustrate the incorporation of single variable scanning data into modeling & simulation data sets. 3. Development of fixtures for dynamic scanning to assess product behavior To capture in-motion, real-time 4D scanning data, new dynamic fixturing was engineered and deployed. Results will be presented and analysis shared on the efficacy of the data validation models. Further, it will show comparatives to physical testing modalities and illustrate the benefits over strictly physical testing alone. 4. Opportunities for utilization of enriched data This section offers opportunities to augment current physical testing and virtual model data sets with 4D data. This data acts as an extension of physical testing to increase the value of already existing data to produce a more enriched data lake to help drive predictive modeling efforts. 5. Limitations and opportunities of 4D dynamic behavioral modeling & simulation This will discuss the near and long term development limitations of the technology, as well as cost implications for 4D validated models. Also reviewed will be the advanced tools and capabilities that are anticipated to intersect with this technology in the near-term. 6. Summary and questions The speed of concept-to-market is rapidly increasing, with higher demands on faster and better product testing, inspection, and analysis. The presentation concludes that dynamic 4D behavioral scanning can not only significantly improve the validation of advanced simulation, it can also help drive better efficiency and accuracy in the production and evaluation process.

Speaker Biography:

Jim Topich is the Senior Vice President of Kinetic Vision, supporting engineering operations and business development for the company. He has served on Kinetic Vision's Senior Leadership Team for over 7 years. He has more than 20 years of experience focused on product and process development and is widely regarded as an industry leader actively incorporating imaging and CT data along with modeling and simulation in unique ways to help customers in the retail, biomedical, aerospace, automotive, and consumer packaging industries.

Presenter Name: Tyrus, Jason

Presenter Company: Dana Holding Corporation

Presentation Title: Utilizing SPDM to Democratize Complex Design Analysis and Generate Data Trends (J. Tyrus, Dana Holding Corporation; Lvl: 2)

Session Title: Data Management 1

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 11:30 AM

Type: Presentation

Intended Learning Outcome:

Democratization of CAE workflows

Keywords: SPDM, Democratize, Data, Engineering Analysis, Optimization. DOE, Process Management, Data Management, FEA, CAE

Abstract:

In order to increase the value of simulation process and data management (SPDM) to users and realize the full potential of a SPDM system, it must be used effectively to democratize complex simulation processes and generate data trends for easier decision-making. Automation in templates to quickly generate searchable data and meaningful data trends is key to democratizing repetitive time-consuming processes and achieving buy-in from reluctant users. With expected fast turnaround times and rapid product design cycles, design optimization is typically run as a manual process on a selective basis without doing an organized study of important variables; however, developing user-friendly guided workflows incorporating automation for complex simulations greatly reduces setup and post-processing time, thereby allowing detailed studies to be run more frequently and effectively. Using this methodology, design optimization can be expanded to include more variables and parameters to quickly generate organized data for effective decision-making. In addition, product simulation processes can be utilized to evaluate material and manufacturing limits, thereby resulting in more robust product design. Since more variables and parameters can be included in optimization studies along with material and manufacturing limits, the benefits and trade-offs of design changes can be thoroughly studied by using tools such as Results Analytics to rank alternative design variations and show data trends to reach an optimized design before building physical prototypes. The current focus at Dana is to utilize SPDM capabilities to develop and deploy simple guided workflows that utilize automation to generate searchable data such that it can be quickly compiled to show data trends and aid in the decision-making process, thereby giving expected value to users while improving product design and evaluation. In this presentation, examples of democratizing simulation processes to generate meaningful data trends for decision-making are shown in the context of some of Dana's key product lines.

Speaker Biography:

Jason Tyrus is a Senior CAE Engineer at Dana Incorporated. He is part of the Power Technologies group, working on design analysis and optimization of sealing products for automotive and heavy-duty applications. He also leads the Dana Simulation Process and Data Management methods developer group. He received the Master of Science degree in mechanical and aerospace engineering and the Bachelor of Science degree in mechanical engineering from Illinois Institute of Technology in Chicago, IL, as well as the Bachelor of Arts degree in engineering science from Benedictine University in Lisle, IL.

Presenter Name: Tzolas, Nikos

Presenter Company: BETA CAE Systems SA

Presentation Title: A Complete Framework for DOE Studies in Occupant Protection (N. Tzolas, BETA CAE Systems SA; Lvl: 3)

Session Title: Optimization 1

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 3:00 PM

Type: Presentation

Intended Learning Outcome:

How a DOE study for Occupant Safety can be setup and how results can be evaluated

Keywords: Occupant safety, DOE, optimization, dummy positioning, occupant injury results,

Abstract:

A complete framework for DOE Studies in Occupant protection. Among the most important studies during a vehicle's design process are those of its performance in several regulated and proprietary Crash Test simulation scenarios. Particularly, the simulation studies for the safety of vehicle's occupants are of prominent importance. To achieve the highest possible standards of occupant safety, engineers pursue to improve the safety features of vehicles by simulating a wide range of crash scenario. In each scenario different factors affect the occupant injury results and the most effective way to identify these factors is to perform design of experiments (DOE) studies. DOE studies can be used to optimize the vehicle's structure, in order to direct the force of a crash away from the occupants, and for the optimization of the restraint systems. For the second case many different properties of the restraint systems (seat-belt and airbag), of the seat and of the coupling between them and the Anthropomorphic Test Device (ATD) can be used as design variables to examine the injury results on the ATD. The seating configurations of the future autonomous vehicles will add more design variables in such DOE studies. The position of the seat with respect to the driving direction along with the inclination of the seat will have to be studied. In this paper a DOE study, for calculating the injury results variation of a Hybrid III 50th ATD in a front impact sled test, is demonstrated. This analysis carried out with the Optimization Tool of BETA CAE Systems' ANSA pre- processor, and LS-DYNA. META post- processor was used to extract automatically all responses (injury peak values and time history curves). The friction between the ATD and the seat, between the ATD and the seat-belt and the actual position of the ATD are used as the design variables.

Speaker Biography:

Studied at Technological Educational Institution of Thessaly from 2000 to 2005 Working at BETA CAE Systems S.A. from 2008 until now

Presenter Name: Vlahinos, Andreas

Presenter Company: Advanced Engineering Solutions LLC

Presentation Title: Techniques for Generating and Simulating Lattice Structures (A. Vlahinos, Advanced Engineering Solutions LLC; Lvl: 2)

Session Title: Generative Design 1

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 11:30 AM

Type: Presentation

Intended Learning Outcome:

The audience will learn the recent capabilities of modern Lattice Structure Generation and Generative Design software tools and get a pictorial overview of a taxonomy of lattice structures

Keywords: Lattice Structures, Generative Design, Additive Manufacturing

Abstract:

The additive manufacturing (AM) industry continues to grow with new machines, faster processes and a large selection of materials. Lattice structures are used by nature and they are very effective for lightweight structural panels, energy absorption devices, thermal insulation, high performance heat exchangers, ballistic protection and porous implants. Design practitioners are now enabled to unleash the full potential of AM with the use of Lattice structures. A Taxonomy of Lattice Structures and an overview of the currently available generation techniques for on surface (i.e. triangle), 2 ½ D (i.e. honeycomb), 3D beam (i.e. Diamond, Octet) and 3D shell (i.e. Gyroid, Lidinoid) lattice structures will be presented. Modern CAD and CAE tools can design, optimize and validate lattice structures' performance. Since this all capability is available within integrated CAD and CAE environments, the designer reduces the product development time and increases confidence in the design. For small number of the lattice structures a full geometry representation is sufficient for modeling and simulation. For medium number of lattice structures a simplified representation (beams and shells) is required. For large number of lattice structures a homogenization workflow is required. A demonstration of these techniques will be presented. A technique that explores the effectiveness of a typical lattice structure using the Geometric Efficiency Index will be also presented. The Geometric Efficiency Index is the ratio of stiffness reduction over the mass reduction. This technique uses homogenization to compute the Geometric Efficiency Index and enables the designer to select the most efficient lattice structure cell for the demand. The Topology Optimization Process is used to reduce weight, maintain strength and improve thermal performance in 3D Printed Designs. The main bottleneck in this process was the conversion of topology optimization results back to CAD geometry. This presentation will demonstrate how to combine Sub-Divisional surface modeling, Topology Optimization and Lattice Structure generation tools to generate optimum designs. Examples of light weighting helicopter components using lattice structures and Additive Manufacturing will be presented.

Speaker Biography:

Not Yet Provided

Presenter Name: Vlahinos, Maiki

Presenter Company: nTopology

Presentation Title: Additively Manufactured High Performance Heat Exchangers (M. Vlahinos, nTopology; Lvl: 2)

Session Title: Generative Design 1

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 11:00 AM

Type: Presentation

Intended Learning Outcome:

Demonstrate how minimal surface structures can revolutionize the heat exchanger industry through the integration geometry generated by implicit kernels while utilizing traditional CAE and CFD tools.

Keywords: gyroid, heat exchanger

Abstract:

Recent advances in implicit geometry modeling are enabling design engineers to have complete control over geometry and develop complex periodic structures; that when coupled with advanced manufacturing techniques provide the opportunity to greatly increase performance in heat exchange applications. Specifically, triply periodic minimal surfaces, such as the gyroid, have several advantages. They can separate an otherwise single domain volume into two different and independent yet continuous regions. These periodic structures inherently provide a large surface for the minimum amount of material within a defined boundary. They smoothly intermingle the two independent regions, the cold and hot fluid domains, maximizing the surface area contact while reducing pressure drop within the fluid passages. Lastly, the gyroid and other minimal surface lattices do not require any support structures during the additive manufacturing process. Together, these unique geometry characteristics make minimal surface topologies ideal for enclosed volumetric infills for not only improving the thermal performance of heat exchangers but light-weighting the unit as well. Coupled with advances in additive layer manufacturing, improved additive materials can aid in the increased performance of a heat exchanger. Specifically, the use of cutting edge high strength aluminum alloys enable thinner walls that maximize heat transfer and increase fluid volume while maintaining the ability of the heat exchanger to meet structural integrity requirements. The improved thermal capacity and heat transfer of a heat exchanger with a triply periodic minimal surface structure internal to the heat exchanger structure will be demonstrated. This presentation will include documentation of the design process, iterations, analysis tools and results of integrating advanced CAD, CAE, and CFD tools used to design, validate, and manufacture a representative fuel cooled oil cooler for aerospace applications. Learning Objectives Demonstrate how triply periodic minimal surface structures can greatly enhance heat exchanger performance through the use of an advanced implicit geometry kernel in conjunction with traditional CAE and CFD tools.

Speaker Biography:

Maiki Vlahinos is a Senior Application Engineer at nTopology with a primary focus in the Aerospace and Defense industries. He brings nearly a decade of CAE expertise in CAD, FEA and CFD to the nTopology team. His work, Thermal Performance of Minimal Surface Heat Exchangers, was most recently presented at the SIM-AM 2019 conference in Pavia, Italy and featured analysis performed in ANSYS CFX and Discovery Live.

Presenter Name: Walker, Ken

Presenter Company: MSC Software

Presentation Title: Open Data Formats in Commercial FEA Software (K. Walker, MSC Software; Lvl: 2)

Session Title: Data Management 2

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 1:30 PM

Type: Presentation

Intended Learning Outcome:

Advantages of open (non-proprietary) data formats and APIs in analysis workflows.

Keywords: HDF5, Nastran, Patran, Apex, Marc

Abstract:

In general, commercial finite element software provides custom methods that allows users to support unique requirements with their FEA software and files. Examples include user subroutines to define nonstandard material behavior (constitutive models), element libraries, environmental conditions (loads/bcs), and integration of FEA results to downstream processes or to third party applications (for co-simulation). These are generally done with industry standard tools (FORTRAN, C, C++, FMI, and OpenFSI). One area that has not been addressed is results data and the associated interface. Output from commercial FEA programs is typically provided in two formats: 1) ASCII text formatted for printing and 2) a binary results file. Binary files have two primary advantages over text files: smaller size and faster access. However, most binary files also use a proprietary format and interface. Accessing data in these files requires knowledge of the vendor's proprietary API. As a result, it can be difficult for the "typical user" to work with them. For these reasons, many customers often write scripts to extract data from the text output file. While text parsers are easier to code and verify, this method has downsides in regards to complexity, maintenance and performance. By comparison, noncommercial FEA software has leveraged open systems for at least two decades. For example, Sandia Labs's SEACUS system uses the Exodus II database across all of its solvers, and is built on netCDF and HDF. For all of the reasons above, users gain meaningful benefits when FEA providers implement open data systems. One open system to store very large datasets is HDF5 from the HDF Group. It is much easier for the "typical user" to work with results in an HDF5 file. First, the data can be view without writing any software. When custom software is required, the HDF5 API has several advantages: 1) it is a general purpose interface (not vendor specific), 2) a wide variety of languages are supported, and 3) it is not dependent on FEA vendor maintenance (the vendor simply documents the data schema). One example of a HDF5 implementation in commercial FEA software was done by MSC Software. This paper presents details regarding that implementation for 4 FEA products: MSC Nastran, Patran, MSC Apex and Marc. It will cover motivation, user benefits, and deployment details. In addition, examples of customization use cases will be presented.

Speaker Biography:

Ken Walker is a Senior Manager on MSC Software's Presales team with more than 30 years experience using FEA applications across a broad set of industries and customers. Prior to joining MSC, Ken was a consultant performing mechanical and structural analysis in the energy industry. Areas of interest include linear and nonlinear analysis, task and process automation, and application of FE analysis best practices.

Presenter Name: Walsh, Joe

Presenter Company: The ASSESS Initiative

Presentation Title: An Update from the ASSESS Initiative (J. Walsh, The ASSESS Initiative; Lvl: 2)

Session Title: Cultural Challenges

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 12:00 PM

Type: Presentation

Intended Learning Outcome:

The changing role of simulation is being driven by business objectives and a Simulation Revolution is underway

Keywords: Democratization, Simulation Revolution, Digital Twin, Systems Modeling, MBSE, Business Chgallenges

Abstract:

The role of Engineering Simulation is changing. The changing role of Engineering Simulation is really about business benefits. However, achieving those benefits and associated growth of the Engineering Simulation market is tempered due to the lack of expertise available. The ASSESS Initiative is a broad reaching multi-industry initiative with a primary goal to facilitate a revolution of enablement that will vastly increase the availability and utility of Engineering Simulation, leading to significantly increased usage and business benefits across the full spectrum of industries, applications and users. The vision of the ASSESS Initiative is to bring together key players for guiding and influencing the software tool strategies for performing model-based analysis, simulation, and systems engineering. To achieve this vision the ASSESS Initiative collaborates with multiple activities and organizations across the complete spectrum of Engineering Simulation including NAFEMS. The primary goal of the ASSESS Initiative is to facilitate a revolution of enablement that will vastly increase the availability and utility of Engineering Simulation, leading to significantly increased usage and business benefit from model based Engineering Simulation technologies across the full spectrum of industries, applications and users. The ASSESS initiative has been organized around a key set of themes associated with expanding the usage and benefit of Engineering Simulation. The ASSESS Congress provides an opportunity for key participants to explore and progress these themes in depth. In addition to the ASSESS Congress, theme focused working groups have been established to move the actionable themes forward between each annual ASSESS Congress by providing direction and guidance related to the mission, goals, activities, deliverables and collaborations for each ASSESS theme. Align = Alignment of Commercial, Research and Government Efforts Business = Business Challenges Engineering Simulation Credibility DOES = Democratization of Engineering Simulation Generative = Generative Design Integration = Integration of Systems and Detailed Sub-System Simulations Twin(s) = Engineering Simulation Digital Twin(s) This session will provide an update on the ASSESS Initiative completed and planned activities to support the Simulation Revolution.

Speaker Biography:

Not Yet Provided

Presenter Name: Walsh, Joe

Presenter Company: The ASSESS Initiative

Presentation Title: Understanding a Generative Design Enabled Design Process Paradigm Shift (J. Walsh, The ASSESS Initiative; Lvl: 2)

Session Title: Generative Design 2

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 1:30 PM

Type: Workshop

Intended Learning Outcome:

Understand the potential and challenges related to Generative Design

Keywords: Generative Design, Democratization

Abstract:

The ASSESS Initiative has recently released a Strategic Insight paper entitled "Understanding a Generative Design Enabled Design Process Paradigm Shift." The vision for Generative Design is to enable a significant paradigm shift in the current design processes via the creation of computer-generated designs as early as the concept stage by Design Engineers. These generated designs are based on proper specifications of the intended use case, design space, performance objectives, and design constraints that account for the desired performance and manufacturing/assembly/fabrication of the design. This approach overturns the current practice where designs must first be created so they can be evaluated against their performance requirements. Generative Design techniques also have the potential of being a key enabler for Democratization of Engineering Simulation by providing simulation-driven design concepts that allow a user to define a design scenario as input to a Generative Design tool to explore the design space for feasible design options. Driving Generative Design up front to the “early stages” of the development process will change the nature of the work that is performed throughout the design process. The significant paradigm shift in the design process that could be enabled by Generative Design is the ability for Design Engineers to use automated design processes that are performance driven and manufacturing/assembly/fabrication “aware.” Generative Design is a form of design space exploration that is generally underpinned by physics-based simulations. A typical problem may have the statement, “give me designs for my use case that meet my stiffness and stress requirements and with minimum weight.” Generative Design should be employed as early as possible, before the design space becomes overly constrained. However, this does not negate the vision that optimization and validation be applied repeatedly as the product design is developed. There have been numerous attempts to define Generative Design where many of these are from suppliers of technology who define Generative Design in terms of the solutions that they offer. Through efforts of the ASSESS Generative Theme working group and multiple ASSESS Congress working sessions, the ASSESS Initiative has developed the following definition of Generative Design and highly recommends that end users, software vendors, industry analysts, and research organizations adopt this definition to enable a common understanding. Generative design is the use of algorithmic methods to generate feasible designs or outcomes from a set of performance objectives, performance constraints, and design space for specified use cases. Performance objectives and constraints may include factors from multiple areas including operational performance, weight/mass, manufacturing, assembly or construction, usability, aesthetics, ergonomics, and cost. This workshop will explore the following topics: 1. What is Generative Design 2. The possibility of a Paradigm Shift 3. What Software Capabilities are Required for a Paradigm Shift 4. A Capabilities/Suitability assessment model 5. Organizational and Cultural Challenges Required to Enable a Paradigm Shift

Speaker Biography:

Not Yet Provided

Presenter Name: Walsh, Joe

Presenter Company: intrinSIM LLC

Presentation Title: Generative Design Use Case Requirements Assessment (J. Walsh, intrinSIM LLC; Lvl:)

Session Title: Generative Design 2

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 2:30 PM

Type: Presentation

Intended Learning Outcome:

Keywords:

Abstract:

N/A

Speaker Biography:

Joe Walsh founded intrinSIM in late 2009 to enable rapid next-generation application development for engineering software, and he also co-founded the ASSESS Initiative in mid-2016 to significantly increase the usage and benefit of Engineering Simulation. Mr. Walsh brings over 40 years of experience, expertise, relationships, and collaborations in the CAE, CAD, interoperability, and component software industries. Before founding intrinSIM, He was the VP of Business Development for Simmetrix, where he was responsible for sales, marketing, and business relationships. Before joining Simmetrix, he was VP of Worldwide Sales for IronCAD LLC, VP of North American Sales for DS/Spatial and Spatial Corp., Partner and Founder of New Renaissance, President/CEO and co-founder of FEGS Inc. the North American subsidiary of FEGS, Ltd. of Cambridge UK, President/CEO of PAFEC Inc. the North American subsidiary of PAFEC Ltd. of Nottingham UK, Director of Engineering Applications for Clevenger Corporation and Mr. Walsh has almost ten years experience in engineering analysis positions specializing in CAD/CAE integration, CAE automation, and design optimization. Joe Walsh holds an Architectural Engineering degree from Milwaukee School of Engineering.

Presenter Name: Wanjiku, John

Presenter Company: Siemens Digital Industries Software

Presentation Title: Enabling the Digitalization of Transformers (J. Wanjiku, Siemens Digital Industries Software; Lvl: 1)

Session Title: Electromagnetics & Electrostatics

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 4:00 PM

Type: Presentation

Intended Learning Outcome:

The need for simulations in digitalizing of power distribution equipment (e.g. power transformers)

Keywords: Electromagnetics, Digitalization, Transformers, IoT, Simulations, Predictive maintenance

Abstract:

The global power transformer market is expected to grow at a compounded annual growth rate of 7.1% to reach $ 37.3 billion dollars by 2022. This is largely driven by new opportunities in emerging markets, and retrofits in mature markets. However, there is continued increase in volatility in the grid, like the integration of renewable sources, and new types of loads such as EV charging and data centers, with a decline in traditional high-inertia generation. These changes in the generation and demand patterns, result in more dynamic loading of the transformer, affecting its service life. These devices are expected to last for decades, e.g., 30 to 40 years for power transformers, irrespective of the volatility in the grid. In addition, there is budget reduction for maintenance and replacement, that is, operators are asking more of their existing assets. How can we address some of these challenges? By exploiting digital technologies and connectivity. That is, digitalization of transformers. For example, according to the ABB special report on transformers; Transformer monitoring can reduce the risk of catastrophic failure by 50%, the repair costs by 75%, and the associated loss of revenue by 60%. The annual cost savings can amount to 2% that of a new transformer. This presentation will show how simulations enable transformer digitalization. It will covers 3 main topics: 1. Operators can mitigate the risks associated with losses by reducing the simulation time needed to explore designs without foregoing accuracy, in the generation of an EM digital twin. 2. Transformer failure due to insulation and transformer oil dielectric breakdown can be assessed, for predictive maintenance. 3. The mapping of thermal fields helps in the positioning of the hotspot temperature sensors, which are then used in the regulation of the hotspot temperature, to optimize remaining life, and in the scheduling of condition-based predictive maintenance. So, by simulating and replicating virtual tests, manufacturers and operators can not only reduce the number of physical prototypes, but also be able to optimize the remaining life in an equipment, and scheduling of condition based maintenance.

Speaker Biography:

John Wanjiku John Wanjiku joined Mentor Graphics, A Siemens Business, Montréal, Canada (formerly Infolytica Corp) in December 2016, after his Ph.D. in Electrical and Computer Engineering majoring in Electrical Machines. He has more than five years of experience in the design of electric machines and core loss measurements. His interest is in the simulation-driven development of electric and electromechanical devices. John is a member of IEEE and its Industry Application Society (IAS). He is currently a Low-frequency Electromagnetics Specialist at Siemens Digital Industries Software.

Presenter Name: Wen, Zhongli

Presenter Company: Esteco SPA

Presentation Title: Design Optimization of CNG Vessels Transportation (Z. Wen, Esteco SPA; Lvl: 2)

Session Title: Optimization 4

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 1:30 PM

Type: Presentation

Intended Learning Outcome:

Innovative design optimization approach for gas transportation using numerical simulations

Keywords: Optimization, compressed natural gas, CNG, transportation, filament winding, autofrettage

Abstract:

This article reports the main achievements of the European project called 'GASVESSEL', which aim to open up new possibilities to exploit stranded, associated and flared gas where this is currently not economically feasible as well as to increase the gas transport possibilities of currently exploited gas fields with a new cost effective CNG (Compressed Natural Gas) transport concept. This can globally unlock up to at least € 35 billion/Yr worth of gas as such helping to rebalance the European and global energy security equations. GASVESSEL will innovate different steps in the value chain; from a decision support model to simulate and benchmark costs of the novel CNG concept against alternative gas transporting systems until the ship design and manufacturing process of the innovative lightweight Composite Overwrapped Pressure Vessels (PV's). The innovation of the CNG transport concept is enabled by a novel patented solution for the manufacturing of up to 70% lighter Pressure Vessels compared to steel alternatives, enabling new CNG ship designs with much higher payloads and therefore dramatically lower transportation cost per m3 of gas. The optimization software modeFRONTIER and VOLTA web-based solution have been used by the partners in the different phases of the Project for the design of the system. In function of each different geographical scenarios (which includes East Mediterranean, Barents Sea and Black Sea) and gas demand, parameters such as ship size and number, storage and facilities units at the ports have been optimized in order to reduce the transportation costs and therefore gas tariff. Components of the gas vessels, material and type of the fibers that wraps the liner, have been then optimized to minimize weights while respecting high value of safety factors. Using traditional pressure vessels the relevant thickness of the walls induces both a significant weight of the vessels and a limited ratio between the volume of the transported goods and the total one, comprehensive of the tanks themselves. To overcome these issues, it is possible to manufacture the tanks using an internal thin metal liner wrapped with several layers of fiber-reinforced composite materials (filament winding); the obtained structure, being light and stiff, assures that the transportation of the compressed natural gas can be competitive in the market. The filament winding is a popular fabrication method suited to the manufacture of light and stiff axisymmetric structures as the pressure vessels or the pipes. Strands of filaments impregnated with resin are wounded around a rotating mandrel by a translating guide that can move along one or more axes. The wrapped vessels are subjected to the autofrettage treatment: an internal pressure higher than (about 1.5 times) the maximum expected operating pressures applied to the tank to partially deform the metal liner over its elastic range. The composite overwrap remains in its elastic range and, when the internal pressure is unloaded, tends to its original undeformed shape, inducing on the liner a compressive stress field. When it is applied the operative load, the stresses acting on the structure occurs to be lower than those obtainable without the autofrettage treatment. Optimization loop is defined in order to find, for a given winding angle distribution, the minimum number of winding layers which are necessary in order to respect the structural constraints (reach maximum admissible stress in the central cylindrical portion of the vessel at burst pressure 900 bar) using an analytical model of the mechanical behavior of the pressure cylinder. The mechanical behavior of the optimal solutions will be tested using FEM models and experimentally.

Speaker Biography:

ZHONGLI WEN, Senior Application Engineer, ESTECO SPA Dr. Zhongli Wen works as Senior Application Engineer at Esteco SPA with Mechanical Engineer background (University of Trieste, Italy). Before join Esteco he had work experience at Ford Motor Company, Dearborn, Michigan (US) in external vehicle fluid dynamics department. In

2013 he started at Esteco in the Engineering Team where he supports customers with the applications of the optimization software modeFRONTIER. He has worked at several Regional Projects (iCAST, Cantiere 4.0) and European Founded Projects (Umrida, OptimHEX, GASVESSEL) with experience in steel solidification, marine, aerospace, heat exchange and oil&gas technologies. From 2016 he is also in charge of the Esteco business in Asia.

Presenter Name: Westwater, Gregory

Presenter Company: Fisher Controls International LLC

Presentation Title: Implementing Simulation Earlier in the Design Process (G. Westwater, Fisher Controls International LLC; Lvl: 2)

Session Title: Democratization

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 4:30 PM

Type: Presentation

Intended Learning Outcome:

Attendees will learn about how to increase utilization of simulation earlier in their processes, allowing simulation to have greater impact on projects, and reducing risk to project schedules.

Keywords: Early simulation, democratization, best practices, collaboration, simulation workflows

Abstract:

This presentation will cover lessons learned over two years of seeking to increase use of simulation earlier in the design process. The presented work occurred in a large, multinational company where traditionally simulation was largely employed at the stage of final validation prior to product release. At this point most design features are set and the cost of redesign is expensive, both in terms of schedule delay as well as modifications to capital equipment, thus opportunities for optimization are passed by and late discoveries of design deficiencies are painful. To avoid these pitfalls and to better leverage the influence of simulation the effort was undertaken to engage design groups in earlier simulation. To launch the effort a series of discussions were held with users and managers, soliciting their feedback and perspectives. This brought the realization that there was great interest in democratization of simulation, and also that work processes focused on final validation were too rigid to provide meaningful value at the early stages of design where concepts are changing quickly and inputs are not fully defined. Thus new workflows were developed, providing multiple channels for simulation work to proceed, allowing for democratization where appropriate, while making experienced analysts available for more nuanced simulations. Included in these workflows is a consultation with an analyst to assist in selecting the proper channel based on the nature of the work. As the effort has progressed there has also been learning about opportunities to simplify existing analysis methods to provide results faster with an acceptably small tradeoff in accuracy. The pursuit of these exploratory analyses has also led to a more collaborative approach between design teams and simulation experts, allowing those requesting the work to become more educated consumers of simulation, and permitting analysts to better understand the needs of the requestor. Observations and trends from the usage of exploratory simulation will be covered, including examples of pitfalls, refinements in approach, how implementation varied in multiple world areas, and how different work groups varied in their adoption. Benefits of specific successes in exploratory analysis are discussed, including reduced project schedule risk and increased understanding of designs and margins. Important but less tangible gains which contribute to an overall improved usage of simulation in the organization are also covered.

Speaker Biography:

Gregory Westwater is a Senior Engineering Specialist with eighteen years of experience doing numerical simulation work on control valves and other Emerson Automation Solutions products. He received his BSME and MSME degrees from Iowa State University. In addition to prior presentations at NAFEMS conferences he has also presented work related to simulation at ASME conferences on Pressure Vessels and Piping (PVP) and Verification and Validation (V&V).

Presenter Name: Wilson, John

Presenter Company: Siemens Digital Industries Software

Presentation Title: Leveraging Boundary Condition Independent Reduced Order Models (J. Wilson, Siemens Digital Industries Software; Lvl: 1)

Session Title: Thermomechanical

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 4:00 PM

Type: Presentation

Intended Learning Outcome:

This presentation discusses the current approaches available for analyzing the temperature response of a dynamic electronic system and introduces a new method based on a novel BCI-ROM approach.

Keywords: BCI-ROM, DCTM, DELPHI,FANTASTIC

Abstract:

The value of a Dynamic Compact Thermal Models (DCTM) in electronics thermal design have been understood for a number of years through their ability to accelerate the design process. Explicit representation of all components with a detailed system level CFD (Computational Fluid Dynamics) analysis is not well suited for understanding the dynamic temperature response of a system. A transient CFD analysis can be prohibitively time consuming. Thermal RC networks have been used as a DCTM but are time consuming and require a trial-and-error approach to develop. In addition to the difficulties and limitations of the current approaches, the compact models generally don't support parallel design processes such as Electro-Thermal or reliability predictions. Transient superposition is another method that has been used to accelerate the design process and is applicable to many system topologies without the need for fitting and testing multiple RC networks until the desired accuracy is achieved. Though transient superposition is an accurate approach it hasn't been widely adopted by the thermal design community in part due to their boundary condition dependence and limited port-ability to other design flows. Reduced Order Modelling is an alternative approach to extracting a DCTM from a thermal simulation model. A BCI-ROM (Boundary Condition Independent Reduced Order Model) provides analysis speed, Boundary Condition Independence, and solution environment flexibility to facilitate parallel design processes that require temperature response as an input. The new approach to BCI-ROM development is an extension of the FANTASTIC method and is applicable to any arbitrary system topology for the thermal design of electronics. The process requires little expertise to develop and generates a BCI-ROM of user defined accuracy. This presentation discusses the current approaches available for analyzing the temperature response of an electronic system and introduces a new method for BCI-ROM development. Examples shown will include a multi-chip module (MCM) and an IGBT subject to the UDDS: FTP-72 Drive Cycle for an Electric Vehicle

Speaker Biography:

John Wilson has over 20 years of electronics thermal design experience in simulation and testing. John has a BS and MS in Mechanical Engineering from the University of Colorado at Denver and then joined Flomerics in 1999 which was acquired by Mentor Graphics and is now part of Siemens Digital Industries. John has managed more than 100+ electronics thermal design consulting projects ranging from chip package level, PCB, enclosure to large system level across of a wide range of applications including consumer electronics, communications, industrial and automotive electronics. He has developed a practical, comprehensive knowledge of IC package thermal testing and analysis correlation through his work in Mentor California thermal test facilities. John also has 11+ years of experience of managing US based teams of engineers performing consulting thermal design projects and supporting clients in using simulation and testing tools.

Presenter Name: Wolf, Klaus

Presenter Company: Fraunhofer SCAI

Presentation Title: VMAP Enabling Interoperability in Integrated CAE Simulation Workflows (K. Wolf, Fraunhofer SCAI; Lvl: 3)

Session Title: Data Management 2

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 2:00 PM

Type: Presentation

Intended Learning Outcome:

How to utilise VMAP standards and tools for material and engineering data transfer within complex simulation processes involving different simulations and software.

Keywords: interoperability, standards, manufacturing simulation, software interfaces, data mapping, material models, simulation workflows

Abstract:

With the progress in CAE simulation leading to more complicated and integrated workflows, data control and transfer becomes essential. This is extremely important in the manufacturing industry where complicated simulation workflows are necessary in tracking material changes throughout the manufacturing process. Traditionally this has led to many one-off solutions created by engineers in their desire to solve their process design problems within the defined timescales. Naturally the result was that many methodologies for transferring information become available but were stand alone and/or unavailable to different departments or entities. The VMAP data standard is the first to address this issue and solves the problem by standardising the data being transferred to enable complete software interoperability. Additionally, VMAP provides a library of IO routines to help engineers speed-up the creation their workflows thereby removing the emphasis for considering data formats. This enables easier and more flexible data transfer, use of different softwares for different simulations and the creation of re-useable processes that can easily be adapted to include more or different data. Moreover, this enables software interoperability for post-processing and data manipulation and processing. VMAP is cost-free and is supported by the international VMAP Standards Community made up of independent software vendors (ISVs), developers, academia and other entities and provides the CAE industry with a focus group to provide guidance, collaborate, evolve and maintain VMAP. This paper describes the VMAP standard and IO libraries, example of its successful implementation via various use cases. The important roles of the VMAP Standards Community are also described.

Speaker Biography:

Priyanka holds an MSc in Computational Engineering from Ruhr University Bochum in Germany. She has worked in the Simulation domain in both aero and auto sector. Currently, she is working as a Technical Coordinator at Fraunhofer Institute for Algorithms & Scientific Computing SCAI handling the VMAP Project.

Presenter Name: Yang, Wenlong

Presenter Company: ESI North America

Presentation Title: Estimation of Material Properties of Noise Control Treatments from Random Incidence Transmission Loss Measurements (W. Yang, ESI North America; Lvl: 2)

Session Title: Multiscale & Multiphysics 4

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 11:00 AM

Type: Presentation

Intended Learning Outcome:

Estimating the material properties of noise control treatments using measured sound transmission loss

Keywords: Noise Control Treatments, Poroelastic materials, Inverse Characterization, Sound Transmission Loss, Randcom Incidence, Multi-Layer

Abstract:

The evaluation and optimization of acoustical performance of poroelastic noise control treatments require a knowledge of the macroscopic material properties in additional to geometric properties. Unfortunately, the direct measurement of macroscopic material properties not only requires extensive laboratory equipment, but also prone to errors. On the other hand, measurement of the acoustical performance of noise control materials are quite straightforward. Consequently, inverse methods have been developed to estimate these properties from acoustic performance metrics such as sound transmission loss and absorption coefficient. Most of the prevailing inverse techniques use normal incidence sound transmission loss and/or absorption coefficient measured by impedance tubes applicable to single layer noise control treatments. While the estimation of fluid properties of these materials has been extensively investigated, the estimation of mechanical properties is generally not accurately predicted. This is circumvented by considering the elastic effect of the edge-constraint together with the finite element method modeling of impedance tube. These methods have been incorporated and are available in commercial elastic porous material characterization software. Nevertheless, these methods still have limitations. First, most of the approaches have been based on normal incidence performance metrics measured using standing wave impedance tubes. However, to evaluate the effectiveness of the noise control treatments, automotive OEMs set targets based on random incidence performance metrics such as random incidence sound transmission loss. Second, these approaches are based on single layer tested in the impedance tubes. On the other hand, to quantify the effectiveness of the noise control treatments, sound transmission loss measurement from two-room suite under random incidence is widely used. The primary objective of this paper is to investigate the inverse characterization of macroscopic properties for of multi-layer noise control treatment using random incidence sound transmission loss measurements. To achieve this goal, a new method for material characterization of noise control treatment has been proposed. The proposed approach utilizes genetic algorithm where the fitness function is the difference between the test and simulations of insertion loss that is derived from sound transmission loss. The simulation results of sound transmission depend on the values of the material parameters, which are set to be the design variables. In each iteration during the optimization process, the sound transmission could be simulated from the updated values of the material properties of the noise control treatment. The material parameters are assumed to be successfully estimated when the fitness level is reached. The proposed approach is demonstrated by applying the method for the estimation of typical noise control treatments. Additionally, the robustness of the proposed approach is also investigated.

Speaker Biography:

Dr. Wenlong Yang is vibro-acoustics engineer working for ESI North America. He is an experienced and professional engineer who has performed years of engineering consulting and training services for automotive, marine, aerospace and heavy industries. The scope covers from small components such as muffler to large objects such as ship or rocket. He believes in the power of math and familiar with theories: Finite Element Method, Boundary Element Method, Statistical Energy Analysis, Hybrid Method, Ray Tracing, etc. and he is always enthusiastic on solving challenging engineering problems.

Presenter Name: Yavuz, Ibrahim

Presenter Company: ANSYS Inc.

Presentation Title: Thermal Effect on Headlamp Lighting Performance (I. Yavuz, ANSYS Inc.; Lvl: 2)

Session Title: Thermomechanical

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 5:00 PM

Type: Presentation

Intended Learning Outcome:

How multi-physics simulation can help in assessing thermal deformations and meeting requirements/regulations for headlamps, and also in extension for radars, lidars, and HUDs.

Keywords: Headlamp, Thermal, Optics, Electronics, Structural, CFD

Abstract:

Todays headlamps are important styling components for cars, especially for brand recognition, but are also increasingly getting more attention from a safety point of view with the emergence of new technologies, like LEDs, sensors, integrated cameras, and Lidars. With these new technologies all crammed into the headlamp, manufacturers face new thermal management challenges. Current headlamp models have high geometrical complexity with many electronic components, where these models can include dynamic parts in the case of an adaptive curve light, or include sensors needed for autonomous driving. The thermal management analysis of these new headlamps are especially challenging, as all heat transfer mechanisms need to be included for accurate simulations. The electronic components may need to be investigated in detail, specifically, the combination of solar load and the released heat from the electronic components may impact deformation of plastic parts that may in turn affect shape and lighting performance of the headlamp. Consequently, comprehensive lighting studies demand advanced modeling capabilities and are perfectly suited for Multi(ple)-physics simulations that include electronics thermal, CFD, FEA and lighting analysis. In this study, we are going to investigate a headlamp that presents deformation of parts due to thermal expansion, which in turn influences the performance of optical modules to meet lighting regulations. Specifically, we propose to use electronics thermal to conduct detailed PCB-level modeling, and map the properties into a comprehensive thermal simulation including radiation and solar load on the headlamp enclosure. The resulting temperature field will then be mapped to a structural simulation for deformation of some the lighting components. Finally, these deformed parts will be used in lighting simulations to analyze the affected optical performance of the headlamp. Here we will compare the lighting performance of the original and deformed/modified headlamp. We have seen that the Luminous Intensity can drastically change with deformed headlamp parts, and that the illumination pattern will be affected due to these deformations as well. Ultimately, these deformations will also affect pass/fail conditions of the headlamp per regulations.

Speaker Biography:

Ibrahim Yavuz is an Application Engineering Manager at ANSYS in the Ann Arbor, MI office, specializing in the Automotive Industry. He has a Ph.D. in Aerospace Engineering, and has extensive experience in a wide range of CFD applications including Powertrain, Aerodynamics/Aero-acoustics, Air Handling, and Vehicle/Electronics/Battery Thermal Simulations.

Presenter Name: Zahner, Jesse

Presenter Company: Sigmetrix

Presentation Title: Understanding the "Connected" Digital Enterprise (J. Zahner, Sigmetrix; Lvl: 1)

Session Title: Data Management 1

Presentation Date & Time (*EDT; New York*): 6/16/2020 @ 11:00 AM

Type: Presentation

Intended Learning Outcome:

This paper will discuss the effective use of information inside of a digital enterprise as it relates to inspection and simulation information

Keywords: digitally-connected enterprise, visual data, simulation, inspection, tolerance analysis, gd&t

Abstract:

Most companies today use some form of Product Lifecycle Management (PLM) system to manage the data related to the products they design and deliver to their customers. These PLM systems are most often focused on managing the various pieces of information, including the relationships between each of the items, and providing access to personnel needing access to specific data. The format of the data contained within is determined by the application used to create it, but since the focus of these systems is most often human consumption, either directly or via the authoring software, the data is most often not easily interchanged between the systems where it is ultimately used. While PLM systems allow companies to operate efficiently by making necessary information readily available, many realize that the data requires human involvement to move from one system to another. To reach the next level of efficiency and improve their competitiveness, world-class companies are striving to become "digitally connected enterprises" in which information can move easily between systems without extensive human involvement. Such companies rely on the careful storage and usage of strategic information that can be widely accessed, contributed to, and understood by the various systems involved throughout the stages of a product's lifecycle. To be successful, it is important not only to record information, but also to ensure that it is stored in formats that can be readily consumed. A design engineer today, for example, may create many 3D models with visual annotations showing dimensions and tolerances that get shown on the associated drawings. Such visual data is important so that people involved in the creation and verification of the parts understand the requirements. However, this important information in this format is useless when creating the instructions for the machining or inspection systems. To improve the effective use of the information, it must be created semantically (i.e. associated to the surfaces of the part to which it applies). It must also either be created in a format directly consumable by the downstream applications or automatically converted to a format that is understood while maintaining the integrity of the definition between the two data definitions. When done properly, the inevitable changes that occur during or even after the initial development process are quickly propagated to all systems involved in the production of the product. It is also becoming more common to run simulations to predict product performance before an actual product or prototype is produced. Such simulations, when done properly and connected to the data, can also be used with data obtained from production to provide predictions of product performance without extensive, ongoing assembly-level testing during production. Today's methods for recording inspection, however, typically don't support this additional utilization of the simulation models. For example, functional gaging provides nothing more than pass/fail criteria for that individual part. Inspecting and recording part characteristics differently can support significantly more benefit. Ideally a digitally connected enterprise will connect the entire lifecycle of a product, from design, to manufacturing, to inspection, and back to design to support constant improvement. This paper will discuss the effective use of information inside of a digital enterprise as it relates to inspection and simulation information. A connected enterprise needs to consist not only of relevant information, but meaningful data that can be used in future iterations of a product or process. Topics discussed will include today's methods for recording inspection data, the usefulness of a connected enterprise, product-level simulations as it relates to performance, and how data, when not gathered correctly, can be a limiting factor across the enterprise.

Speaker Biography:

Jesse is a Product Specialist working for Sigmetrix. He earned his undergraduate and Master's degree from Purdue University in the field of Product Lifecycle Management (PLM), and continues to expand his knowledge of PLM, Model-Based Enterprise and rising technologies that could overturn the industries of today.

Presenter Name: Zamani, Vahid

Presenter Company: Ford Motor Company

Presentation Title: A Computer-Aided Engineering Method for Fan Blade Durability Assessment (V. Zamani, Ford Motor Company; Lvl: 3)

Session Title: Durability & Damage Tolerance

Presentation Date & Time (*EDT; New York*): 6/17/2020 @ 12:00 PM

Type: Presentation

Intended Learning Outcome:

A practical example of Virtual Sign-off eliminating the need for physical test

Keywords: CAE; Durability; Fan Blades; Virtual Sign-Off

Abstract:

When operating on the ground transportation vehicles, rotary equipment such as cooling fan blades are subject to a variety of loads including aerodynamic pressures, harmonic or random vibrations and centrifugal effects. In addition, because of the rotational nature of their function, the fans may show various undesirable behaviors that could be induced or magnified by the external loads. Most important of such unwanted response is resonance condition that occurs at critical speeds. High levels of structural strain and stress are observed under resonance conditions. To ensure durability and robustness of the cooling fans, several physical tests must be carried out during the design process to achieve final design verification. Of course, these tests have their own limitations, for example, monitoring all physical locations on the components is impossible. We present here how CAE simulation (Finite element and CFD analyses) can eliminate the need of such expensive and lengthy physical tests by capturing critical speeds and predicting stress levels at such conditions on the whole component. This is accomplished by obtaining Campbell Diagram for the fan component, identifying critical speeds that has been proven to be in close correlation with test data. We also show how dynamic analysis models transient and steady-state response of the rotating fan at those rotational speeds by introducing harmonic and non-symmetric aerodynamic pressure profiles as well as centrifugal effects. Total stress levels simulated by our method are in a very good correlation with existing test data. The frequency content of the input and output variables in the CAE model are consistent with what is observed in the actual experimental data. It is demonstrated that centrifugal effects are the major contributor to the stress levels except on the resonance conditions where the aerodynamic loads play major effect. Our method will allow faster and more efficient design process.

Speaker Biography:

Dr. Vahid Zamani is a product development engineer at Ford Motor Company. He works on failure analysis, fatigue and durability of vehicle components involving rotordynamics and on modeling of rubber components' mechanical behavior.

Presenter Name: Zebrowski, Mark

Presenter Company: Consultant (Ford Motor Company, Retired)

Presentation Title: Simulations Reality - How Simulation Can Act Like a Vehicle Loan from Tony Soprano's Jersey State Credit Union (M. Zebrowski, Consultant (Ford Motor Company, Retired); Lvl: 2)

Session Title: Simulation Governance 2

Presentation Date & Time (*EDT; New York*): 6/18/2020 @ 1:30 PM

Type: Workshop

Intended Learning Outcome:

How to Run Simulation as a Successful, Profitable, High-Quality and Repeatable Business

Keywords: Strategy, Tactics, Operations, Rework Cycle, Balanced ScoreCard

Abstract:

Mark Zebrowski will build upon his award winning - Best Workshop of 2018, voted on by the Conference Attendees - "What's Wrong with Simulation, What Happens if It's Not Fixed and How to Fix it" by Showing the Performance Data from a Simulation Re-Work Cycle Identifying the High Leverage Points He will then switch his view from backward looking to forward looking and discuss The Importance of Honestly Knowing where you are in the Simulation Maturity Model The Importance of Knowing the Complexity of the Simulation Environment The Importance of Maneuverability, not Speed, when Performing Simulation and making Improvements to the Simulation Processes All of this leads to a Performance Review System called Simulation's Balanced Scorecard. The Balanced Scorecard (BSC) concept is a strategic planning and management system that organizations use to: Communicate what they are trying to accomplish Align the day-to-day work that everyone is doing with strategy Prioritize projects, products, and services Measure and monitor progress towards strategic targets A key benefit of using a disciplined framework is that it gives organizations a way to "connect the dots" between the various components of strategic planning and management, meaning that there will be a visible connection between the projects and programs that people are working on, the measurements being used to track success, the strategic objectives the organization is trying to accomplish, and the mission, vision, and strategy of the organization. The Simulation BSC is an outward-looking system rather than the inward-looking approaches employed by most Simulation Groups and Vendor. It looks at Financial, Customer, Internal Process and Organizational Capacity data. He will then review the Simulation BSC and the 13 Attributes that it's based on. And how this approach leads to a methodology of evaluating your organizations performance. All the above leads to a methodology for reviewing the proposals that might be submitted to your organization from Simulation Vendors.

Speaker Biography:

Not Yet Provided