



CASE STUDIES | session 2

ENGINEERING THE ELECTRIC VEHICLE REVOLUTION EXTRAPOLATION IS NOT PREDICTION

Engineering Analysis & Simulation in the Automotive Industry

Electrification & Advanced Lightweighting Techniques

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Hybrid Electric and Pure Electric Vehicles

Hybrid Electric Engine Optimization Using *modeFRONTIER*

Top industry players design tasks for HEV/EV systems in ESTECO technology to quickly identify the right engineering strategies and overcome highly constrained design problems.



Trends and challenges in HEV and EV industry

Hybrid electric (HEV) and pure electric (EV) vehicles are quickly becoming coveted items with **market growth forecasted at a compound annual rate of 6%**; the EV segment alone is estimated to grow at a rate of **39% up to 2020¹**.

DESIGN CHALLENGES

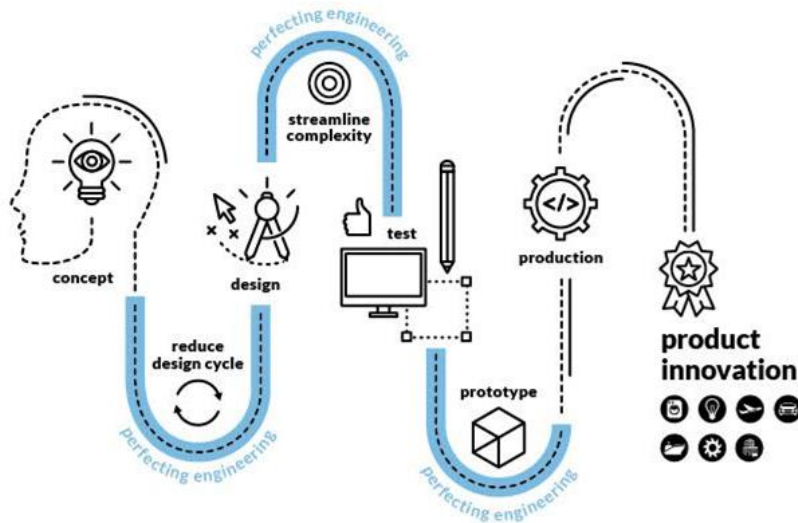
- ✓ Traction motors require **recalibration** for HEV/EV applications
- ✓ Designers **lose time reviewing** hundreds of designs
- ✓ Designs must consider **structural and thermal limitations** along with electromagnetic **design constraints** in motor magnetics
- ✓ Advanced designs require significant **computational resources**



About ESTECO



ESTECO is an independent technology provider delivering first-class software solutions aimed at perfecting the simulation-driven design process. With more than 15 years' experience, we support engineers and companies in designing better, more efficient products.



We specialize in customer-focused solutions for numerical optimization, CAE integration, process automation and simulation data management.

ESTECO Technologies – A Perfect Match

VOLTA
collaboration environment

modeFRONTIER
execution engine

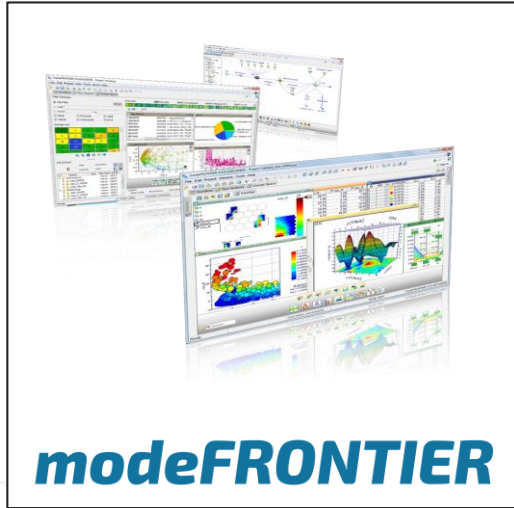
BEEP MN
web editor



>> ESTECO Technology

Our smart **engineering suite** brings enterprise-wide solutions for design **optimization**, simulation **data management** and **process** integration and **automation**.

We help companies excel across their innovation journey and accomplish the shift to **agile product development**.



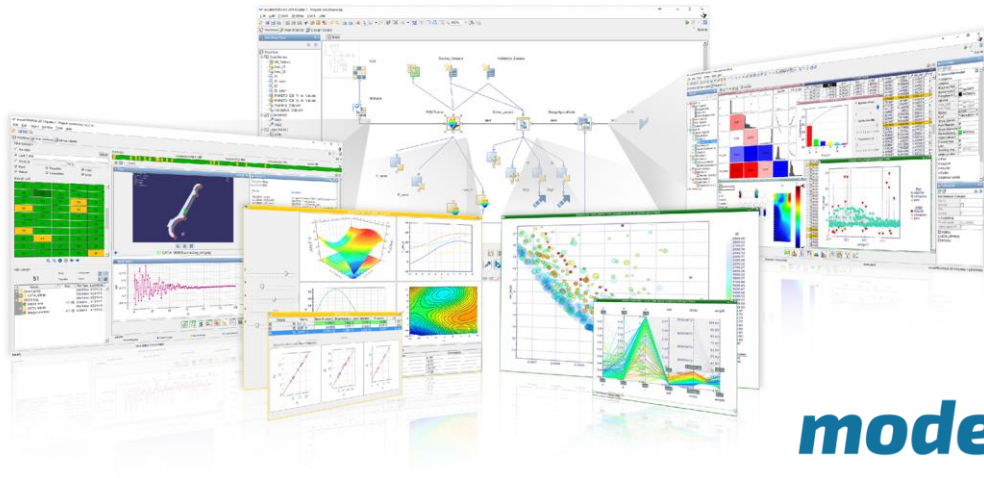
Increases
efficiency
of design simulation tools

inspires
decision making

accelerates
product innovation



>> ESTECO Technology > modeFRONTIER



Streamlines the design process with powerful workflows, innovative algorithms and advanced post-processing tools.

modeFRONTIER


is an integration platform for multiobjective and multidisciplinary optimization. It provides a seamless coupling with third party engineering tools, enables the automation of the design simulation process and facilitates analytic decision making.






optimizing the HEV/EV design

modeFRONTIER manages the strong non-linearity of HEV/EV design processes and identifies the **best components** and mechatronics **integration** by:



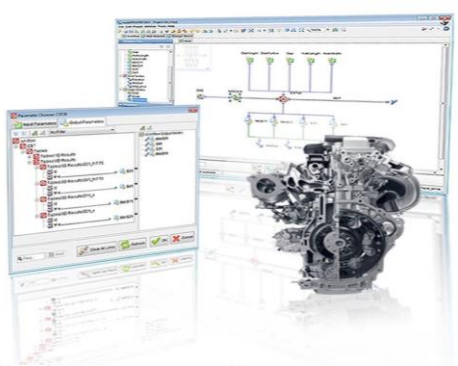
helping to develop optimal control strategies, power management, torque/speed coupling & vehicle dynamics



Enhancing multidisciplinary behavior at system level (mechanical, electrical, thermal & magnetics)



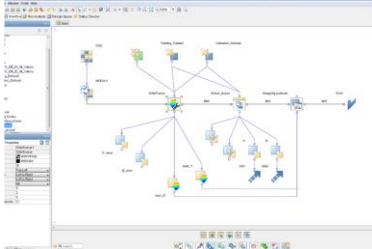
identifying the optimal configuration and size of HEV/EV powertrains & components





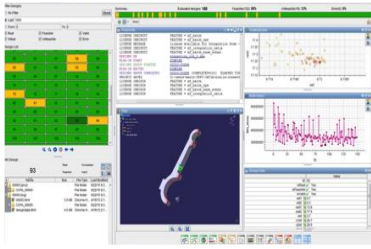
modeFRONTIER Technology

modeFRONTIER offers a **modular environment** giving access to different sets of functionalities



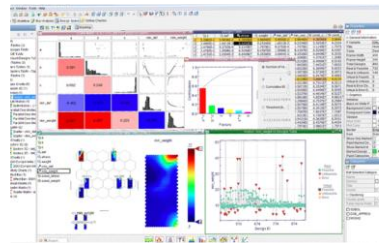
ACCESS THROUGH **mFmP**
modeFRONTIER modePROCESS

WORKFLOW BUILDING



ACCESS THROUGH **mF**
modeFRONTIER

PROCESS MONITORING



ACCESS THROUGH **mFmS**
modeFRONTIER modeSPACE

ANALYZING RESULTS



LUCID

ENGINEERING THE ELECTRIC VEHICLE
REVOLUTION - EXTRAPOLATION IS NOT
PREDICTION



ESTECO Technology Day on Optimization

David Moseley
Director, Powertrain

Lucid

- California-based electric-vehicle startup company
- Founded 2007 as Atieva by ex-Tesla / Oracle execs
- Initially developing battery pack technology
- Now developing our first vehicle - the Lucid Air
- In 2016, Atieva was appointed by FIA as the sole battery-pack supplier for Formula E



Essence

ENERGY



PERFORMANCE DRIVING

TIME



URBAN COMMUTING

SPACE

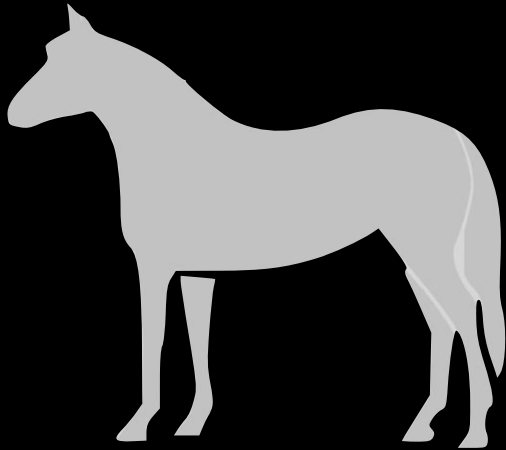


SUBLIME LUXURY

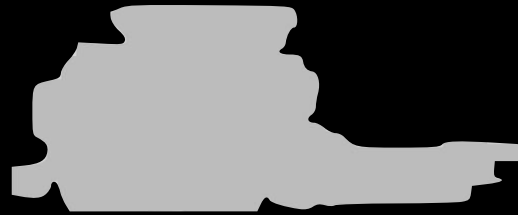
Engineering for Space



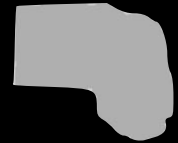
Engineering for Performance



1 HP



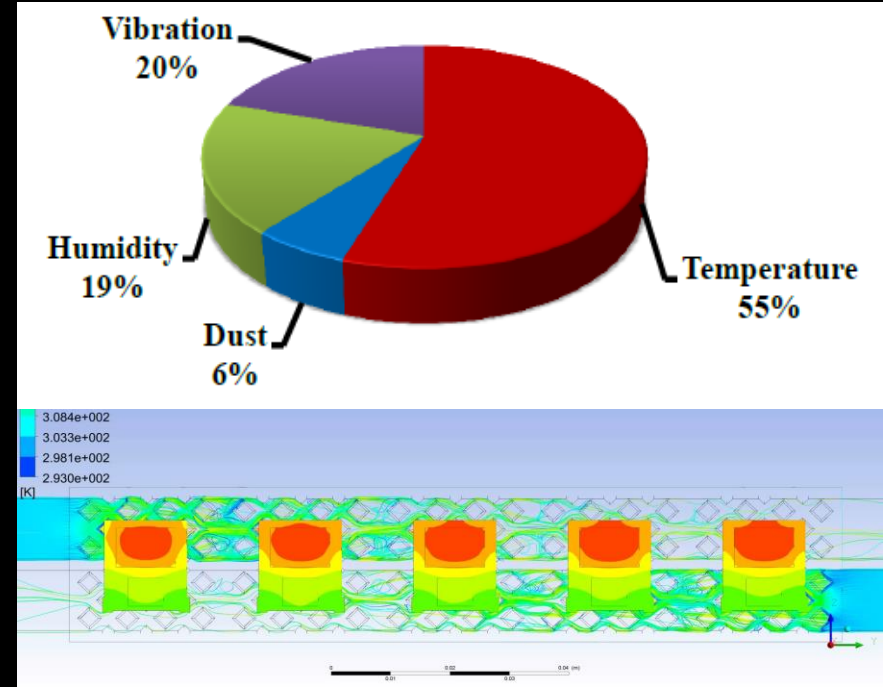
300 HP



600 HP

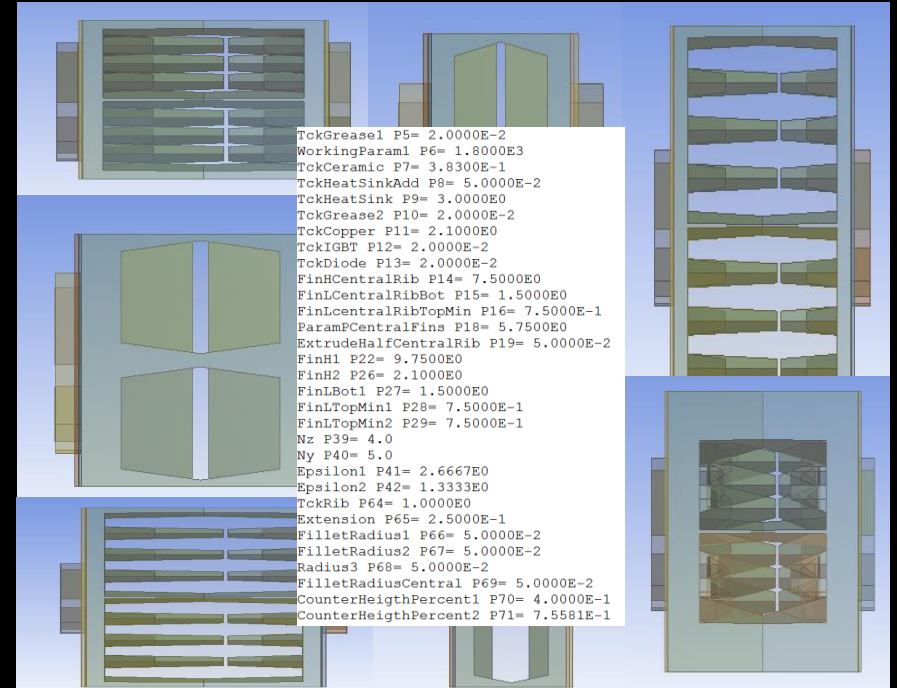
Inverter Design Challenges

- Electronic device failure rates are strongly linked to temperature
 - Doubling with every 10°C rise
- Efficiency driven by
 - Low chip-to-coolant thermal conductivity
 - Temperature equality
 - Low pumping pressure
 - (Physical size)

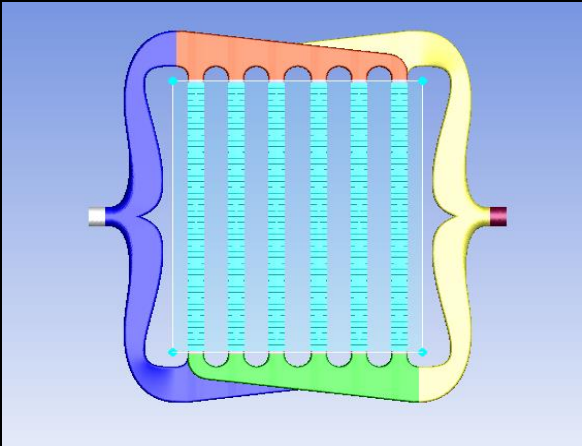
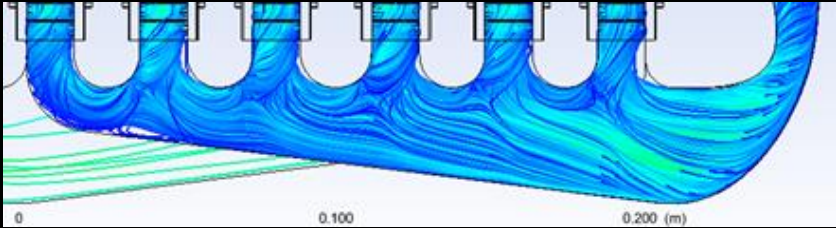


Design Strategy

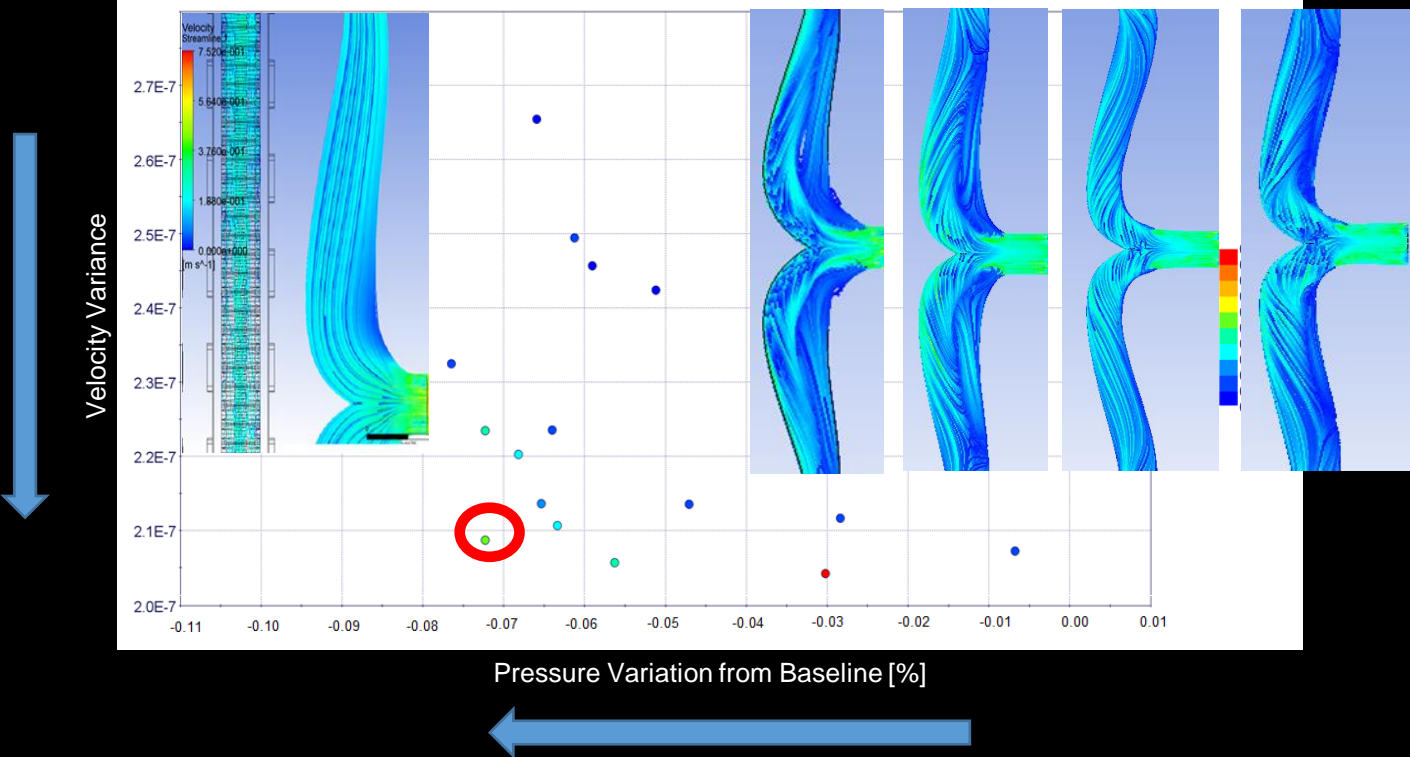
- Conceptual design of cooling channel
- A fully-parametric model ...
- ... enabling a near-arbitrary CFD channel model to be built



Optimization – Manifold Design

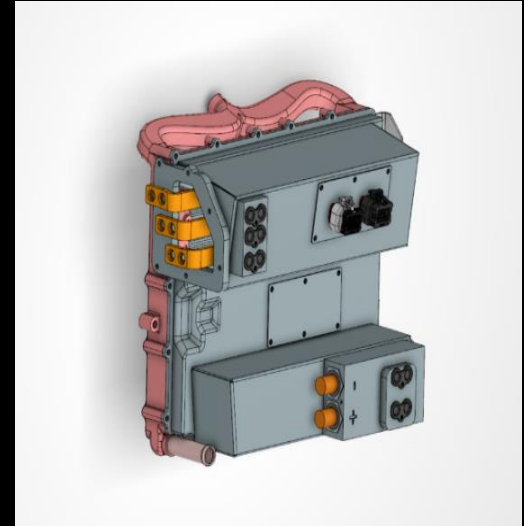


The Inverter Design Challenge



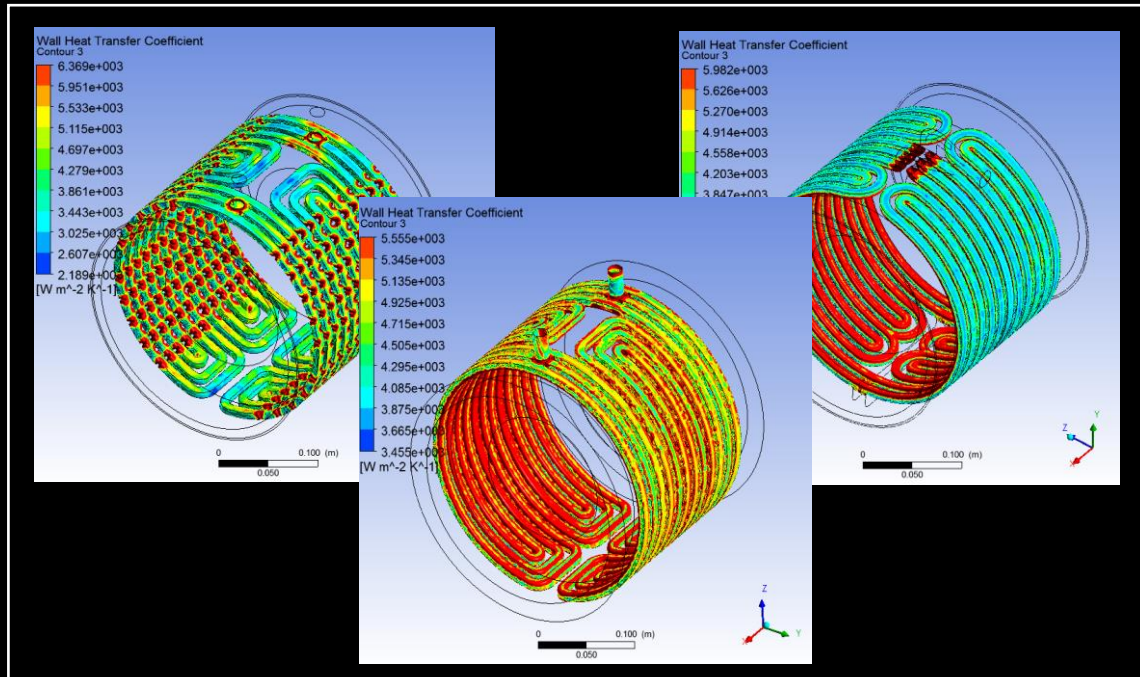
Optimization – Consequences

	Lucid (Gen 3)	Lucid (Gen 4)
Current	1500 A	1200 A
Power	450 kW	350 kW
Power Density	30.0 kW / litre	~39 kW / litre
	29.3 kW / kg	~40 kW / kg

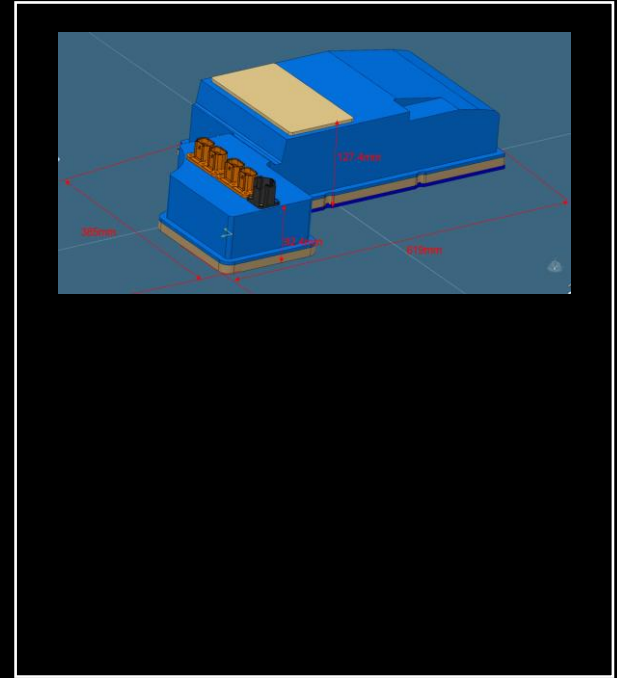


Pervasive Thermal Analysis Optimisation

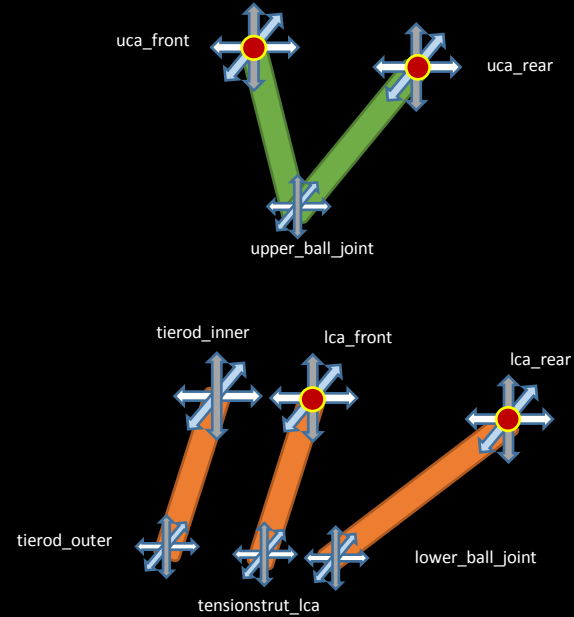
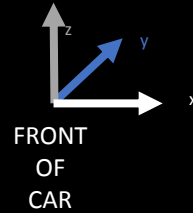
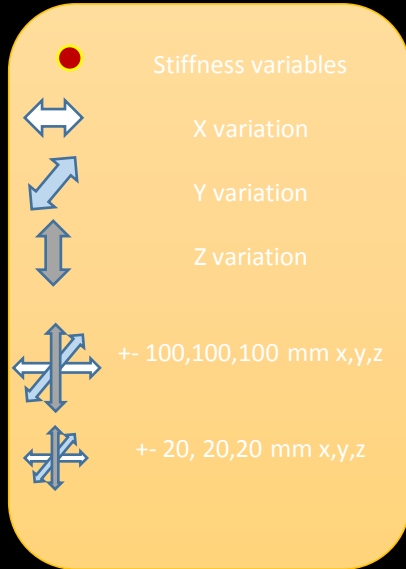
Motor Cooling



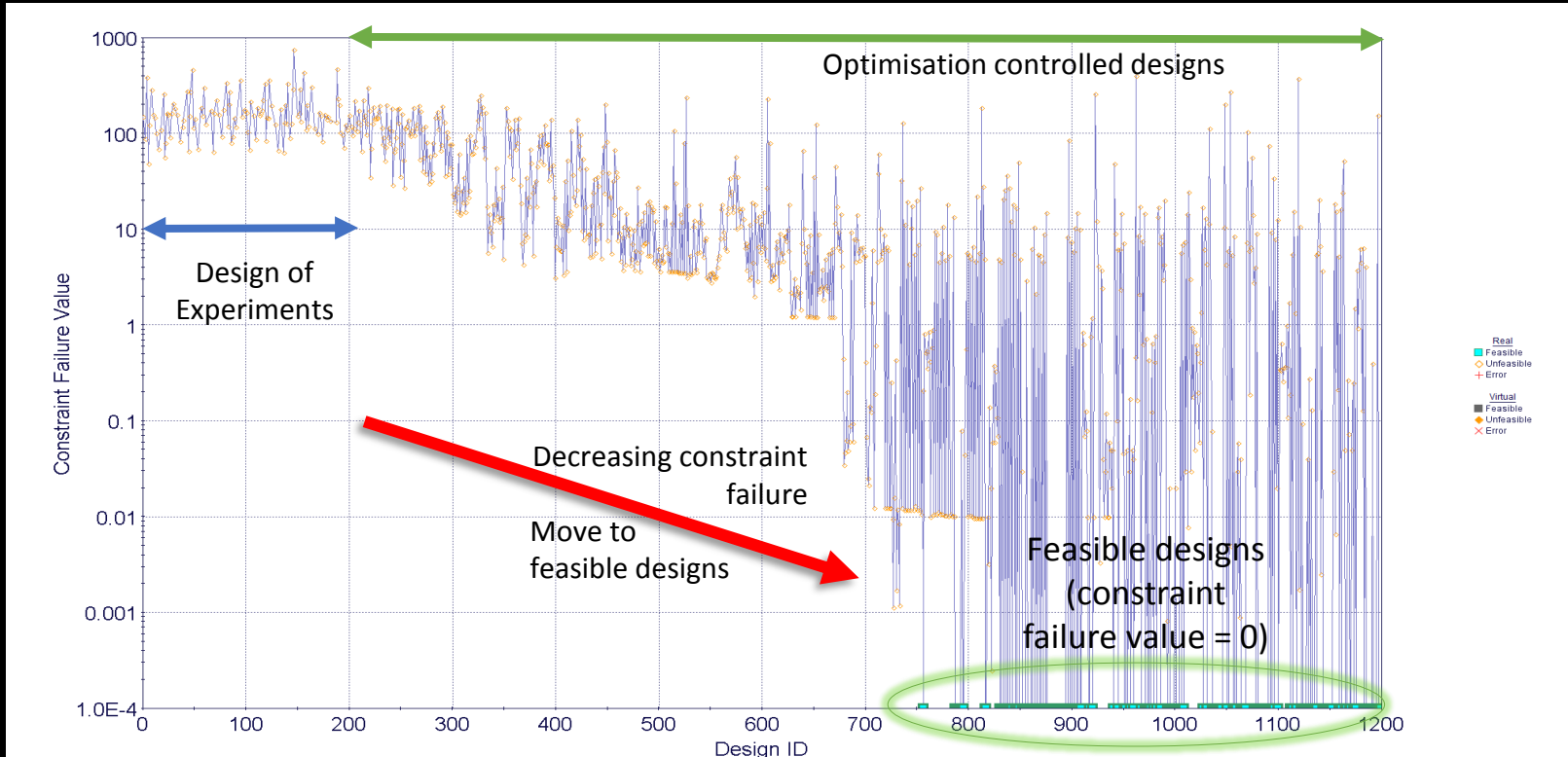
Onboard Charger Cooling



Suspension Optimisation (ADAMS)



Adams modeFRONTIER Design Exploration



Extrapolation is Not Prediction



“IN 2050, URBAN MOBILITY
WILL USE 17.3% OF
THE PLANET’S BIOCAPACITIES,
5X MORE THAN IN 1990”

A D Little – Future of Urban Mobility

Three Millennial “Wants”

- Green Tech
- Safety
- Communication





Preparing For The Future

Optimization results

Alternative Inverter optimal designs identified: efficiency enhanced, failure rates minimized

modeFRONTIER optimization

Design process automation, quick optimization setup and execution and decision-making support help overcome such highly constrained design problems

Towards a green powertrain technology

Urbanisation and its sustainability
Demands of a new generation, with new values and expectations



THANK YOU





Thank you for your attention!

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[Sales: na.sales@esteco.com](mailto:na.sales@esteco.com)



EXPLORE DESIGN PERFECTION

