Suspension Lightweighting with Adams Marc Co-simulation

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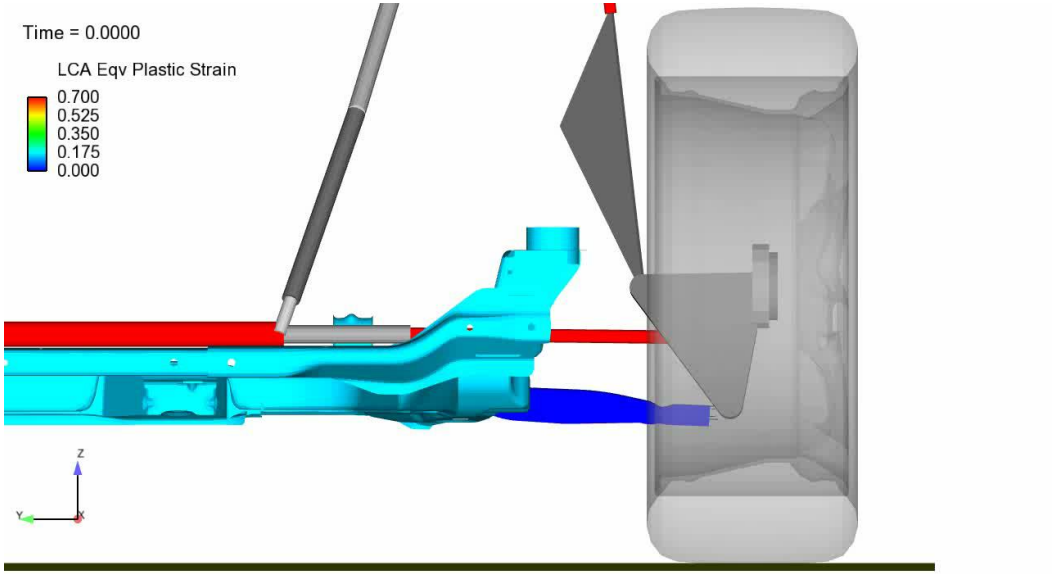
Introduction

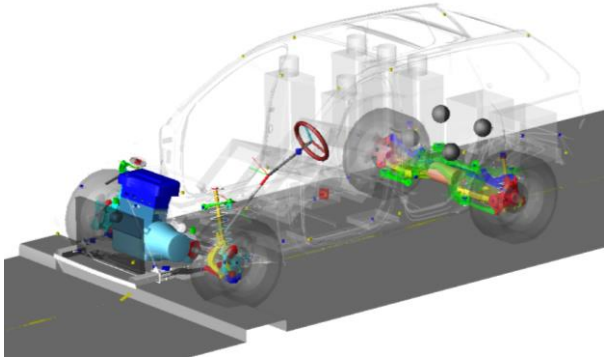
- **Objective:**
  - Meet performance requirements with a lighter suspension to improve the fuel economy



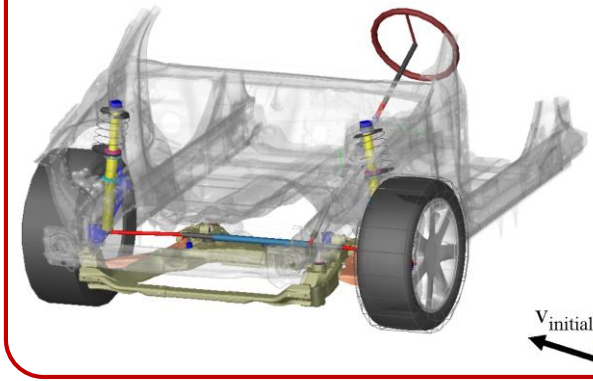
Load Cases - Background

- A vehicle can be subjected to high impact loads a few times during its life cycle
- Test sample: Volvo S80 front suspension
- Two important cases from Volvo Car Corporation (VCC):

Driving over a curb

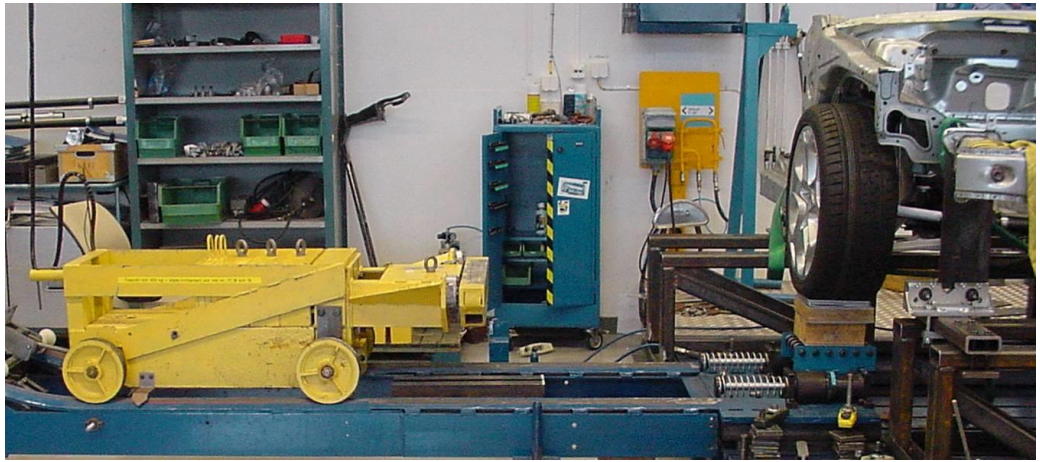


Skid against a curb



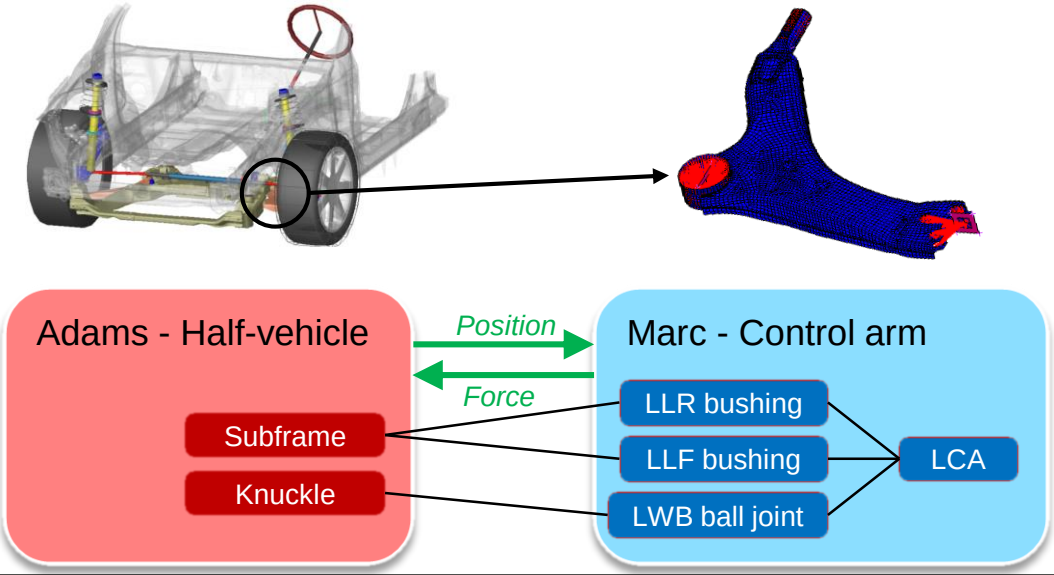
Load Cases - Background

- Events are classified into two categories, Level 1 and 2
  - Level 1 represents extreme customer usage and the criteria is all functions to remain intact
  - Level 2 covers customer misuse and a certain amount of damage is accepted with a safe failure mode



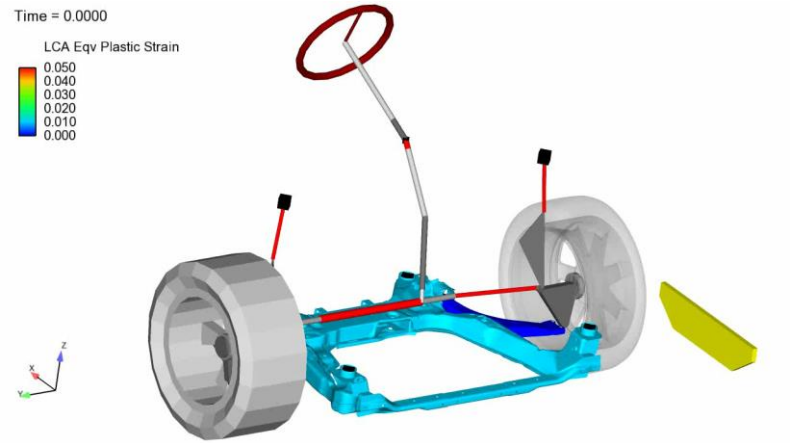
Co-simulation Setup

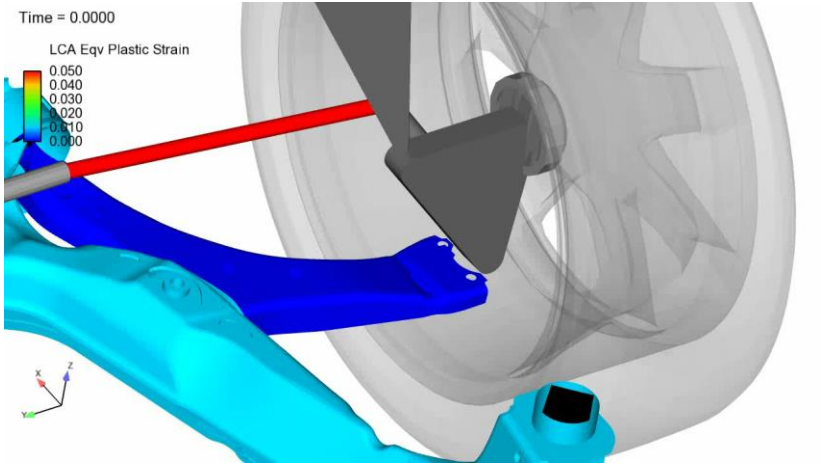
- The Volvo Adams Car model contains the half-vehicle model excluding LCA and bushings LCA-subframe
- Marc model contains the LCA and the two bushings connecting the LCA to the subframe



Skid against a curb, **low impact** velocity

Level 1

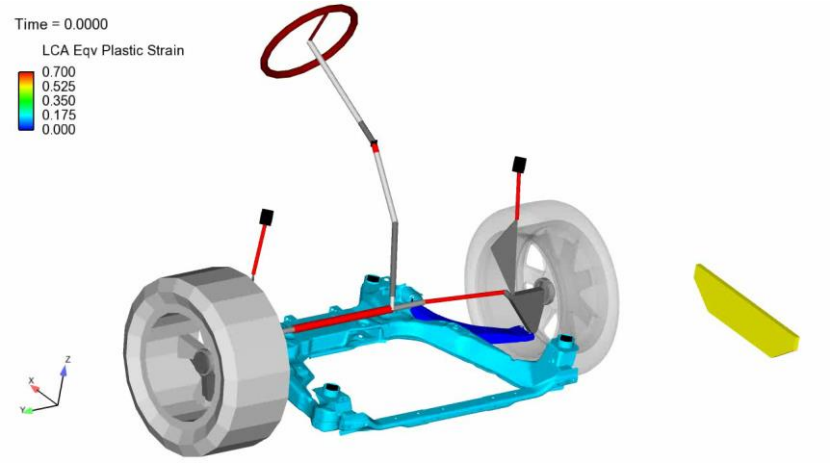


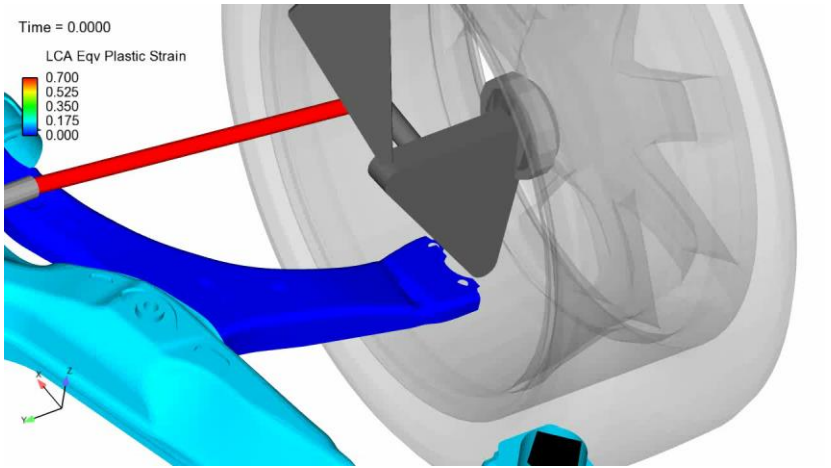


Animation generated using CEI EnSight

Skid against a curb, **high impact** velocity

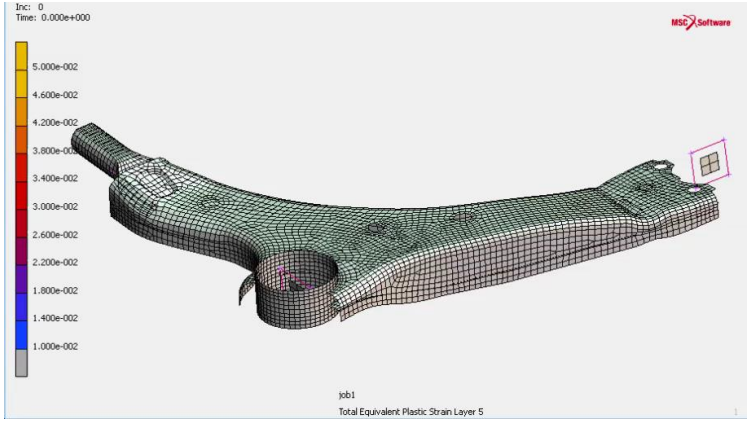
Level 2

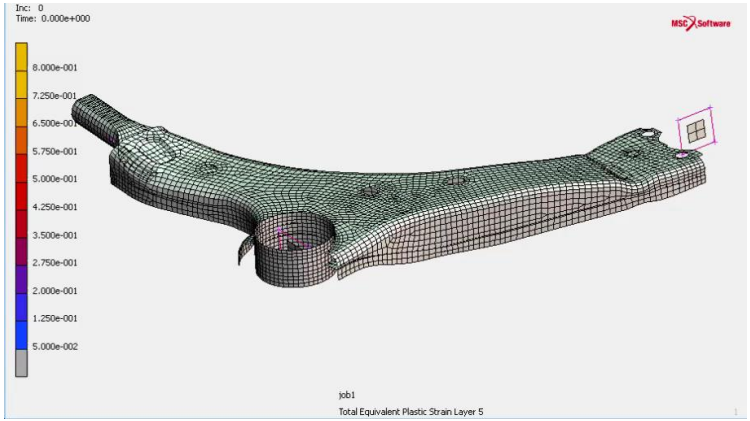


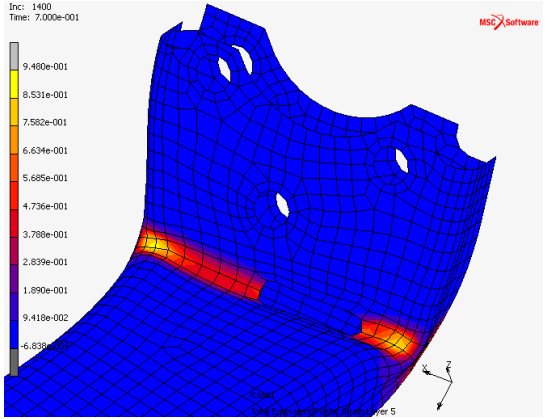


Animation generated using CEI EnSight

Low and high impact velocity, Marc results

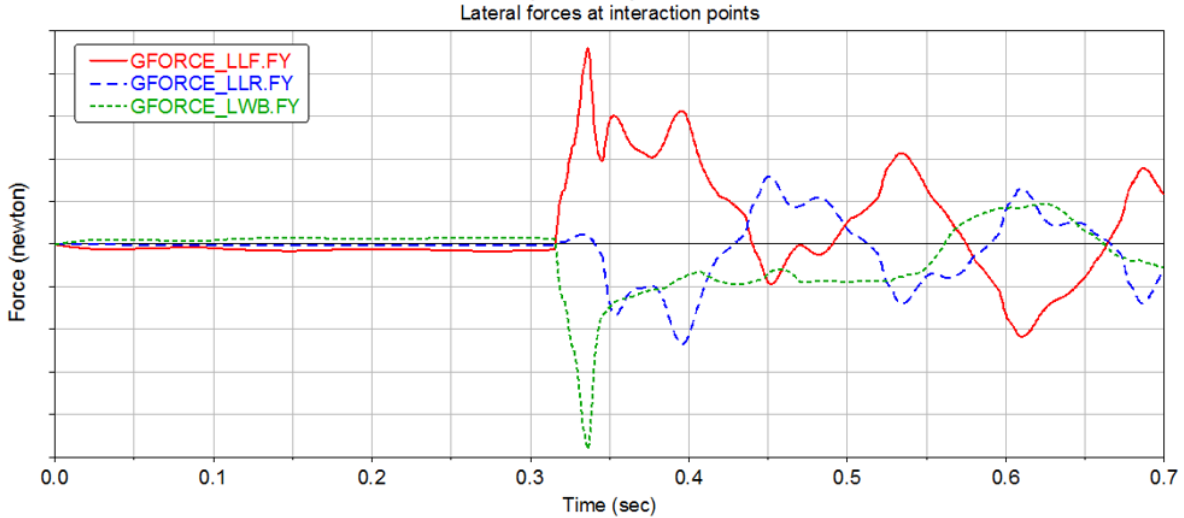






Forces - high velocity impact

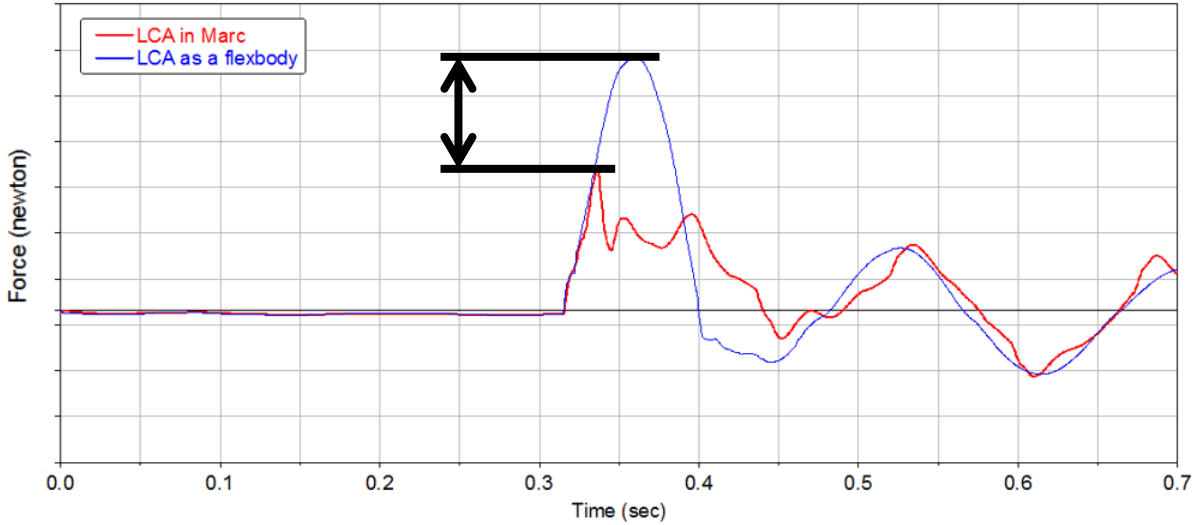
- Lateral forces in link arm connection points



Forces - high velocity impact

Level 2

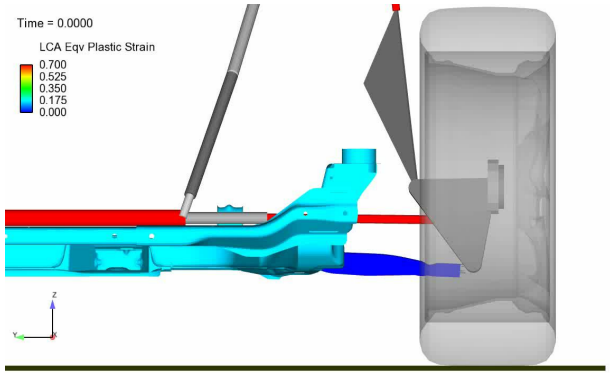
- **Comparison, lateral force in front bushing**
  - Link arm as flexible body (linear elasticity only)
  - Link arm as Marc component (fully non-linear)

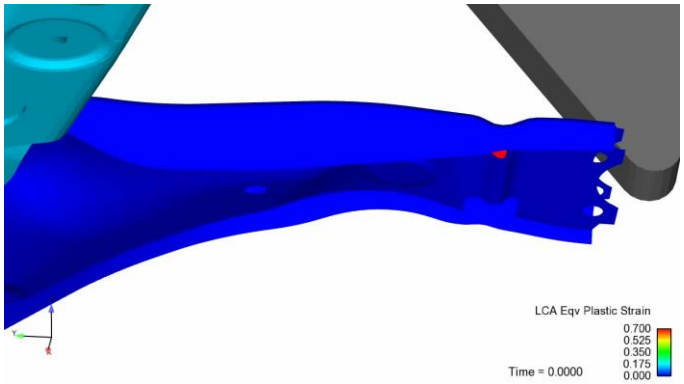


The plot shows the importance of including non-linearity to correctly estimate the peak loads for this type of event

Conclusions

- Adams Marc co-simulation of the Volvo S80 front suspension accurately predicted the behavior of a skid against a curb load case
- Simulation showed same behaviors as physical tests
- Created lighter suspension without overdesigning certain components
- Reduced the prototype verification cycles with more accurate simulation from the beginning





Thank You!

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