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
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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