BI-DIRECTIONALLY COUPLED CFD AND MULTI-BODY DYNAMICS SOLVERS APPLIED TO TANKER TRUCK VEHICLE DYNAMICS

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ABSTRACT

Computer aided engineering is playing a more predominant role in the design process for commercial and passenger vehicles. Better understanding the real time loading and responses on a vehicle during intended (or unintended) use can result in improved design and reduced cost over traditional assumptions. Sloshing of liquid within the cargo tank of a commercial tanker truck results in increased loading on the vehicle's suspension when undergoing different types of acceleration maneuvers. The change in loading can have a significant effect on the design of the vehicles suspension components and braking components. The ability to investigate the fully coupled behavior of the mechanical and fluid systems is a key technology to enable improved designs for these types of applications.

In this work, the multi-physics problem arising from fluid sloshing within a tanker truck undergoing acceleration is investigated through the use of bi-directional coupling between AcuSolve and MotionSolve. This application represents a challenging test case for simulation technology within the design of commercial vehicles.

The presentation covers a computational fluid dynamics (CFD) analysis of a simplified tanker truck undergoing straight line acceleration. Bi-directionally coupled solvers are used to compute the multi-body-dynamic (MBD) responses of the vehicle due to sloshing within the vehicle’s tank. The changes in the fluid volume within the cargo tank are computed by the CFD code using an Arbitrary Lagrange-Eulerian (ALE) mesh motion approach. The forces resulting from the sloshing are then passed to the MBD solver and the response of the tanker truck is computed. This exchange of forces and displacements occurs at run time and is enabled through a socket connection between the two solvers.