# Coupled Fluid / Structure Interaction Simulation Using Abaqus CEL

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*For a system which involves a fluid medium contained inside a deformable structure, such as a fuel tank system, a simulation which couples the structure and fluid may be required depending on the system performance metric of interest. Simulation methods for fluid / structure interaction (FSI) have been gradually developed by CAE engineers since the advent of increased computing power. A limitation in using previous FSI simulations is the dynamic event time period that the FSI method can simulate. With the new CEL function, Abaqus can simulate a coupled fluid / structure dynamic event of several seconds real-time duration in days instead of weeks as compared to other available software. Abaqus/Standard and Abaqus/Explicit CEL function can be used to create a seamless fuel tank system simulation method to assess the fuel tank assembly and road loading performance.*

*Keywords: sloshing, coupled Eulerian-Lagrangian, fluid / structure interaction (FSI)*

## 1. Introduction

When a vehicle is accelerating or decelerating on a road surface, the fuel inside a fuel tank sloshes, and the moving fuel exerts pressure on the fuel tank surfaces. This transient hydrodynamic pressure is also transmitted to the fuel tank straps and the supporting body/frame structure in contact with the fuel tank shell as well as components inside the fuel tank. The consequences are that the following vehicle performance may be affected: (1) airborne and structure-borne slosh noise and (2) fatigue life of the fuel tank, straps, and components inside the fuel tank. For such a fuel tank system, a simulation which couples the structure and fluid may be required. One of limitations in using existing FSI (Fluid Structure Interaction) simulations is the dynamic event time period that the FSI method can simulate within an acceptable turnaround time.

The new pure Eulerian analysis capability in Abaqus/Explicit allows effective modeling of applications involving extreme deformation, including fluid flow. The Eulerian capability can be coupled with traditional Lagrangian capabilities to model interactions between highly deformable materials and relatively stiff bodies, such as in fluid-structure interactions. This new capability is called the Coupled Eulerian-Lagrangian (CEL) function and was released by Simulia in Abaqus 6.7EF. With CEL, fluid sloshing can be