ACOUSTIC ANALYSIS OF FUEL TANK SLOSHING DURING BRAKING

D. Marriott[1], I. Demin[2]

[1]MSC Software, [2]TI Automotive

ABSTRACT

Predicting sloshing noise as early as possible during the design process has become an increasingly desired simulation for fuel tank suppliers. It enables suppliers to build products directly to customer specifications, at the minimum cost, in a shorter timeframe. Ideally, it needs to be run during the quote stage to avoid hidden obstacles later.

With good correlation to physical results and with an established user base, sloshing simulations can now be augmented by investigation into the noise aspect of the fluid structure interaction of the fluid and tank with the surrounding environment. Novel approaches have been incorporated to smooth this chaining of simulations between the CFD and acoustics solvers.

Traditional CFD sloshing methods tend to take from five to nine days to run the slosh test to completion. The method that has been developed is based on utilizing Dytran (explicit nonlinear fluid-structure interaction solver) and requires only a few days to run while also including the effects of the flexible structure – something which traditional CFD cannot do.

With the rise of acoustic solvers to solve in more detail noise and noise abating techniques using special coating materials or identifying source locations for further structural improvement, the scope of applications are growing as well. Of the two main methods of acoustic analysis, vibro-acoustics for structural vibration noise source and aero-acoustics for pressure sources in different medium, vibro-acoustics will be used in this example.

This study investigates the chaining of Dytran and Actran to solve for the vibro-acoustic noise of structures undergoing an explicit dynamic event.

Initial undertaking of solving for sloshing noise by chaining the Dytran structural acceleration results for all the surface nodes as an input to Actran vibro-acoustics, identified key issues that are further investigated. The initial procedure identified large data files that need to be processed as well as the role of filtering for explicit solver noise. Also identified was the role of improved realism on the sloshing simulation side to produce accurate acoustic results. These lessons were then used to improve the process for a more integrated chaining procedure and using the best acoustic solver for the right transient application.

The new acoustic result was then compared to test result.

Simpler models were also used to validate the chaining procedure more carefully to identify potential crucial areas where slight deviations could have a significant impact on the acoustic results.

SUGGESTED THEMES

Sloshing, noise, automotive, CFD, FSI, acoustics, explicit, Actran, MSC Nastran, Dytran