MULTI-BODY DYNAMICS AND ACOUSTIC SIMULATION FOR GEAR APPLICATION

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ABSTRACT

Gear systems are widely used in automotive, train and heavy machine industries. In the past decades, acoustic optimization focused much on vehicle power components like the engines. The reduced engine noise has therefore led to the emergence of secondary noise sources, among which, the transmission noise. Henceforth, gear noise becomes an important source of inconvenience for customers and environment. Gear noise is mainly due to the gear tooth contact. It is well known that improving the design of gear and teeth can reduce the noise emitted by the system. In this way, the multi-body dynamics software, Adams, helps to simulate the gears in their environment (casing). This simulation can also include flexible bodies, modeled by finite elements (FEA), which enable the transmission of the rattle to the case to induce the case vibration. The FEA modeling not only adds the physics of structure dynamics to the simulation process but also increases the fidelity and accuracy of the numerical model. The Actran software can then be used to simulate the acoustic radiation around the casing from its surface vibration. Multiphysics are therefore highly established in the simulation process and all the steps are simulated in time domain. Multi body system and structural dynamics are strongly coupled, taking into account mass, inertia and stiffness effects. Then acoustic radiation is handled by a weak coupling simulation.

To reduce the engineering effort, a software plugin is now integrated into the Adams GUI interface. This helps the engineer to launch the acoustic simulation directly from Adams without opening Actran. Typical acoustic results are computed and output automatically, including sound pressure level at selected positions around the gear case, audible wave files for listening to the sound and color maps to visualize the sound radiation.

Typical applications are presented. The first is the analysis of clutch noise of a gearbox. The related sound is purely transient and can only be handled in time domain. The second application is the increase of the rotation speed of rotor shafts (run-up), which illustrates the analysis of rattle noise.