ACCELERATING MID-FREQUENCY ACOUSTIC SIMULATIONS IN MSC NASTRAN USING PARALLEL PROCESSING

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ABSTRACT

Traditional Finite Element (FE) based modal approaches—which are deterministic (non-probabilistic) in nature—are frequently employed by automotive industry to predict the frequency response of large vibro-acoustic models involving a body structure coupled to an acoustic cavity. The accuracy of a deterministic FE based modal approach is sufficient in the low-frequency range where the modal densities are typically low and their natural frequencies are well separated. In the mid-frequency range (300 Hz – 2000 Hz), the modal densities are typically high and non-uniform, which causes the response to be highly sensitive to model parameters such as material and geometric properties, etc. To better gauge the response in the mid-frequency range requires a non-deterministic (probabilistic) approach that can handle model uncertainties. One approach under exam-ination for use in the automotive industry is the non-deterministic NPVM approach [1-3]. It has already been successfully applied on industrial vibro-acoustic models [4,5].

The NPVM approach is a Monte-Carlo approach that can require 1000s of frequency response simulations to generate the requisite data needed for a non-deterministic averaging. Often in a frequency response simulation for vibro-acoustic models, the dominant cost is the computation of the modes to generate a model representation. In the NPVM case, the overall wall clock time is dominated by the frequency response calculations. As each one of the potentially 1000s of frequency response calculations are independent, the problem can be considered embarrassingly parallel. Thus, it is crucial that distributed memory parallelism (DMP) be available and easy to use. In this presentation, for the NVPM approach, we consider distributed parallel performance and use within MSC Nastran. We explore initial performance opportunities using a combination of distributed memory processing as well as shared memory processing (SMP) for each frequency response calculation. We explore several options for SMP parallelism within frequency response calculation from Intel's MKL Pardiso to dense linear algebra algorithms. It will be shown that MSC Nastran's existing DMP and SMP capabilities, coupled with Intel MKL Pardiso multithreaded solver, allow for optimal usage with additional performance improvements to be obtained in the future.

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