

## Case Study

# Energy Finite Element Analysis by MES used to Control Interior Automotive Noise

### Business Profile

Michigan Engineering Services, LLC (MES) is a research and development company, specializing in developing commercial software and advanced technology for engineering simulations. MES' activities span both the defense and the commercial industrial sectors. Through the engineering services component of MES, an efficient technology transition is facilitated to its customers.

### Need

Automotive companies have the need to control airborne noise which gets generated in the interior of a vehicle due to external sources such as motors, engine, transmission, tires, etc. It is strongly desired to have the least amount of noise with the smallest possible penalties in cost and weight.

### Challenge

Numerical methods can offer information for determining the type, quantity, and placement of acoustic, mass, and damping treatments. Using conventional Finite Element Analysis (FEA) for simulations up to 8KHz to 10KHz (typical upper frequencies of interest for airborne noise) is either computationally expensive or infeasible, due to the small size of finite elements which are required to model the vehicle at such high frequencies.

### Solution

The Energy Finite Element Analysis (EFEA) requires a small number of elements in the model because the new primary variables are based on the energy of the structural vibration and of the acoustic field. The EFEA uses a library of elements (similar to the FEA) for modeling any physical system and a library of joints (similar to the coupling loss factors in Statistical Energy Analysis) for representing the power transfer mechanisms which exist in the system.

### Benefits

The EFEA model can be developed using the same tools (i.e. Altair HyperMesh™) and by following a process similar to developing FEA models. Due to the significantly fewer elements required compared to FEA, alternative designs can be evaluated rapidly enough in order to influence the design.

### Results

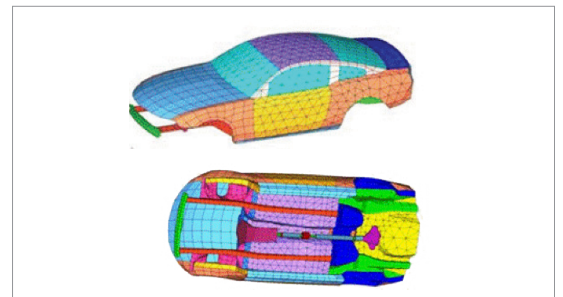
The simulation results have been compared successfully to test data multiple times for production vehicles. Panel contribution analysis identifies the most effective utilization of treatment.

# MES

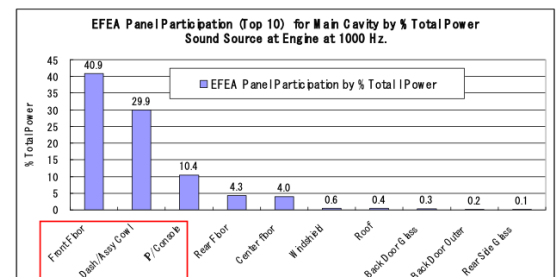
Michigan Engineering Services



Controlling Automotive Interior Noise



Structural and Acoustic EFEA Model



Main Panel Contributions to Interior Noise

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