Ride Comfort Optimization of a City Bus

Project Description
Using global optimization techniques, improve ride comfort for passengers in a city bus due to the bus going over road irregularities.

Analysis Model
Beam, shell and spring elements were used to model the entire bus
# of elements: 10694
# of nodes: 7861 (47154 degrees of freedom)
Analysis: Linear time domain analysis with ABAQUS (static condensation procedure is used)
Loading: Prescribed displacements at the bottom of the tires

FE model of city bus

Design Variables
Parameters of the three subsystems affect the ride comfort: the power unit isolation, the wheel suspension, and structural parts of the chassis frame and the body. Since other parameters could not be changed, the stiffness and damping parameters of the power unit mounts were used as the design variables. There were four design variables.

Cost Function
The ride comfort has been defined in terms of the root mean square (RMS) of the frequency-weighted acceleration in the vertical direction at a specific location in the bus (ISO Standard, 1997). Three locations were used to define this discomfort function: driver's seat, middle standing area, and sofa in the back. It is desired to minimize this function.

Constraints
Bounds on the design variables.

Results
Several local optima were found using different algorithms. Each run took about 2 -6 days on an SGI Octane workstation. The normalized local optima varied between 0.9794 to 1.0641. The ride comfort parameter improved by only about 8 percent compared to the nominal design.