Naval Research Laboratory - Office of Naval Research
Materials Science and Technology
http://mstd.nrl.navy.mil

Science and Technology Success Stories

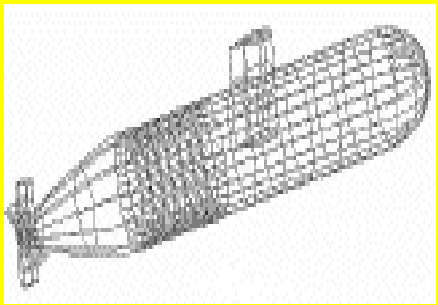
Accurate Model Reduction For Large Problems

The Naval Research Laboratory (NRL) has an ongoing program developing new, highly accurate model reduction methods for application to large degree of freedom (DOF) computer simulations of heterogeneous materials and structures. The approach is based upon projection operators, is applied to the entire governing set of differential equations, and encompasses most of the known methods.

Recently, this effort has successfully combined model reduction with frequency windowing to produce a new class of methods called Frequency Window Reduction (FWR) for application to large structural acoustics as well as electromagnetic problems. FWR is incorporated within a finite element environment and allows large reductions in DOF while maintaining high accuracy. The response at hundreds of frequencies can now be calculated solving greatly reduced problems. Modal methods (with arbitrary loadings allowed for re-analysis) have also been directly included into FWR yielding unprecedented accuracy for reduced models.

LARGE FEM STRUCTURAL MODELS

many degrees-of-freedom (DOF's) because of:



- complex geometry
- large differences in scales
- coupling to "infinite" media
- all of the above

Accurate Model Reduction For Large Problems

Military Impact

- Ability to perform accurate frequency sweeps of very large models of naval and aerospace structures
- Direct incorporation into Naval acoustic FEM code(s)
- Improved predictive capability for many applications in acoustics and electromagnetics

Potential Civilian Spin-offs

- Incorporation into a major FEM commercial program for world-wide use
- Improved acoustic analysis of many commercial structures in aerospace, automotive, etc

Point of Contact

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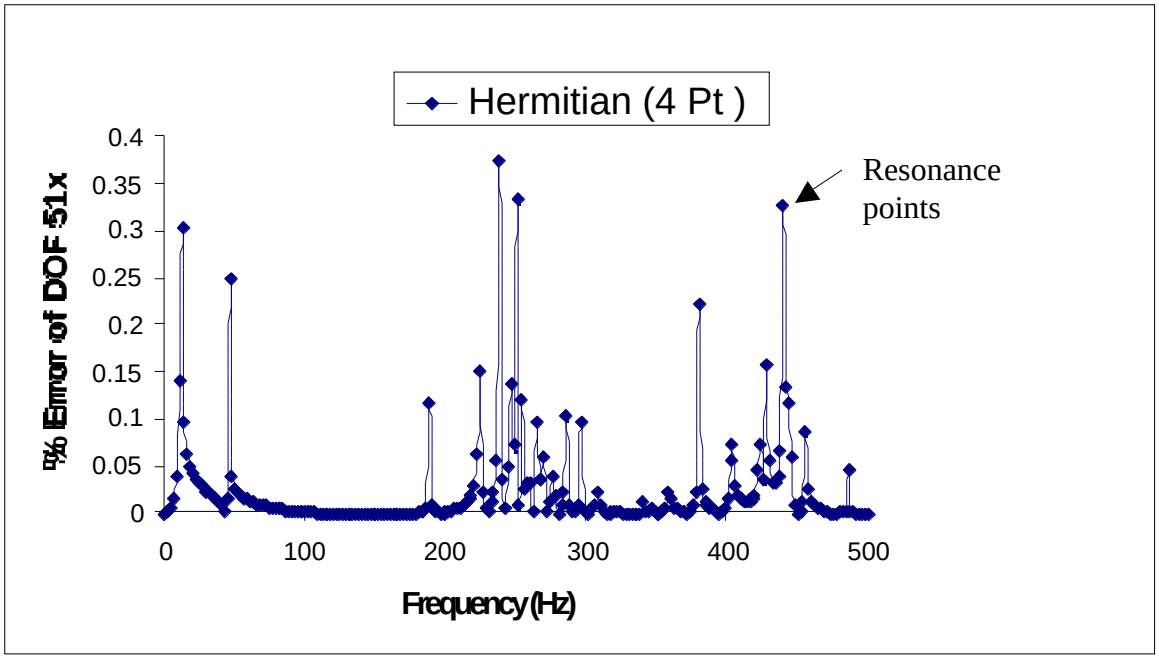

Example of FWR results (no modes included) for a half sphere shell model. 71% reduction in DOF, and very high accuracy with the error under 1% across the entire frequency window. Four point Hermitian interpolation used for the frequency window.