

"Highly Efficient Modal Frequency Response Analysis"



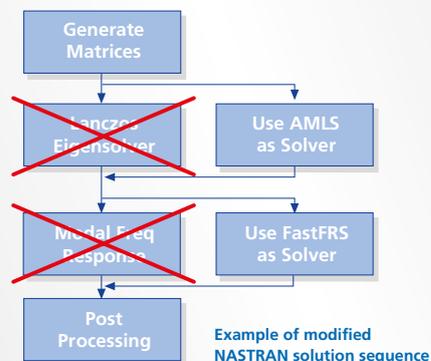
Why another solver?

The availability of the Automated MultiLevel Substructuring (AMLS) software has enabled frequency response analyses using very large FE models and many modes. With certain simplified types of damping the resulting modal matrices can be solved easily. However, modeling damping accurately can make modal frequency response problems computationally very expensive to solve. Accurately modeled damping results in matrices that are fully populated rather than diagonal. The modal frequency response then requires a matrix factorization at each frequency. The time required for each factorization is proportional to the cube of the number of modes, so analyses up to higher frequencies, for which many modes are required, become extremely expensive.

FastFRS (fast frequency response solver) addresses this issue by performing only one numerical operation whose cost is proportional to the cube of the number of modes, rather than one such operation at each response frequency. The solver obtains an exact, direct solution, rather than an approximation for which the user specifies a cutoff frequency, a convergence tolerance, or some other parameter requiring special expertise or instruction. As a result, FastFRS is very reliable and easy to use.

Implementation

CDH/FastFRS has been implemented with an interface to MSC.NASTRAN, MD.NASTRAN, NX-NASTRAN and ALTAIR RADIOSS software, so that it can be used in industrial vibration and acoustic analysis. CDH/FastFRS can be used in modal frequency response (NASTRAN SOL111) analysis and requires a minimum of effort on the part of the user to take advantage of drastic reduced job turnaround times.



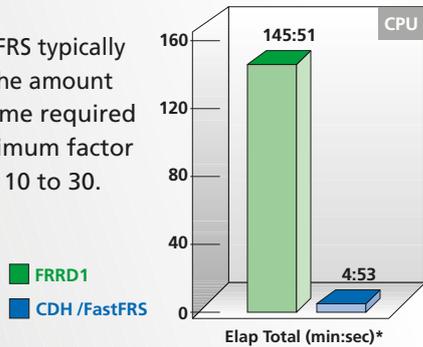
FRF Solution method

- Direct (FRRD1) solution requires $\sim m^3/6$ operations for factorization of a dense coefficient matrix at each frequency, where m is the number of modes.
- It is advantageous to solve an eigenvalue problem whose cost is proportional to m^3 only once, making the per-frequency cost of the remaining computation proportional to m^2 .
- Demonstrated dramatic improvement on many industrial FR problems.

Performance

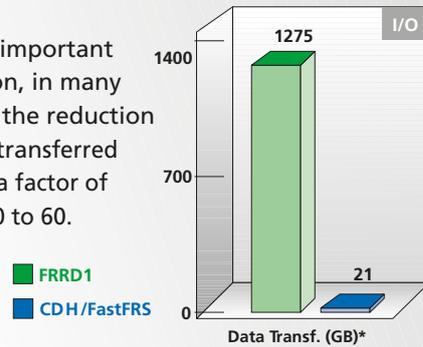
CPU

CDH/FastFRS typically reduces the amount of CPU time required by a minimum factor of about 10 to 30.



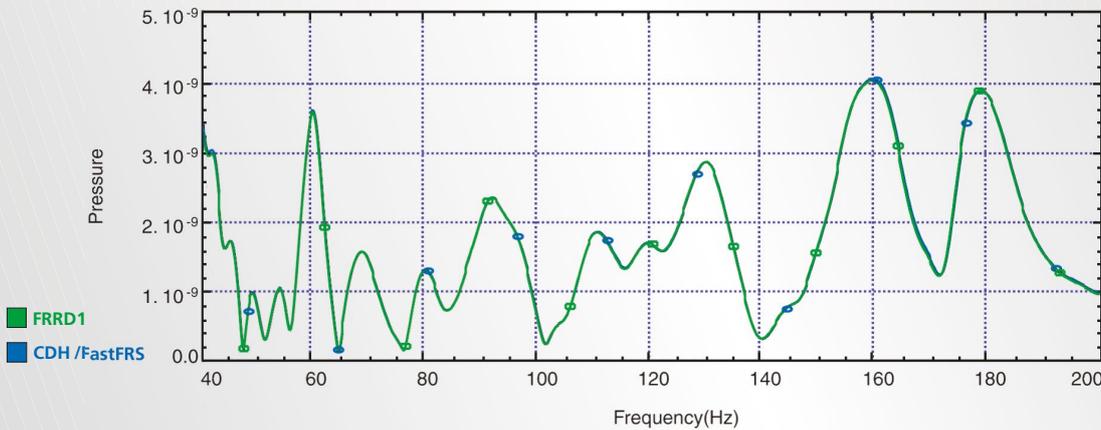
I/O

A more important reduction, in many cases, is the reduction in data transferred (I/O) by a factor of about 40 to 60.



*Model Size: 16 Mio DOF, 7406 Modes, Modal Frequency Response Analysis. All calculations are carried out using NASTRAN on a Linux 64 compute server (8 cores).

Accuracy



Summary

- Combination of AMLS and FastFRS allows the user to solve NVH problems to even higher frequencies.
- With many modes, diagonalizing the modal FR problem is much more efficient than solving a fully coupled problem at each frequency.
- Result, the most efficient solution method available, with no truncation error.

Software-Hardware Support:

Supported Software:

MSC.NASTRAN
MD.NASTRAN
NX NASTRAN
Altair RADIOSS

Supported Hardware:

HP-UX (ia64)
IBM AIX
Linux64 (x86_64 and ia64)

MSC.NASTRAN is a proprietary product of MSC.Software Corporation.
MD.NASTRAN is a proprietary product of MSC.Software Corporation.
NX NASTRAN is a proprietary product of Siemens Product Lifecycle Management Software Inc.
Altair RADIOSS is a proprietary product of Altair Engineering, Inc.

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