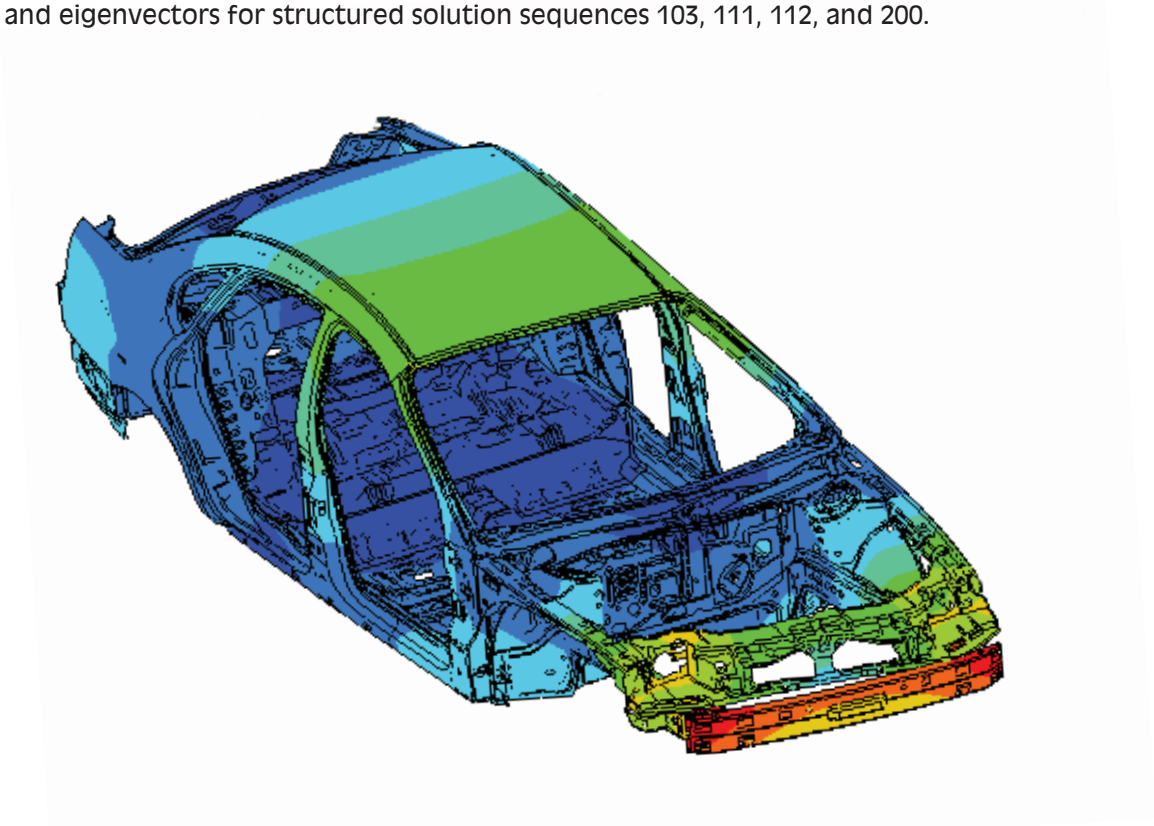
SMS

High Performance Eigensolver Software

SMS is a high performance software for calculating eigenvalues and eigenvectors during structural vibration analyses. Often the lowest natural frequencies of a finite element model are directly related to some performance index of the structure. Additionally, eigenvalue information is used to create a modal reduction of the structural model to reduce the cost of frequency response and/or transient dynamic analysis. Improving the performance of the eigensolution process has a beneficial effect on many analysis tasks.

Vanderplaats Research & Development, Inc. (VR&D) provides the SMS eigensolver that dramatically reduces both the CPU and elapsed times for all ranges of problem sizes compared to the current state-of-the-art Lanczos algorithm. A multiprocessor implementation of SMS is available in the latest GENESIS release, as well as in the stand-alone product, VRAND/SMS. VRAND/SMS is a plug-in for MD Nastran (formally MSC NASTRAN from MSC.Software), and NX.NASTRAN (from Seimens PLM Software) that uses SMS to solve the eigenvalues and eigenvectors for structured solution sequences 103, 111, 112, and 200.



- SMS allows eigensolutions to run from 2 to 5 times faster than the conventional Lanczos method on small to midsize problems and 5 to 10 times faster for large scale problems
- SMS can perform eigensolutions on extremely large finite element models that are often unsolvable using Lanczos
- Setting up the substructure scheme is completely encapsulated - all the user has to do is switch SMS on
- SMS requires less disk space than conventional eigensolvers like Lanczos
- SMS processes residual vectors when present (i.e. static augumentation modes)
- VRAND/SMS can optionally calculate the modal damping matrix based on the reduced set of generalized modal coordinates. This speeds up processing for modal transient and frequency response analyses

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The SMS Algorithm

The SMS algorithm is an extension of the Craig-Bampton method for coupling substructures via Component Mode Synthesis (CMS). CMS extends static-condensation based substructures to dynamic analysis by partially accounting for the inertial loading of the substructures by way of a set of truncated, "component" or "fixed interface" modes. This technique has been widely used to manually reduce large eigenvalue problems to more manageable sizes.

SMS is a parallel processor implementation of an algorithm that applies the Craig-Bampton method to each stage of processing in a sparse matrix reduction. Because the method is based on creating approximate reduced component models, it provides approximate eigenvalues and eigenvectors. The implementation is designed such that calculated coupled system frequencies at the upper end of the desired frequency range exhibit less than about 0.3% error. Calculated coupled system frequencies at the lower end of the spectrum typically show less than 0.001% error.

The use of approximate results should not be troublesome to analysts who understand that numerical analysis of structures always involves approximation. It is expected that lower modes are sufficiently accurate for use in design and optimization, while the higher modes are sufficiently accurate for modal reductions.

SMS Usage

SMS is available in GENESIS as an alternative eigensolver to either the Lanczos or subspace iteration methods. The SMS method is selected by inserting "SMS" in the method field of the EIGR bulk data entry.

The number of parallel processors may be set in GENESIS with the executive control command "THREADS = n" where n is the number of parallel threads (i.e. processors) to use.

SMS is easy to use within NASTRAN: users only need to add two INCLUDE lines in their input files and VRAND/SMS will work to speed up the eigensolution.

The SMS solver is also available to third party software companies to be embedded in their own programs. If you are an FE vendor, please contact VR&D to investigate working together to embed SMS into your program.

Other VR&D Products Available

GENESIS - Structural Analysis & Optimization software

GENESIS is a fully integrated finite element analysis and design optimization software package. Analyses include static, normal modes, direct and modal frequency analysis, heat transfer and system buckling. Shape, sizing, topography, topometry and topology optimization are the design options available to the user. Typically the optimization requires less than ten detailed finite element analyses, even for large and complex design tasks.

Design Studio for GENESIS

Design Studio for GENESIS is a design oriented pre- and post-processor graphical interface for the GENESIS program

VisualDOC

VisualDOC is a software system that simplifies adding optimization to almost any design task. It uses a powerful intuitive graphical interface, along with gradient based and non-gradient based optimization, response surface (RS) approximate optimization, and design of experiments (DOE) methods. VisualDOC interfaces easily to your own code or third-party analysis programs.

DOT - Design Optimization Tools

DOT is a general purpose numerical optimization software library which can be used to solve a wide variety of nonlinear optimization problems. If you require only an optimization engine to incorporate into your design software, DOT will serve that purpose.

BIGDOT

BIGDOT is intended to solve very large, nonlinear, constrained problems where gradient information is available, and function and gradient evaluation is efficient. BIGDOT is capable of solving continuous, discrete/integer or mixed variable problems. Problems in excess of 100,000 variables have been solved by BIGDOT.

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