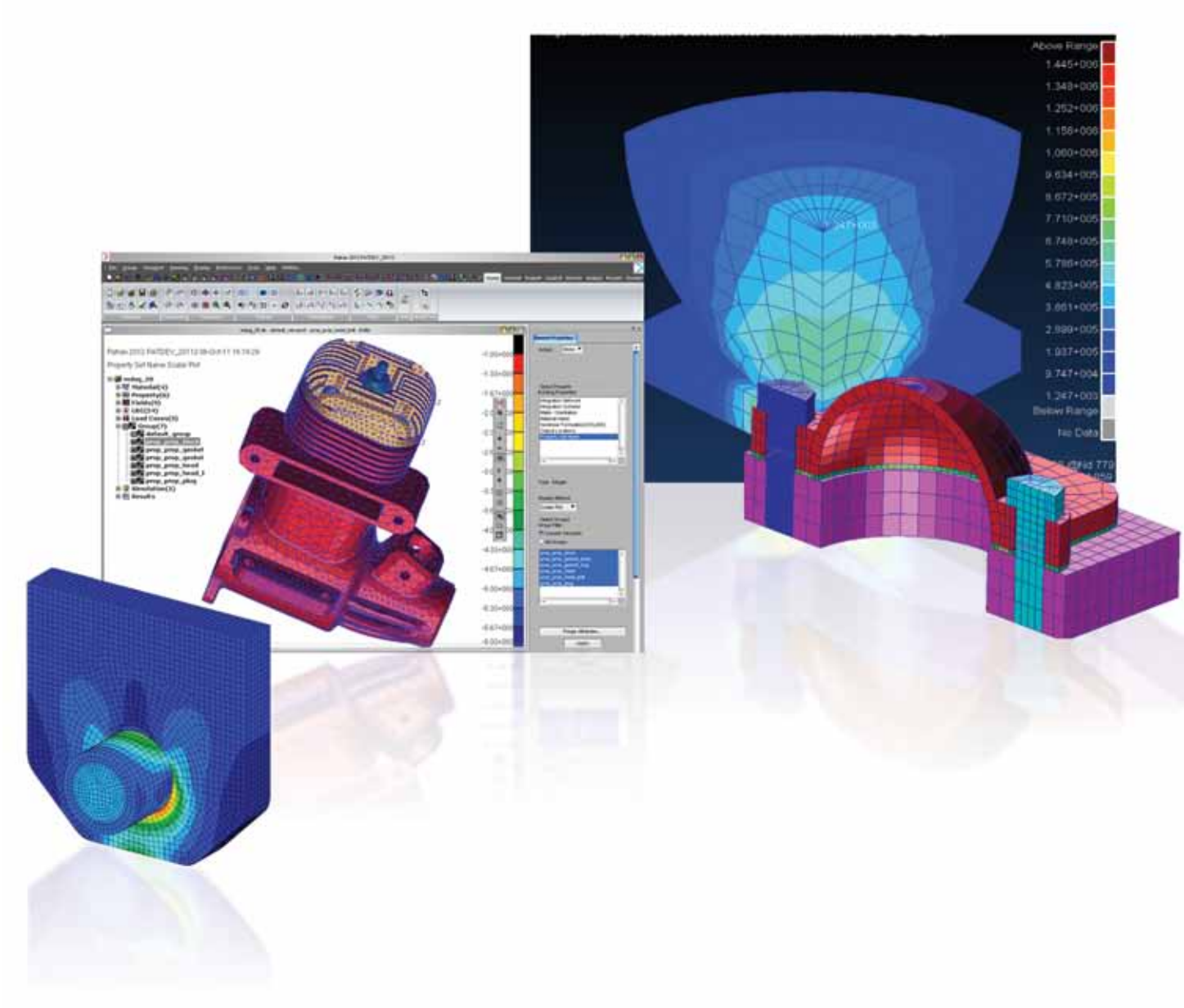
PRODUCT BRIEF

MSC Nastran 2012



MSC Software

Welcome to MSC Nastran 2012

MSC Software is proud to introduce MSC Nastran 2012. This release consolidates MSC Nastran and MD Nastran into a single solution. All advanced nonlinear and multidiscipline capabilities from MD Nastran are now available with MSC Nastran 2012. Additional enhancements to this release focus on implicit and explicit nonlinear analysis, segment to segment contact, linear analysis, high performance computing, composite analysis, design of control surfaces, aeroelasticity, and acoustics.

Nonlinear Extensions

Simulate Implicit Nonlinear

- Perform nonlinear analysis with simpler and smarter nonlinear convergence robustness
- Work with enhanced segment to segment contact analysis supporting large deformation and friction

Perform Explicit Nonlinear Simulations

- Generate faster results with further implementation of Distributed Memory Parallel
- Simulate manufacturing and other coupled scenarios with the addition of Thermal analysis capability
- Build expanded simulations with the addition of new materials, capability of defining Euler Body Force, and new LS-Dyna Libraries

Capability Improvements

Easier 3D Linear Contact

- Produce linear contact analyses with greater ease thanks to new smart contact defaults

Improved Results for Composites

- Assess more critical data of composite materials in dynamic analysis

Optimize Your Designs

- Conduct optimization studies for control surface settings with MSC Nastran's optimization capability

Simplify Aeroelasticity Calculations

- Create easier Aeroelastic analysis with improvements to Spline Blending
- Perform Static Aeroelastic analysis with more ease when defining aircraft maneuvers with the TRIM bulk data entry

Enhanced Acoustic Analysis

- Acoustic Analysis is more convenient and functional with improvements to weakly coupled acoustic analysis, participation factor analysis, frequency dependent analysis, and other additions

Performance and Power

High Performance Computing for Higher Productivity

- Obtain results faster with improvements to Automated Component Modal Synthesis (ACMS) and Unsymmetric Solutions
- Analyze faster with the addition of NVIDIA GPU and Intel AVX hardware support
- Reduce analysis times for solutions requiring complex Eigenvalues and Eigenvectors with the new Implicitly Restarted Arnoldi Method

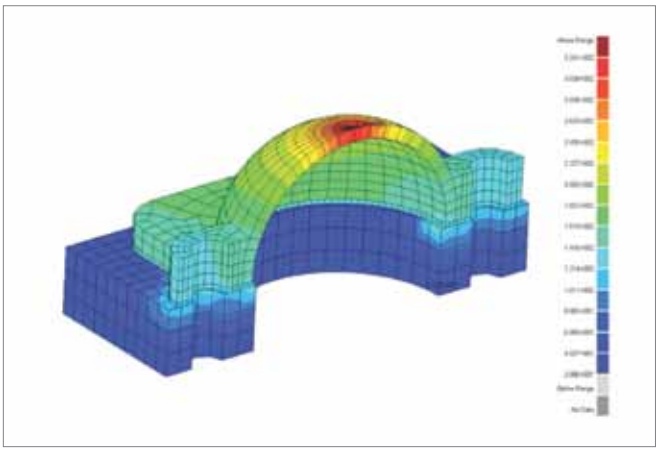
Thank you very much for your continued support of MSC Nastran.

The MSC Software Product team

Nonlinear Extensions

Simulate Implicit Nonlinear (SOL400)

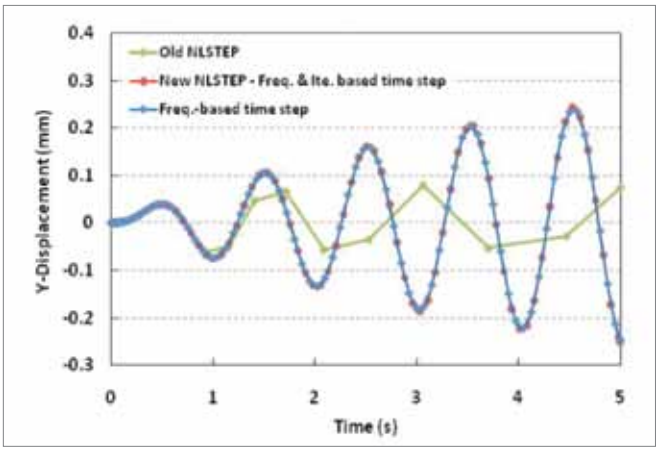
Nastran's Implicit Nonlinear Analysis capability simulates scenarios where nonlinear relationships arise due to contact and constraint changes, geometric nonlinearities, and material nonlinearities. The new features in MSC Nastran 2012 make Implicit Nonlinear Analysis simpler and more capable.



Cylinder head and Engine block - Coupled thermal mechanical analysis

Simpler and Smarter Adaptive Time Stepping

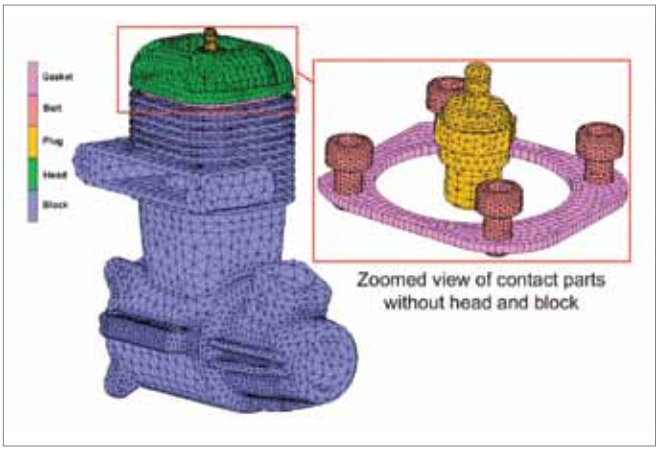
Users can now perform a nonlinear static and transient dynamic analysis by supplying fewer control parameters. The user specifies the convergence criteria, step size control between coupled loops multi-physics loop and step/iteration control for each physics loop. The new implementation provides the novice with smart defaults, while giving flexibility for experienced users to fully customize the stepping procedure.



Comparison of stepping schemes

Segment-to-Segment Contact

Segment-to-segment contact can now be used in models with large displacement analyses. The feature also supports friction modeling and implementation of non-symmetric matrix for sliding friction. These enhancements produce smoother stress results and improve the accuracy of contact analyses.

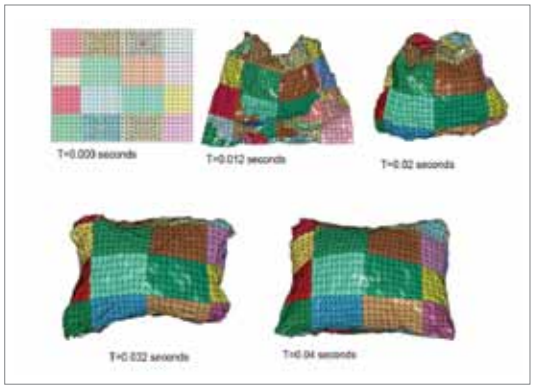


Segment-to-Segment contact analysis of Model Airplane Engine

Perform Explicit Nonlinear Simulations

Distributed Memory Parallel (DMP) Support for Adaptive Euler

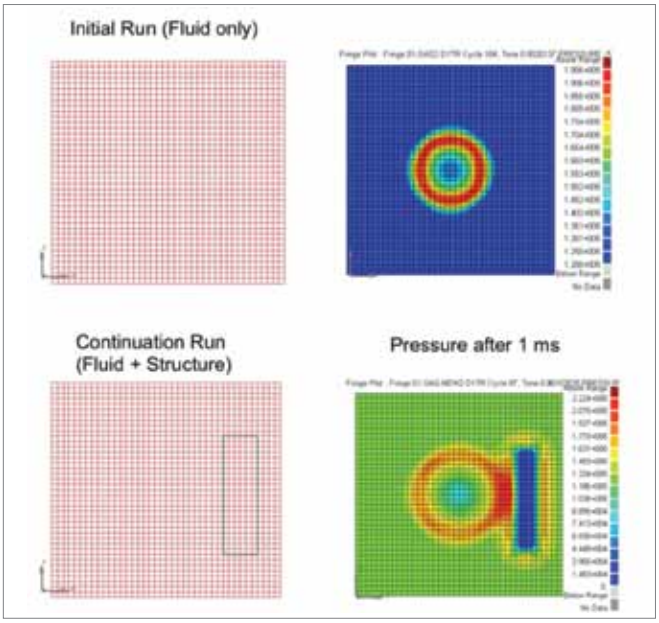
When the structure in fluid-structure interaction (FSI) simulations undergoes severe deformation, MSC Nastran allows the adaptive mesh to be expanded to follow the movement of coupling surfaces, avoiding the need to create extraneous elements at the start of the analysis, thus resulting in significant reduction in simulation runtime. With DMP support adaptive Euler capability in this release allows the users to run the CPU intensive FSI applications on multiple cores for improved performance. Load balancing schema implemented with DMP ensures that the cores perform about the same amount of work helping improve scalability on multiple cores. CPU intensive applications such as fuel tank sloshing, airbags and occupant safety that require adaptive mesh can benefit from this new implementation.



Explicit Nonlinear analysis of an airbag

DMP support for Archive Files

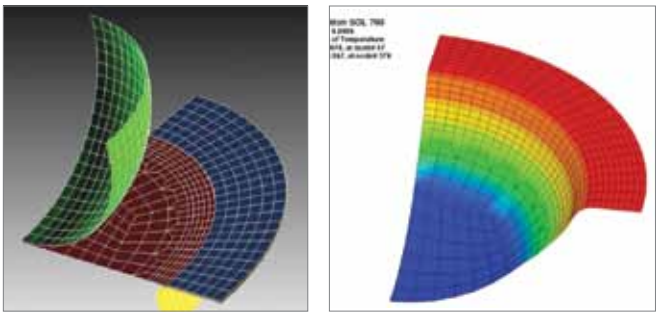
In applications like blast wave simulations, the Euler mesh has to be sufficiently fine enough to capture the initial expansion and propagation of the blast wave through the medium. However, once the blast wave has expanded, a coarser mesh is sufficient to capture the wave expansion, and using initial full model with both structure and explosives with fine mesh is CPU intensive and requires longer simulation time. With the use of Archive output file now supported by DMP, users can restart the analysis with a coarser mesh in the far field, saving computer resources and improving the analysis efficiency.



Fluid Structure Interaction of a blast wave

Thermal

Transient thermal analysis is now supported by the explicit solver of MSC Nastran. Thermal capabilities include Coupled Thermal Structural Analysis, Thermal Contact, Thermal Materials, and Thermal Loading and Boundary Conditions. This includes thermal contact capability to transfer temperature and structural response using thermal conductivity and head conductance. With these enhancements users can more accurately simulate manufacturing processes and other multi-physics applications.



Metal forming analysis

New Materials Models

New material models for wood and ice are implemented in this release. This will help users solve simulations such as helicopter blade impact on trees, ship impact on piers and wooden debris, hail impact, ship collision to icebergs, construction, and numerous other applications.

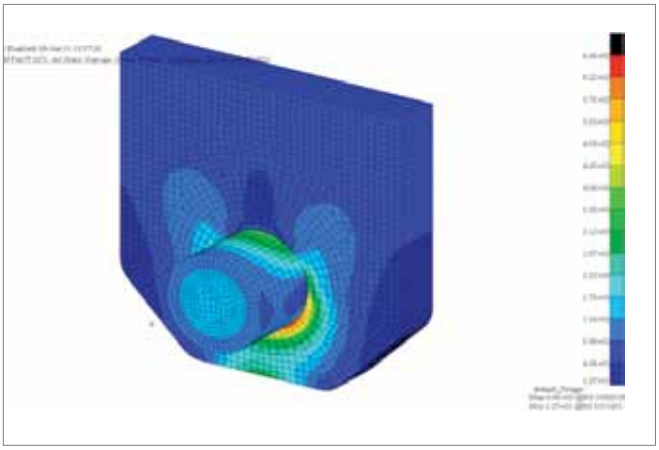
Euler Body Force

The new ability to assign time dependent accelerations to geometric regions which contain fluid leads to improved analysis performance. Using this capability, users can also specify time dependent change in direction of acceleration field. This method results in significant performance gain in models involving fluid sloshing simulations.

Capability Improvements

Easier 3D Linear Contact

With the consolidation of MD Nastran and MSC Nastran, all MSC Nastran can now access linear contact modeling which supports 3D touching contact in linear statics and glued contact for linear statics, normal modes and dynamics. The new defaults make 3D contact easier to set up and provide modeling efficiencies when working with assemblies.



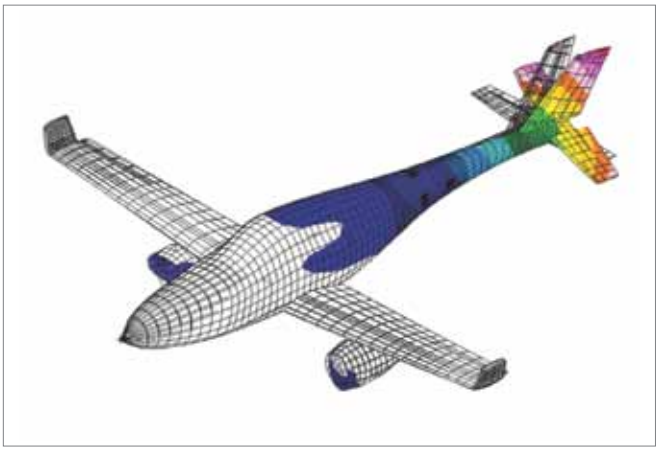
Pin and Clevis Model

Improved Results for Composites

MSC Nastran 2012 can now output lamina stresses, lamina strains, failure indices, and strength ratios at the ply level for the dynamic solution sequences, frequency response, transient response, and random vibration analysis. This addition will better aid composite designers in their pursuit to locate ply failure in a composite laminate.

Optimize Your Designs

Users can better optimize the control surface settings with MSC Nastran's new ability to include control surface settings as part of an overall structural optimization task. This new ability in MSC Nastran stands to compete with the old "trial and error" method that seeks a compromise between structural weight and surface complexity.

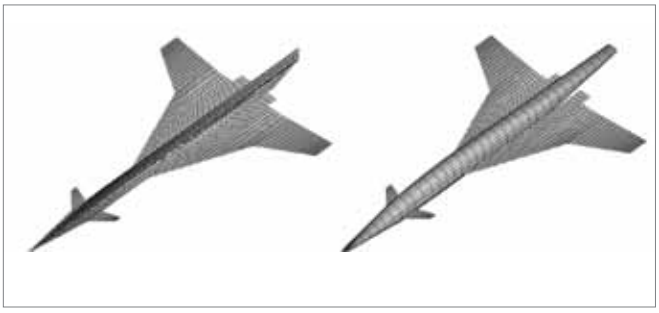


Aircraft Assembly Displacement Field

Simplify Aeroelasticity Calculations

Spline Blending

Splines are a critical constituent in Aeroelasticity analysis, and this release improves their ease of use in a model. Specifically, Spline Blending, the process of overlapping splines and using blending techniques to average the displacements of the adjacent splines, is improved by only requiring the user to select splines that participate in the blends and define the depths for the overlap regions. MSC Nastran then automatically selects the aerodynamic and structural grids that are within your defined depth and adds them to the relevant splines. This is a move forward that proves more favorable than the previous technique of manually selecting several hundred aerodynamic and structural grids involved in a blend.



Aerodynamic Model

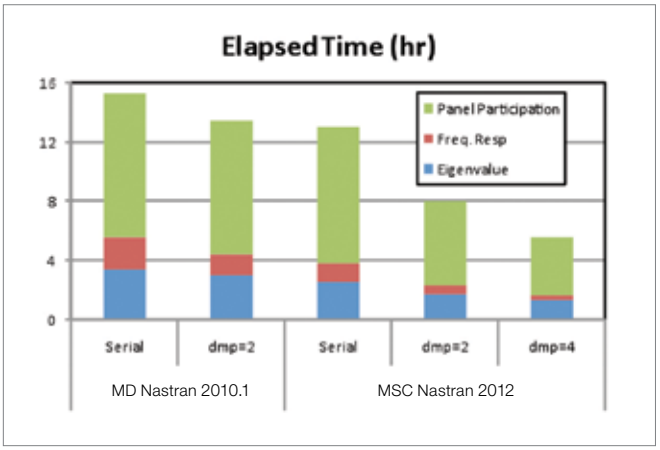
Trim Definition

Users performing Static Aeroelastic analysis will benefit from the added ease when defining aircraft maneuvers with the TRIM bulk data entry. Previously, undefined controllers in the TRIM bulk data entry automatically were defined as free, but in cases with a large number of aerodynamic controllers where numerous controllers must be constrained to zero, large amounts of time were given to reassign the free controllers to a fixed value of zero. The new TRIM bulk data entry automatically assigns undefined controllers to a constrained value of zero, and reduces the amount of time needed to create a Static Aeroelastic Analysis.

Enhanced Acoustic Analysis

Several enhancements are made to MSC Nastran's acoustic analysis capabilities to help users achieve higher efficiency.
These improvements include:

- Efficient single-step approach to interior-exterior acoustic problems
- Panel Participation Factor analysis extended to structural domain responses and made more efficient with MDACMS and DMP implementation
- Integration of frequency dependent trim component and pressure load matrices from Actran
- Computation of particle acceleration on wetted surface
- Capability to write Frequency response function and participation factor functions in ADF format



Comparison is shown of the elapsed time between MD Nastran 2010.1 and MSC Nastran 2012. Graph shows efficient participation factor analysis with MDACMS and DMP.

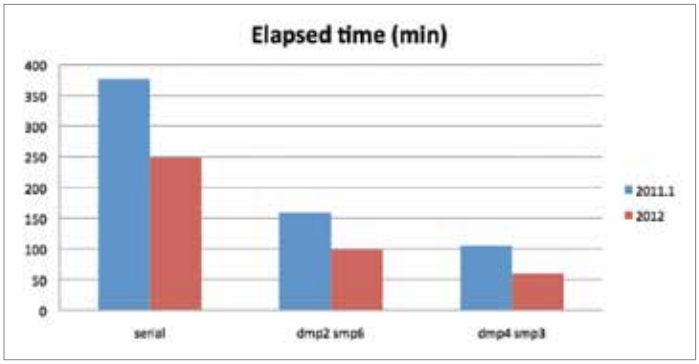
Performance and Power

High Performance Computing for Higher Productivity

Automated Component Modal Synthesis (ACMS)

Users performing large scale modal frequency response analysis such as noise, vibration, and harshness (NVH) studies will see performance gains due to improvements in ACMS. Serial computing achieves an average of 10% reduction in I/O and CPU time, and parallel computing is more intelligent with the use of distributed processing. Through better use of available processing power on multi-processor systems or a cluster, ACMS gives you the speed and productivity you require to solve large models.

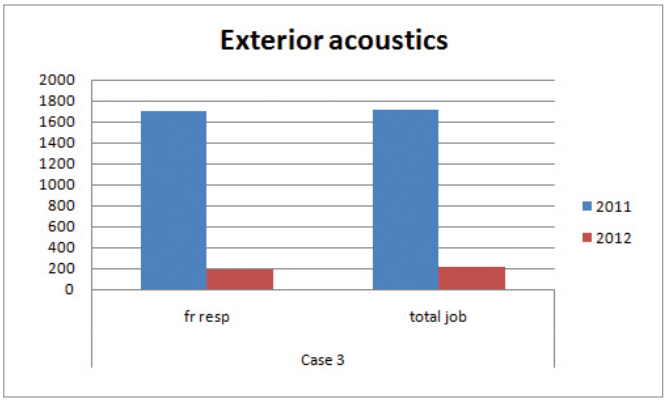
Large Automotive Model
SOL: 111 (Modal frequency analysis)
No. of grid points: 1.2 million
G-size DOF: 7.3 million
No. of structure modes: 3600
No. of forcing frequencies: 320



Analysis Duration using ACMS

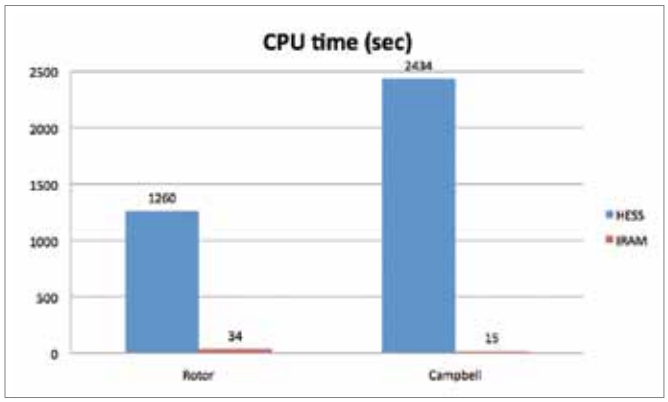
Unsymmetric Solutions

The enabling of high rank update kernels in the default unsymmetric sparse direct solver in MSC Nastran 2012 provides performance improvements of up to four times faster for the following unsymmetric applications: exterior acoustics, complex eigenvalue analysis using the Lanczos method, and implicit nonlinear analysis with friction.



Implicitly Restarted Arnoldi Method (IRAM)

Users performing simulations requiring complex eigenvalues and eigenvectors such as automotive brake squeal, exterior acoustics, and rotordynamic analysis, will see a significant decrease in run times with the addition of the new Implicitly Restarted Arnoldi method, one of many Eigenvalue extractors in MSC Nastran.

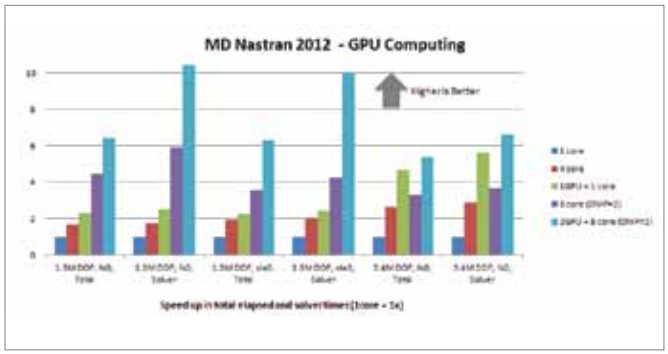


Two models analyzed by two different Eigenvalue extractors

New Hardware Support

This release of MSC Nastran 2012 enables support for NVIDIA GPU (Graphics Processing Units) devices and Intel's "Sandy Bridge" CPU family on GNU/Linux operating systems. Some of the benefits include

- NVIDIA GPU users will notice performance improvements in linear static, modal, and implicit nonlinear analysis.
- "Sandy Bridge" users will see an average analysis speed up of 15% for problems ranging from several hundred thousand to several million DOFs



MSC Nastran 2012 – Essential New Real World Behaviors & Breakthrough Performance

With your continued support, we at MSC Software remain committed to the persistent enhancement of our core linear, nonlinear and multi-disciplinary technologies in MSC Nastran. The numerous new and current benefits in this single solver demonstrate our commitment on multiple levels.

Customer Driven Features

We value customer feedback. MSC commits itself to meeting customer needs and requirements. Many of the new capabilities and enhancements in this release are a direct result of customer-driven efforts. This includes capability and solver enhancements in the areas of performance, contact, materials, usability, and multiphysics. .

Leading Edge Innovation

We push the envelope. MSC continues to bring exciting new technologies to CAE world. As evident in this release of MSC Nastran, advanced solver technologies and new material model capabilities expand the range of problems that can be solved by analysts with greater accuracy.

High Performance Computing

MSC is focused on bringing you the latest High Performance Computing (HPC) technologies to dramatically increase your productivity. The numerous performance improvements in the solvers and new parallel processing methods available in this release will help you reduce your product design cycle and improve your time to market.

Thank You

MSC Software appreciates the confidence and trust that you, our customers, have placed in our products all these years. This is also demonstrated by the customizations of our solutions and level of integration of our products into your CAE processes. You will continue to see more technologies and capabilities in our products and we, as always, are pleased to have you as a customer and partner.

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