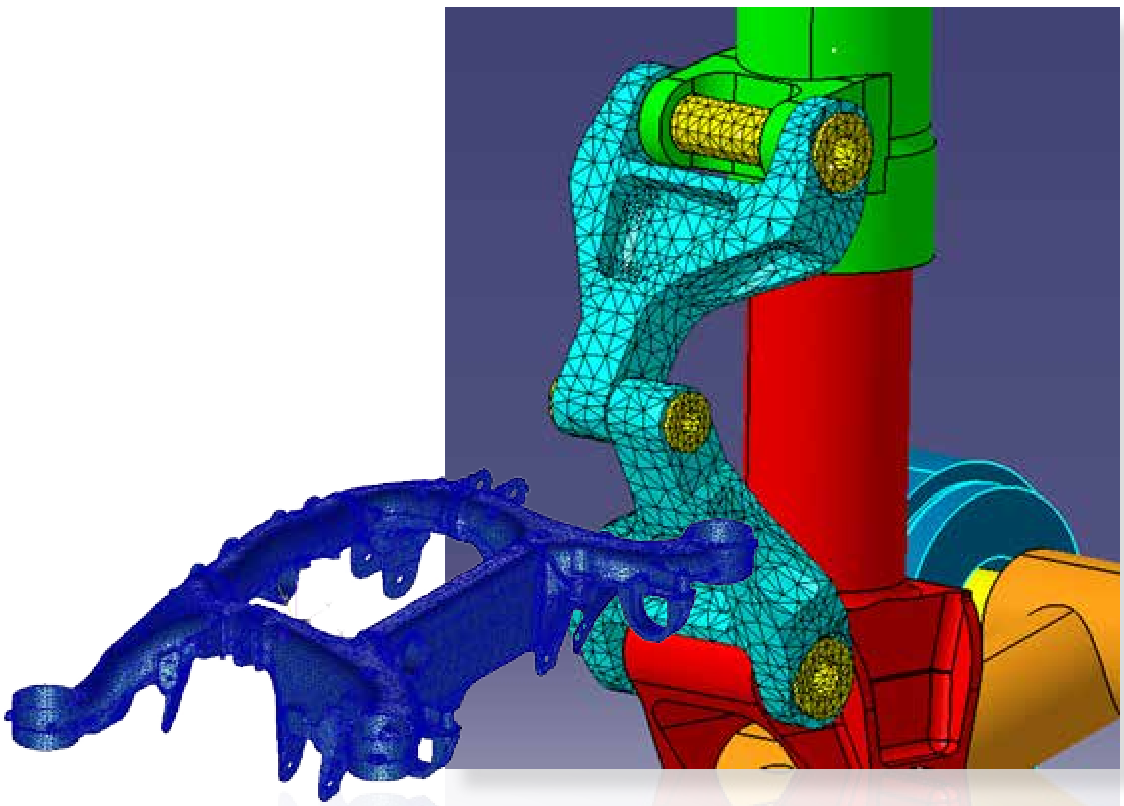
MSC Nastran 2016



Welcome to MSC Nastran 2016!

MSC Software is pleased to introduce you to the exciting enhancements in contact, fatigue, high performance computing, acoustics, optimization, and rotordynamics. Major areas of focus in this release include the following:

Capability Enhancements

Performance

- Shared Memory Parallel (SMP) computing for better performance
- Intel MKL Pardiso Solver for better scalability

Rotor Dynamics

- New 3D modeling capability to model discrete blades and non-symmetric components

Dynamics and NVH

- Equivalent Radiated Power (ERP) for higher order elements, and additional results of velocity and vibration intensity
- Multiple load vectors produced by Actran can now be selectively incorporated in MSC Nastran's frequency response analysis
- Improved efficiency of large poroelastic material simulations

Optimization

- Automated Global Optimization (GO) which combines automatic multi-start global methods and gradient based local optimization methods.
- Multi-model optimization (MMO) enhanced to support larger problems without limit on the number of models

MSC Nastran Embedded Fatigue

- Nodal averaged stresses and strains for consistency across solvers
- Skinning to create 2D stress state on the surface for faster fatigue calculations

Advanced Nonlinear

- Beam contact is implemented with segment-to-segment algorithm for better accuracy
- Interference fit analysis enhanced to handle large interferences/overlaps.
- Connector elements are enhanced to maintain a consistent formulation between linear and nonlinear analysis.

Explicit Analysis

- New material models introduced to simulate time dependent behavior and concrete material response.
- Adaptive solid elements that transform to particles to simulate the effects of debris after failure

Results

- A new results database based on HDF5 standard, which is an open format is introduced
- New utility to display output file data in an easy to read format is provided.

For more details on this release, please review the Release Guide and documentation. Several examples are also available to help you use these capabilities.

Thank you for your continued support of MSC Nastran.

MSC Nastran Product Team

Performance

Parallel Scalability for Eigen Modes

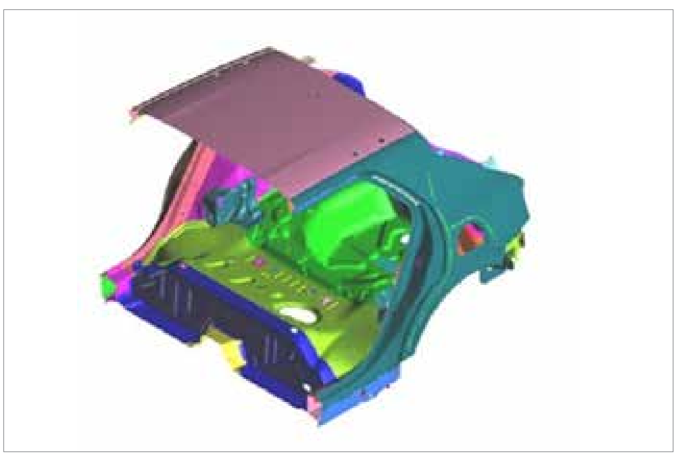
MSC Nastran has been offering the ACMS and Lanczos methods for frequency response studies of mechanical systems. ACMS is an approximate method which is often used for large models and can be orders of magnitude faster than the Lanczos method. Current release uses improved SMP (Shared Memory Processing) to achieve faster performances, as opposed to Distributed Memory Processing (DMP) used in prior releases. 50% parallel efficiency has been observed for 16 processors, compared to 20% efficiency in prior releases. This enhancement improves user productivity without any additional cost.

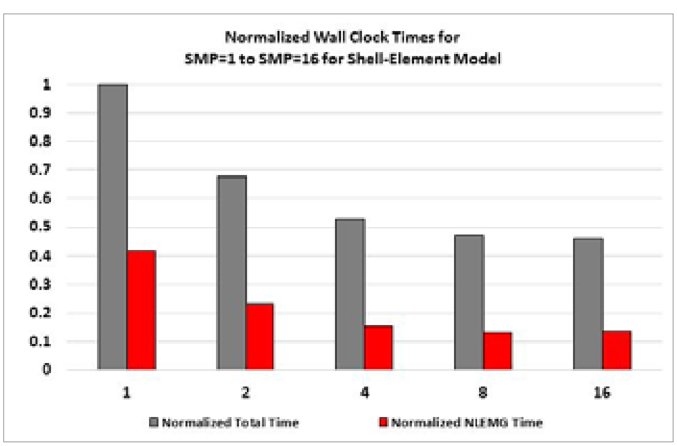
Nonlinear Solver Performance

MSC Nastran SOL 400 performance depends on the performance of the sparse direct solver and the task of compiling element stiffness matrixes and stress recovery. SMP Parallelization can now be used to reduce the overall wall time used for the tasks of stiffness matrix computations and stress recovery. For up to 4 threads, 75% parallel efficiency has been achieved, meaning that the task is 3 times faster with 4 processors.

Linear Solver Performance

MSC Nastran performance depends on the performance of the linear solver used to solve the underlying equations. The 2016 release extends the availability of the Intel MKL Pardiso direct solver to SOL 101, 107, 108, 111, and 200 in order to provide better scalability, therby reducing the simulation time.

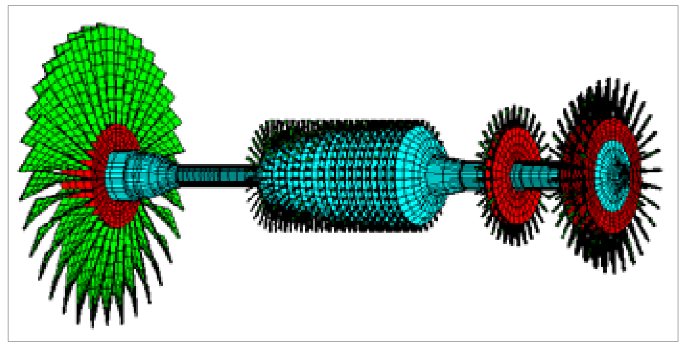




Parallel performance of nonlinear analysis

Rotordynamics

Rotor dynamic analysis is used by turbine, jet engine and aircraft manufacturers to perform static analysis, eigen mode analysis, frequency response and transient response studies. With support for 3-D modeling capability, users can now perform detailed analysis of rotors and support structures. Users can model discrete blades and non-symmetric components of rotors and stators. Many existing MSC Nastran elements have also been enhanced for rotordynamics, so standard pre-processing and post-processing tools like Patran and SimXpert can be used.



3-D rotor model with blades

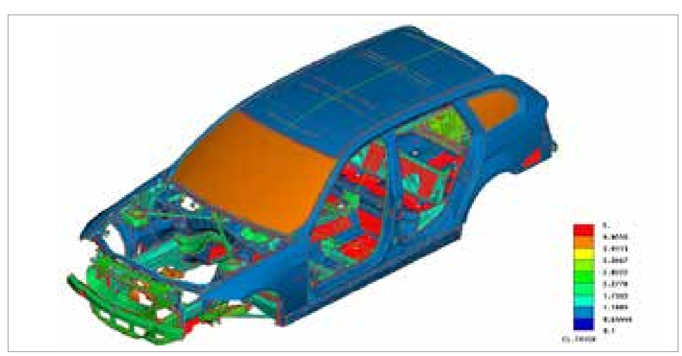
Dynamics and NVH

Acoustic Analysis Results

Results output has been enhanced for acoustic problems with the inclusion of Equivalent Radiated Power (ERP) available for higher order 2-D elements and 3-D elements, Normal velocity to surface of the exposed structure, and Vibration intensity. These improvements provide more detailed information of the acoustic response of the structure.

MSC Nastran-Actran Data Communication

MSC Nastran provides a convenient way to include load vectors produced by Actran, MSC Software's acoustic analysis solution, as part of the dynamic loading in frequency response analysis. Current release extends this capability to accept multiple load vectors per input files. Users can now selectively incorporate any load case in the Actran generated file containing multiple loadcases.
Modeling of Poroelastic Materials, used to model automotive trim material, has been enhanced to support logarithm interpolation in addition to existing linear interpolation giving additional flexibility to users to apply when master frequencies are unevenly spaced.



Car model with mostly shell elements

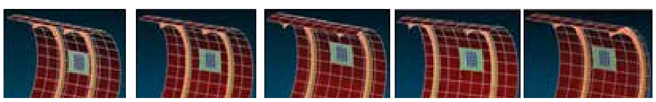
Optimization

Global Optimization

The traditional optimization methods use a local optimization approach, where the final solution depends on the starting point of the search. Automated Global Optimization (GO) feature combines automatic multi-start global methods and gradient based local optimization methods. This approach searches much larger design space for possible better solutions. This also increases the possibility of finding a solution which may not always be possible with local optimization methods.

Multi-Model Optimization

Multi-model optimization (MMO) has been available since the 2010 release, and provides the ability to process separate design models, with different topology or analyses to perform combined optimization. This capability is enhanced to solve larger problems and without limit on the number of models.



Variations of fuselage for optimization studies

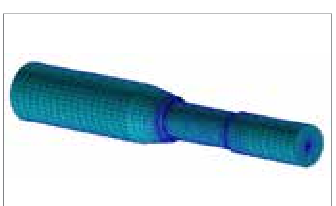
Nastran Embedded Fatigue

Nodal Averaged Results

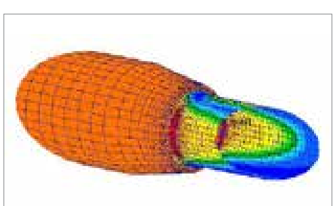
In order to maintain consistency with users having experience with other fatigue solvers, some process changes have been implemented. Use of nodal averaged stresses and strains for fatigue analysis results in faster computation speed and a more realistic fatigue damage factor.

Skinning

Skinning is implemented to create a 2-D stress state on the surface of the model which is generally used for fatigue analysis. This results in fewer calculation points and enables multi-axial assessments and correction on 3-D solid elements.



Shaft modeled with solid elements



Surface damage in notched area (with skinned elements

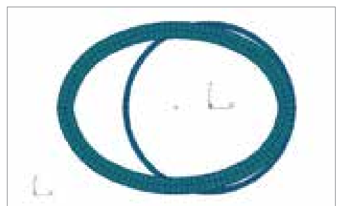
Advanced Nonlinear (SOL 400)

Beam Contact

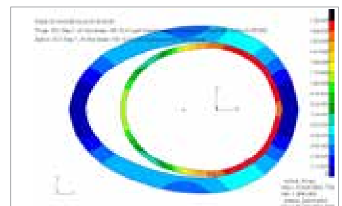
Beam contact is encountered in many engineering applications like stringers and spars in aerospace industry, Bowden cables in automotive, drill strings in oil and gas, and angioplasty catheters in biomedical applications. Beam contact is implemented in this release with segment-to-segment contact algorithm with support for beam cross section, tube-in-tube contact, and beam offsets. This implementation reduces the computational cost of contact and provides better accuracy.

Interference Fit

In the previous releases, MSC Nastran only supported a constant value of interference which was removed in a single increment, which placed limits on the amount of interference. In the new approach in this release, Nastran can handle large interferences/overlaps, which are resolved over multiple increments. Four different methods are available for the users to choose from based on the nature of the model.



Interference fit model



Results of interference fit analysis

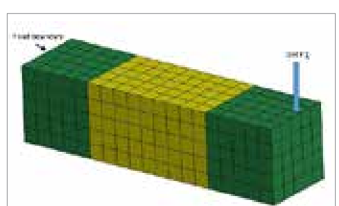
Explicit Nonlinear (SOL 700)

New Material Models

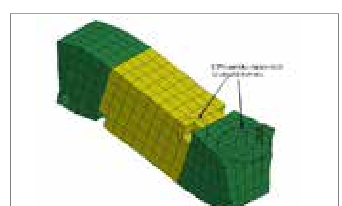
Three new models have been introduced to simulate complex material behavior, namely, a time dependent viscoelastic creep model, Thermo-elasto-viscous plastic creep model, and Riedel-Hiermaier-Thoma model for concrete materials.

Debris Simulation

When material starts to fail, the elements may not have enough stiffness and deform severely making the solution unstable. These elements are commonly eliminated from simulation, but in reality the material debris could still interact with the structure. This release helps simulate the debris effect by transforming the failed elements to SPH particles, which inherit all of the state variables of the failed solid elements.



Cantilever beam



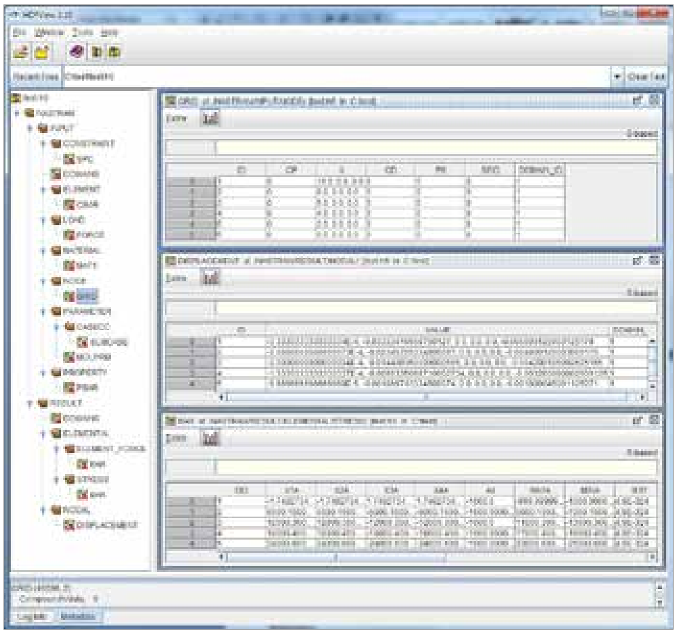
Beam after deformation, with failed elements

Improved performance for model with numerous segments in the coupling surface

Results

New HDF5 Results Format

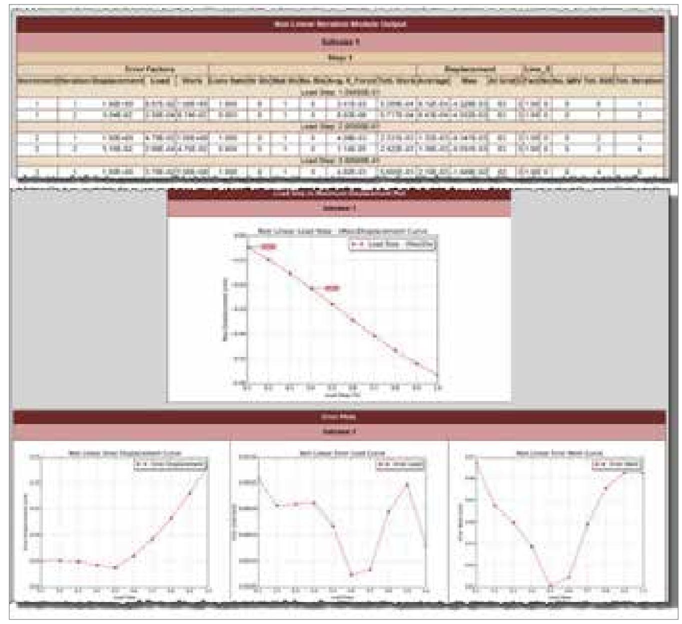
In addition to the existing result formats, MSC Nastran 2016 release introduces a new results database based upon the HDF5 standard, which is an open format that will allows easier access to the results. The data can be accessed via public viewers, or via Python, Java or C++. In the 2016 release the output data blocks are supported for SOL 101,103,105, 107, 108, 109, 110, 111, 200 and 400.



HDF5 browser

Output File Reader Utility

A new utility, F06 Reader, is introduced to read in MSC Nastran output text files (F06, F04, LOG) and produce a friendlier, modern and more useful format of important MSC Nastran information.



F06 reader utility

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