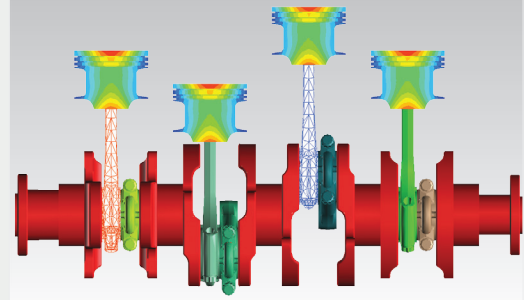# MSC Nastran™
Multidiscipline Simulation Solution for Advanced Engineering

Overview

Leading manufacturers around the globe have relied on MSC Nastran to bring new products to market for five decades by using its capabilities to analyze designs ranging from simple components to complex structures and assemblies. MSC Nastran's modular and scalable solution enables you to start to grow your analysis capabilities as your virtual product development needs expand. As part of your development process, you can use MSC Nastran to assess many functional aspects of your product, such as static and dynamic response, frequency response, multi-body contact interaction, nonlinear material response, and impact and crash behavior due to various working loads and boundary conditions that are experienced during the product's life cycle.

In addition to providing the most comprehensive portfolio of simulation technologies for advanced engineering analysis, MSC Nastran is optimized across multiple, integrated disciplines with the power to handle large-scale problems and to take advantage of the latest high performance computing hardware. MSC Nastran's focus on integrated and multidisciplinary solutions helps you achieve across-the-board efficiency by driving early design validation, improved product performance and rapid insight into product lifecycle performance.

Business Value

- **Accelerate Time-to-Market:** Gain faster, better insight into overall system design performance through multidisciplinary analysis.

- **Improve Engineering Productivity:** Enable efficient communication between various groups of expertise, reduce your dependency on disconnected point solutions and improve analyst efficiency.

- **Reduce Manufacturing Costs:** Accurately predict and correct the design behavior much earlier in the design cycle. Achieve an optimal solution through MSC Nastran's powerful multidisciplinary optimization capabilities.

- **Achieve Lower Warranty Costs:** With precise representation of complex interactions between disciplines, make better design decisions and avoid unexpected operational failures during use.
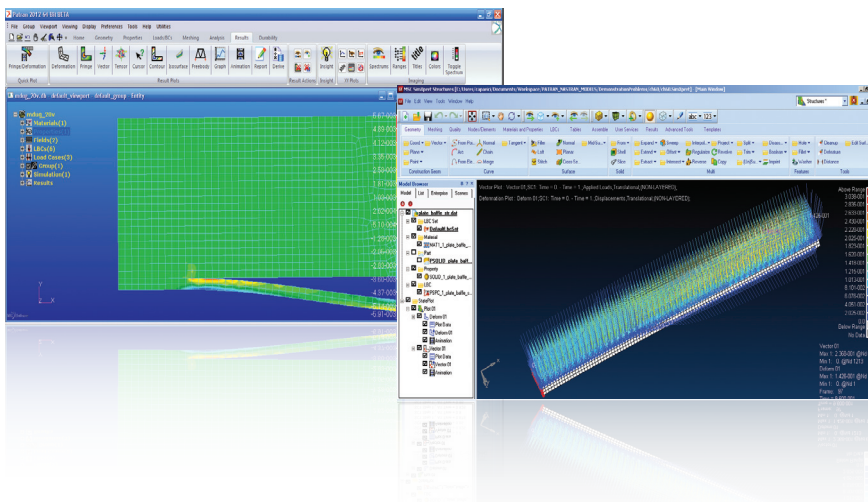
Capabilities

- Optimized for large scale systems, assemblies, dynamics and NVH simulations
- Strength, durability and vibrations assessment of structures
- Structural dynamic response simulation of loads that vary with time or frequency
- Automated Component Modal Synthesis (ACMS) for large modal based analyses and NVH solutions
- Simulation of interior and exterior acoustics for coupled structural acoustic analysis
- Static and transient analysis of structures involving material, geometric and boundary condition nonlinearities
- Linear and nonlinear contact analyses with intuitive contact definitions
- Heat transfer analysis with contact including conduction, convection and radiation
- Failure analysis of structures and composites
- Rotor dynamic stability studies of rotating machinery
- Aeroelastic analysis
- Efficient optimization using sizing, shape and topology optimization with manufacturing constraints
- Optimize large model sections through Automatic External Superelements
- Enhanced iterative and in-core sparse solvers
- Multi-model optimization to simultaneously optimize two or more structural models
- Stochastic simulation
- Use Graphics Processing Units (GPUs) for improved solver efficiency
- Add customized element formulations, materials, contact definition, and more with User Defined Services (UDS)

Benefits

- Accelerate innovation through improved event simulation
- Design optimization to achieve reduced material costs
- Deliver products that meet certification and safety requirements
- Reduce risk by using simulation to save time and cost

MSC Software®

MSC Nastran is Available in the Following Convenient Packages:

MSC Nastran Base

If you are just starting with simulation and your design's function is in the linear domain, this is an excellent starting point. This package enables you to analyze components and assemblies and also study modal and buckling responses. In addition, you can create inputs required for a more accurate flexible body representation for system analysis that you perform using Adams, the leading multibody dynamics solution. The capabilities available to you include:

- Linear Statics
- Modal Analysis
- Buckling
- Connectors
- MSC Nastran Adams Integration
- Linear Contact
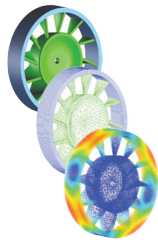
MSC Nastran Linear Structures

MSC Nastran Linear Structures Package is ideal for users who design structures that are expected to exhibit linear response under applied loads. MSC Nastran's optimized architecture enables you to solve models, small to large, in an efficient manner. You can also analyze assemblies and interaction between components through the easy to use linear contact capabilities. Thermal and small nonlinear analysis capabilities supported by this package also help you solve heat transfer problems and scenarios with small strain nonlinearities, with the stress exceeding yield value. Capabilities available with this package include:

- All of MSC Nastran Base Package capabilities
- DMAP
- Dynamics
- Heat Transfer
- Shared Memory Parallel (SMP)
- Dynamic Design Analysis Method (DDAM)
- Acoustics
- Superelements
- Basic Nonlinear
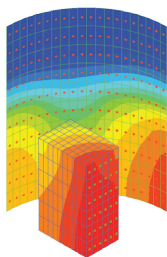
MSC Nastran Structures Package

When your designs are subjected to higher loads or when the materials exhibit more prominent nonlinear behavior, MSC Nastran Structures package provides you with the required capabilities. In addition, the available optimization capabilities enable you to optimize the shape, size and/or topology of your designs subjected to multiple constraints including manufacturing constraints. These capabilities are available in addition to the Linear Structures package:

- All or MSC Nastran Linear Structures Package capabilities
- Implicit Nonlinear (via Marc Translator)
- Design Optimization
- Multi-Model Optimization
- Automated Component Mode Synthesis (ACMS)

MSC Nastran Multidiscipline Implicit NL (Nonlinear) Package

When your simulations require you to study the structural behavior subjected to multidisciplinary loads that could include linear statics, dynamics, thermal response, nonlinear behavior, generalized contact, perturbation studies and more, MSC Nastran provides you with an integrated multidisciplinary solution. By taking advantage of these capabilities, you not only have access to broader simulation spectrum, but also a solution that improves communication across engineering groups.

With this package, available as an add-on, you gain access to MSC Nastran's most advanced implicit nonlinear analysis capabilities that include nonlinear static and transient, advanced thermal, and the unique ability to perform multidisciplinary analysis.
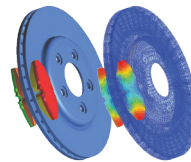
MSC Nastran Multidiscipline Explicit NL (Nonlinear) Package

Engineering structures often need to be designed for impact and crash performance. Occupant safety is a critical design criterion in automobile and aircraft design. Consumer products need to withstand multiple drops and/or impacts that they may experience during service. Since these are very short-time events, special explicit methods are required for performance. The technology of LS-Dyna integrated into MSC Nastran provides excellent capabilities to address these questions.

In addition, some mechanical designs must consider the interaction of the structure with fluid that either surrounds it or is contained by it. Fluid-Structure Interaction (FSI) capabilities of MSC Nastran are extremely useful in simulating complex models like air bags, gas tank sloshing, hydroplaning, blast, underwater explosions, fluid container drop tests and more. Since these problems are also time and computational resource consuming, parallel processing solutions offered by MSC Nastran highly benefit the users in achieving higher productivity.
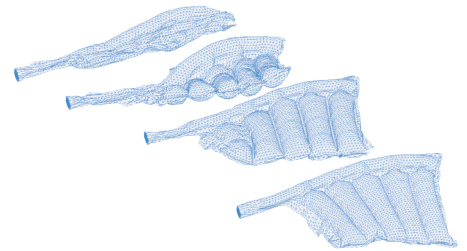
MSC Nastran Optimization Package

With this add-on package, you can perform design optimization to assess the effects of design changes, improve existing designs and ensure that your designs meet all requirements. With the help of size, shape and topology optimization capabilities you can choose the appropriate methodology for your studies. MSC Software's multi-model optimization technology also integrates models from different disciplines and simultaneously optimizes the complete design to meet high-level objectives such as performance, cost, life and weight. You can simultaneously evaluate a large number of designs against a wide range of objectives to provide an objective answer to help you choose the best design.

Additional Add-On Options/Packages

In addition to the packages mentioned above, there are several options that can be added to expand analysis capabilities and also performance. Some of these include:

- Superelements
- Distributed Memory Parallel (DMP) processing
- Support for Graphics Processing Units (GPU) for additional computational power
- Rotor Dynamics
- Aeroelasticity
- Exterior Acoustics
- Advanced PFA for progressive failure analysis of composites
- Explicit Nonlinear Multi-Processor solution
- Implicit Nonlinear Multi-Processor solution
- Nastran Embedded Fatigue for integrated fatigue analysis
- Poroelastic Material modeling for acoustic effects of trim materials

MSC Software®