MSC Software

MSC Software Solutions for Rotating Structures

SOLUTION BRIEF

Software & Services Offerings

- **How we Help**
  Engineering simulation software, implementation & support, modeling & analysis projects, methods development, and training
- **Who we Help**
  OEMs, suppliers, engineering services companies, universities and research labs
- **How to Reach Us**
  www.mscsoftware.com

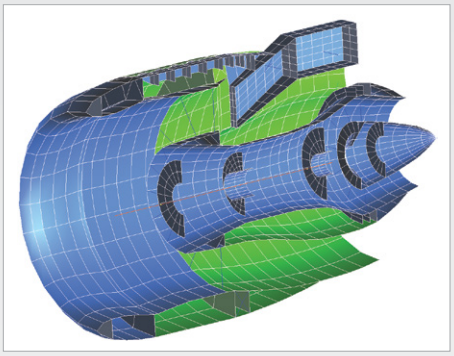
MSC Software offers a number of solutions meant to answer critical questions for the design of rotating systems. Questions MSC Solutions can address include:

- Is the structure capable of sustaining operating conditions?
- How long will the structure last under repeated loading?
- What are the loads acting on the moving structure?
- Are the acoustics of the structure adequate?

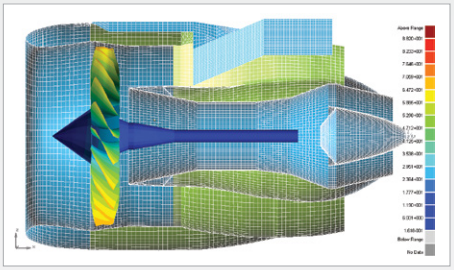
MSC's offerings include software solutions that allow for virtual prototyping of rotating systems, engineering services that make industry experts available to customers, and training that promotes further development of expertise.

Use MSC solutions for common types of rotating systems including, but not limited to:

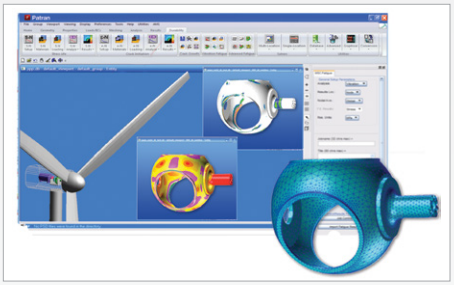
- Tail Rotor Shafts
- Jet Engines
- Auto Engines
- Centrifugal Compressors
- Centrifugal Pumps
- Axial Compressors
- Gas or Steam Turbines
- Motors and Generators
- Turbo-Expanders
- Driven Units



Rotordynamics Model of an Aircraft Engine



Displacement Contours on Fan Blades and Rotor



Life Determination of a Windmill Structural Member

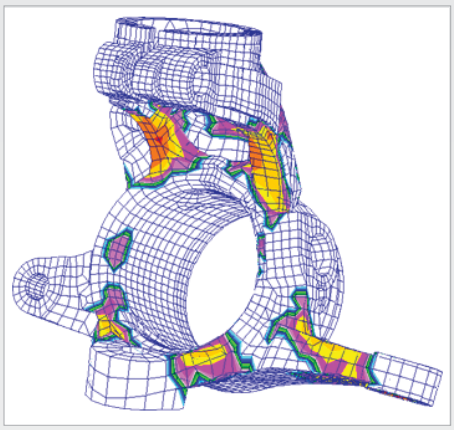
Understand Structural Behavior with MSC Nastran

Rotordynamic Analysis

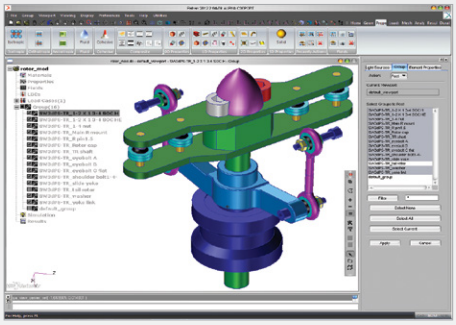
- Use complex eigenvalue analysis to determine whirl modes, including forward and backward whirl, critical speeds, and necessary Campbell diagrams
- Use frequency response analysis to determine the rotor/support response to arbitrary excitation with the rotors spinning at user-specified rates or to excitation that is synchronous with the reference rotor
- Use linear or nonlinear transient response analysis to simulate engine blade-out and subsequent wind milling

Static Analysis

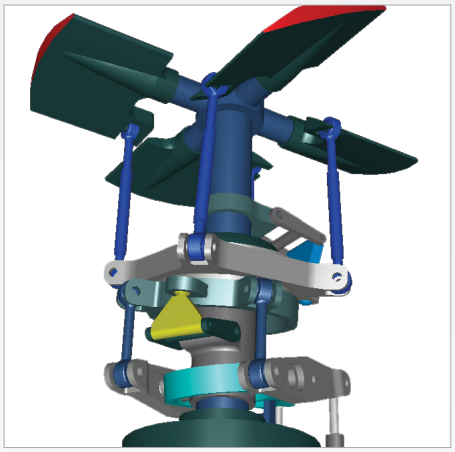
- Determine loads on rotor due to maneuver loads, i.e. pitch or yaw of an aircraft
- Determine stresses and displacements arising from external loads



Fatigue Analysis of a Suspension Component



Use of Contact Pair Methods for Simple Analysis Set up of a Large Rotor Assembly



Determine Loads Acting on a Rotor Assembly

Additional Rotordynamic Capabilities

- Model multiple rotor systems
- Model rotors with one dimensional elements, or new for MSC Nastran 2013.1, axisymmetric elements
- Model squeeze film dampers
- Perform random vibration analysis
- Perform transient analysis of prestressed structures
- Simulate contact of multiple bodies
- Use automated optimization to arrive at higher performing structural designs
- Substructure components

Determine the Life of Products with MSC Nastran Embedded Fatigue (NEF) or MSC Fatigue

MSC Nastran Embedded Fatigue

- Stress life (S-N) and strain life (e-N)
- Multi-axial responses processed using the Critical Plane method
- Parallel processing up to 100 threads
- Multiple fatigue analysis in a single job submission

MSC Fatigue

- Stress life (S-N) , strain life (e-N) and linear elastic fracture mechanics (LEFM) methods
- High-cycle fatigue, low-cycle fatigue and crack growth analysis
- No limit on number of nodes or elements analyzed
- Modifiable materials database with comprehensive set of S-N, E-N, Cyclic and Component curves
- Static, transient and quasi-static loading
- Supports simultaneous application of up to 500 load cases
- Modifiable loads database with standard time histories
- Support for RPC, DAC and ASCII load files
- Non-proportional, multiaxial stress states
- Frequency-domain analysis via PSD
- Compliance function library including numerous crack geometries
- Spot and seam weld analysis

Model Virtual Prototypes with Patran

- A single, comprehensive simulation environment for FEA Analysis
- Direct access to CAD geometry
- Geometric feature recognition/modification with associated mesh and LBCs updates
- Full suite of 2D and 3D meshing tools
- Tightly coupled to MSC Nastran, Marc, and Dytran
- Support for third-party solvers (i.e. Abaqus, Ansys, LS-Dyna)
- Complete post-processing capabilities for results interrogation

Determine Mechanical Loads with Adams

- Powerful numerical analysis application that automatically solves the equations of motion for kinematics, static, quasi-static, and dynamic simulations
- Build, test, and refine mechanical system models
- Use Adams/View graphical user interface to:
  - animate and optimize models
  - automate the simulation process
  - customize the interface to suit your needs
- Enhance your models with flexible bodies or control systems to achieve more realistic simulation results
- Study forced vibrations within your model

MSC Software

> MSC has been a key partner on the LSAT program. Their Adams software and consulting services reduce development cost and risk by providing an understanding of weapon dynamics early in the design process and in more detail than can be obtained from physical testing.
>
> **Paul Shipley, AAI Textron**

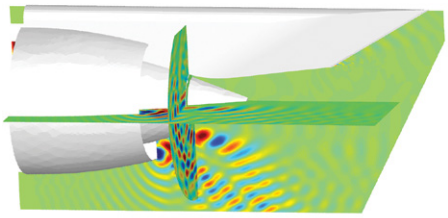
About MSC Software

MSC Software is one of the ten original software companies and a global leader in helping product manufacturers to advance their engineering methods with simulation software and services.

www.mscsoftware.com

Improve Acoustic Performance with Actran

- Analyze the radiation of sound in external environments
- Study the interaction of sound between environment and structures
- Predict the noise generated by complex and turbulent flows
- Model noise propagation in complex flows
- Predict the noise of Turbomachinery



Acoustic Assessment of an Aircraft Engine

MSC Software Announces: Industry Standard MSC Nastran Rotor Dynamics Success

MSC Nastran Rotor Dynamics Improves Propulsion System Analysis and Reduces Time-to-Solution for Jet Engine and Airframe Manufacturers

"When you look at the requirements of a rotor dynamics code, such as blade out simulation, there are no other codes in the world that can perform this combination of analysis," said Dr. Charles Lawrence, structural engineer, Structures and Acoustics Division, Glenn Research Center at Lewis Field, NASA. "These models are incredibly large -- millions of degrees of freedom. MSC Nastran is the only code that can take these large models and abstract them to smaller models and still produce accurate results. This is the industry-standard solution aerospace companies are using and will continue to use in the future to come up with better answers when designing propulsion systems."

"More than ever, today's manufacturers seek to improve the richness of the complex propulsion system simulation process to provide even greater representation of the physical world scenarios simulated today," said Technical Fellow Mohammad Heidari, Boeing Commercial Airplanes Propulsion technology. "MSC Nastran Rotor Dynamics provides an integrated solution that will further help manufacturers to better predict, and help reduce the number of physical tests they currently conduct to develop and certify propulsion systems."

Read More About This Case Study:

www.prnewswire.com
www.mscsoftware.com

Engineering Services

If you want results you can trust and the flexibility of working with extremely skilled engineers who know FEA and how it's applied to engineering problems like yours, MSC is a team you can rely on to improve your product development processes.

We provide consulting support based on your specific needs and requirements. This could range from performing analysis for you on a project basis; one or two times a year, or providing full time staff members to help you create repeatable processes in-house.

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