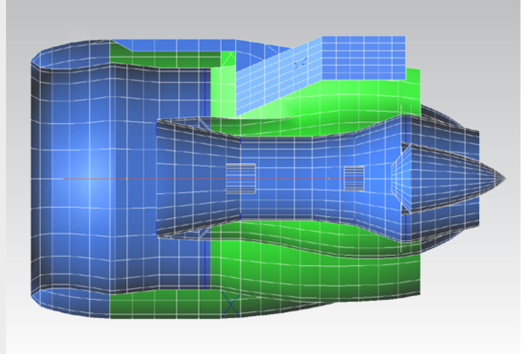
DATASHEET

MSC Nastran™ Rotordynamics

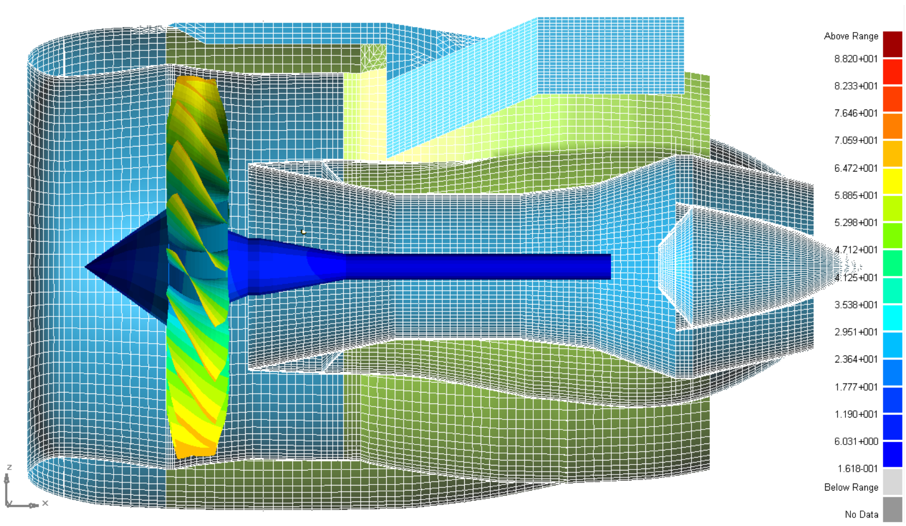
Simulate Rotating Components for Safety and Efficiency



Overview

Rotating structures represent an important and a large class of machinery used in industrial applications, like power stations, marine propulsion systems, aircraft engines, machine tools, transportation systems and numerous others. Rotors equipped with bladed disks or impellers, rotating at high speeds allow them to produce, absorb, transform, or condition an immense amount of energy. The safe and sound operation of such rotating machinery is of paramount importance to achieve entire system efficiency.

The rotor dynamics capability in MSC Nastran provides users with a relatively simple method of performing the design and analysis of structures with rotating components. The MSC Nastran Rotordynamics procedures are developed with input from aircraft engine manufacturers to ensure that their critical requirements are satisfied. The capability has also been enhanced to analyze steam and gas turbines, compressors, pumps, and centrifuges to ensure their stable, safe operation. With this comprehensive solution, users can gain insights into out of balance systems, determine system instability, detect imminent product failure, and calculate safe operating ranges and conditions before the products go into service. The rotor dynamic capability can be used in frequency response (direct and modal), complex modes (direct and modal), static, nonlinear transient, and linear transient (direct only) analyses.



Capabilities

- Simulate Rotordynamic Related Situations such as:
  - Imbalance Response and General Excitation
  - Maneuver Loads
  - Blade-Out Response
- Calculate Critical Speeds and Whirl Frequencies
- Predict Rotor Rubbing
- Simulate Systems Involving Multiple Rotors
- Model and Analyze Squeeze Film Damper Nonlinearities
  - Model General Damper Orbits with Broad Frequency Content
  - Calculate Oil Film Forces by Numerical Integration of Instantaneous Film Pressure Distribution
- Represent rotordynamic models with line or axisymmetric elements
- External superelements for rotor models

Benefits

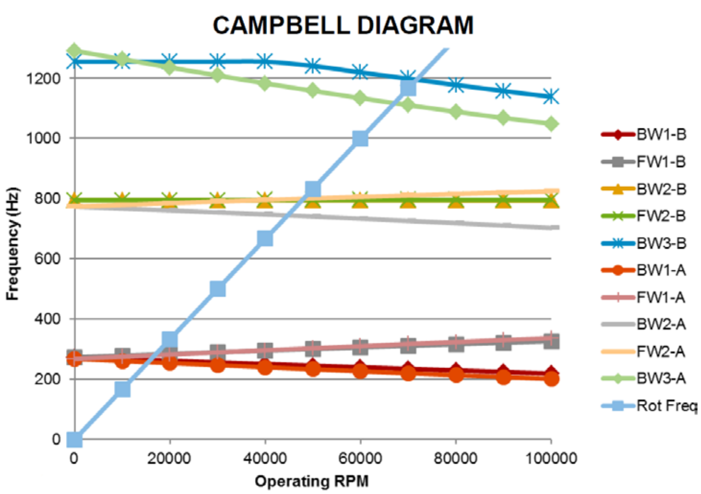
- Reduce Risk and Increase Opportunity Through Rapid Understanding of Rotating Machinery Performance Characteristics
- Proven Solution that Conforms to Stringent Aerojet Requirements and Industry Standards
- Increase Product Stability and Eliminate Damage-Causing Vibration
- Reduce Cost of Physical Prototyping and Test Through Virtual Simulation
- Improve Performance and Margins of Safety
- Eliminate Warranty, Repair, and Litigation Costs Associated with Product Failure
- Meet Design Schedules with Accurate Prediction of Safe Operating Conditions

Rotor Imbalance and General Excitation

You can use frequency response analyses to determine the rotor/support response to arbitrary excitation with the rotors spinning at user-specified rates (ASYNC) or to excitation that is synchronous with the reference rotor (SYNC). The ASYNC calculation determines the response of the system to an external input that is independent of the rotor speed. The SYNC calculation determines the system response to a rotor imbalance or other excitation that is dependent on the rotor spin rate.

Critical Speeds and Whirl Frequencies

Complex modes analyses determine whirl frequencies and critical speeds. Whirl modes are modes of a rotor/support system with the rotors spinning at specified rates. Critical speeds are whirl frequencies that coincide with a rotor spin rate. You can calculate whirl frequencies with the asynchronous option (ASYNC) and critical speeds with the synchronous option (SYNC).



Maneuver Loads

Static analysis determines the loads on the aircraft engine rotor due to pitch or yaw of an aircraft. Severe transverse rotations may be part of the design environment. Limiting rotor motion to prevent blades from rubbing against the interior of the casing may be part of the design criteria. This feature can help you determine if a potential rub condition exists, and improve the design prior to building a physical prototype.

Blade-Out Response

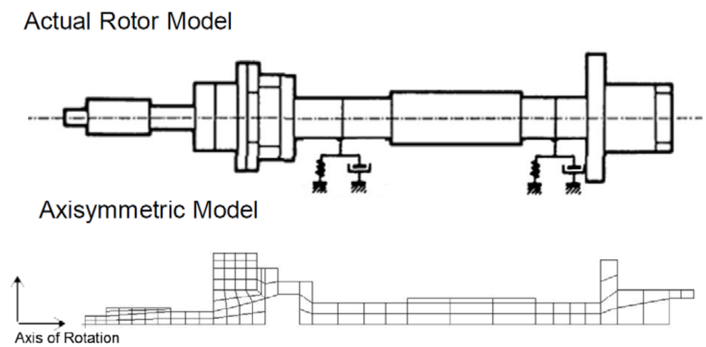
Direct linear and nonlinear transient analyses enable you to simulate engine blade-out and subsequent wind milling conditions. The analysis is used to help you ensure structural integrity during flight by ensuring that excessive vibration levels will not be reached.

Squeeze Film Dampers

Squeeze Film Dampers (SFDs) are used to provide adequate damping to maintain low amplitude vibration levels and to reduce the dynamic loads transmitted to the bearings and rotor support structures. Accurately model SFDs in MSC Nastran and design for general rotor orbits with multiple frequency content. This capability supports static loads and time domain analysis, and models the liftoff phenomenon important in the design of free-floating dampers.

Axisymmetric Rotordynamics

Specially designed axisymmetric elements facilitate the rotordynamic analysis of geometrically axisymmetric structures subjected to general non-axisymmetric loading represented by harmonics. This leads to more accurate prediction of the rotordynamic models, reducing the number of physical testing needed.



Multiple Rotor Simulations

Common rotordynamic systems consist of numerous rotors and present a high level of analysis complexity. Multiple rotors may be included in a single MSC Nastran analysis. Each rotor can be assigned different speeds or speeds dependent on other rotors.

External Superelements

The external superelement capability of MSC Nastran enables engine manufacturers to deliver their rotor models to partners like primary airframe manufacturers in a format that is convenient to both partners.

Corporate
MSC Software Corporation
4675 MacArthur Court
Suite 900
Newport Beach, CA 92660
Telephone 714.540.8900
www.mscsoftware.com

Europe, Middle East, Africa
MSC Software GmbH
Am Moosfeld 13
81829 Munich, Germany
Telephone 49.89.431.98.70

Asia-Pacific
MSC Software Japan LTD.
Shinjuku First West 8F
23-7 Nishi Shinjuku
1-Chome, Shinjuku-Ku
Tokyo, Japan 160-0023
Telephone 81.3.6911.1200

Asia-Pacific
MSC Software (S) Pte. Ltd.
100 Beach Road
#16-05 Shaw Towers
Singapore 189702
Telephone 65.6272.0082