MSC.Nastran™ Aeroelasticity I and II

A Suite of Tools for Aeroelastic Analysis: Static Trim, Flutter, and Dynamic Aeroelastic Response

OVERVIEW

SimOffice™ is a stand-alone environment in which engineers can build, test, review, and improve their designs. SimOffice gives product development engineers the shared technologies they need to assess product performance and accelerate innovation.

The MSC.Nastran™ product family is modular, enabling you to analyze products ranging from simple components to complex structures and systems. This also enables you to start simply and to grow your analysis capabilities as your Virtual Product Development (VPD) needs expand. As part of your VPD process, you can use MSC.Nastran to assess many functional aspects of your products, such as the structural response (displacement, strain, stress, vibration, and temperature) due to its material properties and the loads and boundary conditions that are applied to it during operation.

MSC.Nastran™ Aeroelasticity I and II

The MSC.Nastran™ Aeroelasticity I and II product modules enable the analysis of structural performance in the presence of an air stream for the cost-effective design of airplanes, helicopters, missiles, suspension bridges, as well as tall chimneys, exhaust stacks, power lines, and other structures exposed to aerodynamic loads.

The effects of aeroelastic loads due to subsonic and supersonic environmental conditions can greatly impact the stability, response, and performance of structures. Structural design and control system analysis can involve understanding the performance characteristics due to static aeroelastic stress, loads, aerodynamics, and flutter. Combining the effects of aeroelastic analysis with structural analysis can be challenging. MSC.Nastran Aeroelasticity modules provide the tools to analyze the effects of aeroelasticity and incorporate them into your structural (statics, normal modes, dynamics) product designs, thus reducing the time required for several design iterations and avoiding the costs of addition physical tests.
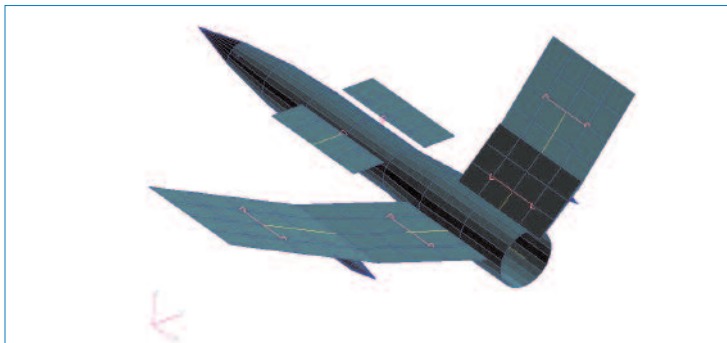
Aeroelastic Model

Why Are Reduced Finite Element Models Used In Mechanical System Simulations?

Classical multi-body dynamics formulations assume that the bodies are rigid. For certain structural parts, however, their flexibility has to be taken into account to obtain more accurate results. A traditional finite element model of a part is too detailed for inclusion into a dynamic analysis of an entire multi-body system.

▮PRODUCT LINE

SimOffice™

Product Family
MSC.Nastran™

▮CAPABILITIES

- Subsonic and Supersonic Aerodynamics.

- Static Aeroelastic Trim Analysis.

- Proven Aerodynamic Theories and Methods.

- Aeroelastic Stability Derivatives.

- Aeroservoelastic Analysis.

- Hinge Moment Calculation.

- Proven Flutter Analysis Methods.

- Transient Aeroelastic Response.

- Frequency Domain Aeroelastic Response.

- Discrete and Harmonic Gust Analysis.

- Design Sensitivity and Optimization.

- Unsteady Supersonic Aerodynamics – ZONA51.

▮BENEFITS

- Save Time and Reduce Costs with a Comprehensive Set of Capabilities to Simulate Aeroelastic Response, Perform Critical Stability Analysis, and Optimize Product Design Upfront in the Design Cycle.

- Rapidly Generate Balanced Aerodynamic Loads to predict the design loads for the vehicle.

- Confidently Predict Flight Vehicle Performance to Reduce the Amount of Physical Testing Required.

- Enhance Communication Between Internal and External Loads Groups Using a Common Analysis Tool and Data Formats.

- Deliver Products that Meet Certification and Safety Requirements.

MSC ⨯ SOFTWARE ®

SIMULATING REALITY

MSC.Nastran Aeroelasticity I

The MSC.Nastran Aeroelasticity I product module provides all the basic the capability to perform static aeroelastic, dynamic aeroelastic, and flutter analysis of structures. This product module operates in combination with the MSC.Nastran Basic and Dynamics, or Standard products providing a set of specialized tools to predict and simulate aeroelastic behavior in combination with structural behavior, perform structural design sensitivity and optimization, analyze dynamic loading including gust, and understand the dynamic stability of an aeroelastic system.

Comprehensive Aeroelastic Capabilities

MSC.Nastran Aeroelasticity I includes the ability to perform the following specific types of analyses:
- Aerodynamic Theories and Methods.
- Aeroelastic Stability Derivative Calculation.
- Static Aeroelastic Divergence Analysis.
- Static Aeroelastic Trim Analysis Including:
  – Critical Maneuver Loads.
  – Hinge Moments.
  – Aeroservoelastic Analysis.
- Aeroelastic Dynamic Response Analysis, Including:
  – Design Sensitivities and Optimization for Aeroelastic Response.
  – Superelement and Restart Support.
  – Integrated with MSC.Patran™ and MSC.FlightLoads™ for Pre- and Postprocessing.

Comprehensive Support For Aeroelastic Loads

The MSC.Nastran aeroelasticity option supports a nonlinear aeroelasticity capability compatible with common industry practice. Loads are considered nonlinear functions of control parameters and are corrected for aeroelastic effects using common weighting factors to better agree with experimental data.

Full vehicle and symmetric or anti-symmetric half vehicle trim analysis generates comprehensive balanced maneuver loads for use in internal loads sizing. Iterative trim algorithms support redundant control surfaces to simulate the effect of control laws in quasi-static analyses. Rigid aircraft analysis is available to provide checks on analysis accuracy.

Stability derivatives, control surface hinge moments and integrated loads monitor points (e.g., root wing bending moment) are recovered as a standard output. Full vehicle data are recovered in both body and wind axes.

Flutter Clearance For Certification

The MSC.Nastran aeroelasticity option supports numerous aerodynamic theories for subsonic and supersonic unsteady aeroelastic analysis such as flutter. The resulting data are directly used in the certification of flight vehicles under the FAA and JAA requirements.

Industry standard methods such as p-k analysis, the k-method and their derivative algorithms provide a comprehensive set of tools to model flutter behavior of damped, linear systems including:
- Flutter Analysis Methods Applicable Across a Range of Mach Numbers:
  – K, KE, PK.
  – PKS (K-Range Sweep).
  – PKNL (No Looping).
  – PKNLS (No Looping, K-Range Sweep).
- Flutter Clearance.

Multiple Flutter Boundary Conditions

The flutter analysis capability allows for the simultaneous consideration of multiple boundary conditions. This is most useful in design optimization where these conditions be treated in a design task.

MSC.Nastran Aeroelasticity II

The MSC.Nastran Aeroelasticity II product module is an add-on module (requires Aeroelasticity I as a prerequisite) that provides a supersonic counterpart (ZONA51) for unsteady aerodynamics, which is compatible with the subsonic doublet lattice method available in Aeroelasticity I. This aerodynamic method is licensed from ZONA Technology, Inc. (www.zonatech.com) and packaged within MSC.Nastran for convenient access by engineers requiring supersonic aeroelastic analysis of structures that experience unsteady supersonic lifting surface aerodynamics such as high-speed transports, launch and re-entry vehicles, air-combat vehicles, and missiles.

EXTEND YOUR INVESTMENT

MSC.Software recommends MSC.Patran™ or MSC.SOFY™ for an integrated modeling and analysis environment.

MSC.MasterKey™ delivers a flexible, token-based licensing system that provides access to the breadth and depth of MSC.Software's world-class Virtual Product Development software portfolio, allowing you to use whatever simulation tools you want, whenever you need them – maximizing your productivity and reducing cost.

MAXIMIZE YOUR RETURN ON INVESTMENT

MSC.Software provides the most comprehensive training, support, and professional services with offices worldwide to provide local and centralized support. Investing in MSC.Software gives you access to extensive client support through comprehensive documentation, direct technical expertise, and customized onsite and offsite training classes taught by experienced engineers.

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