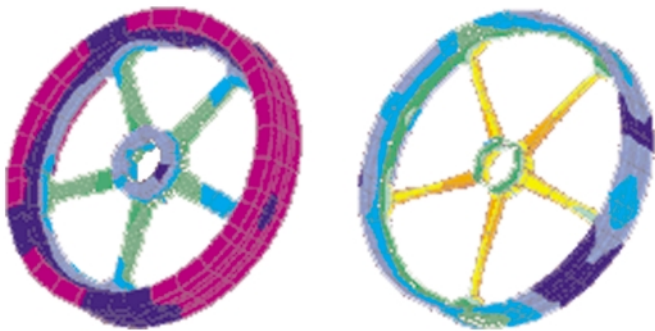


## Design Optimization for your Finite Element models

### OVERVIEW

MSC.Nastran Optimization provides users with the ability to synthesize and optimize their designs. These capabilities are essential for engineers to assess the effect of design changes, improve existing designs, and ensure that their designs meet all requirements. Specialized algorithms provide the capability to analyze fully stressed designs as well as to perform optimization with discrete variables.

Sensitivity analysis, included as part of MSC.Nastran and MSC.Nastran Basic, unlocks the power of the Optimization module.



Significant weight reduction can be achieved through optimization

### DESIGN VARIABLES

The parameters that can be modified as part of the study include:

- Shape variables tied to the geometry
- Sizing variables tied to finite element properties, including element properties, material properties and connectivity properties (e.g., beam offsets)

Shape and sizing variables can both be used in the same run

### RESPONSES

Responses can be either design objectives or performance constraints. Supported types include:

- Preset - Responses available directly from MSC.Nastran. These include items such as weight, volume, displacement, stress, and strain. Specialized responses are available from dynamic analyses (including power spectral density analysis) and aeroelasticity.
- User defined - Combination of preset responses, design parameters and constants
- External - Responses calculated using client-server techniques.

## CAPABILITIES

- Support for many analysis types
- Pre and Post processing support from MSC.Patran™
- Support for fully stressed designs
- Support for superelements
- Continuous and discrete variables
- Support for beam libraries
- Design variable linking
- Adjoint sensitivity analysis
- Robust optimization algorithms
- Sparse data recovery
- Distributed memory parallel supported
- Detailed User's Guide

## BENEFITS

- Study the effect of design changes
- Perform multi-disciplinary analysis and design
- Improve existing designs
- Determine feasible designs that satisfy all design requirements
- Improve correlation between analysis and test results

## Analysis Types in MSC.Nastran Optimization

Basic Analysis	Linear statics analysis Normal modes analysis Buckling analysis
Dynamic Response (1)	Direct and Modal frequency response. Direct and modal complex eigenanalysis. Modal transient response Acoustic analysis
Aeroelasticity (2)	Static aeroelasticity Flutter
(1) Requires Dynamic Response (2) Requires Aeroelasticity I All analysis types can apply superelements (requires superelements)	

### USER-DEFINED EQUATIONS ALLOW USERS TO SYNTHESIZE THE OBJECTIVE, CONSTRAINTS, AND PROPERTIES

- RMS (root-mean-square) type responses
- Cost and other non-structural objectives
- Model updating to match test data
- Beam properties as a function of sectional dimensions
- Minimization of the maximum response
- Spanning of subcases and superelements

### EXTERNAL RESPONSES ALLOW COMPLEX DESIGN REQUIREMENTS

- MSC.Nastran interacts with your analysis software using client-server techniques
- Allows consideration of proprietary design algorithms; for example, in-house buckling analyses.
- Interface similar to the user defined beam library interface.

### DESIGN OPTIMIZATION AND SENSITIVITY ANALYSIS CAN BE SIMULTANEOUSLY APPLIED TO MANY ANALYSIS TYPES

- Linear statics, normal modes, and buckling
- Transient response, frequency response, and complex eigenanalysis, all including acoustics.
- Static aeroelasticity and flutter

### EFFICIENT ALGORITHMS PERMIT THE USE OF HUNDREDS OF DESIGN VARIABLES AND MILLIONS OF RESPONSES FOR LARGE MODELS

Important capabilities include

- Design variable linking
- Approximation methods
- Robust optimization algorithms
- Constraint and load case deletion and regionalization
- Optimization can be restarted from a completed design cycle and continued
- Adjustable convergence criteria and move limits: for faster convergence
- Sparse data recovery for faster speed and minimal disk space
- Adjoint Sensitivity Analysis
- Mode Tracking
- Distributed Memory Parallel Supported
- Superelements can be used to reduce the size of the redesign task

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