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NX Nastran – Dynamic Response

Improve structural dynamic behavior through analysis of a product's response to time or frequency varying loads

Benefits

- Reduce your risk by using simulation to save time and cost compared to physical build-and-break test cycles
- Accelerate innovation through rapid iteration and numerous "what-if" studies
- Improve confidence in final design by virtually investigating the product's performance under all possible operating conditions

Summary

NX™ Nastran® is part of the Simcenter™ portfolio of simulation tools, and is used to solve structural, dynamics and acoustics simulation problems. NX Nastran – Dynamic Response software enables you to compute your product's forced dynamic response to inputs (loads or motions) that vary with time or frequency. An add-on option to NX Nastran – Basic, it complements the linear statics and modal solution capabilities found in the NX Nastran – Basic solution. Assessing dynamic response is critical to a number of industries to ensure passenger comfort in aircraft and automobiles under different operating conditions, or evaluate the effect of vibrations on the performance of consumer products and other high-tech electronic devices.

Designing for maximum performance

The dynamic response of your part or system is governed by its natural frequencies. If your product is excited by inputs having frequencies close to one of its natural frequencies, this will result in a high-amplitude vibratory behavior that could be undesirable, possibly even catastrophic. NX Nastran – Dynamic Response allows you to better understand your product's dynamic response so that you can design it to avoid exciting those frequencies that could cause it to fail when in operation.

Major capabilities

Comprehensive dynamic response:

- Normal modes and complex eigenanalysis
- Frequency and transient response
- Acoustic response analysis
- Random response analysis
- Response and shock spectrum analysis
- DDAM analysis
- Usable with superelements
- Usable with glue connections
- Usable with contact pre-loads
- Interface to MBD solutions (Adams, RecurDyn and SIMPACK)

See Table 1 on following page for a complete list.

NX Nastran – Dynamic Response

Table 1 – Analysis types available with NX Nastran – Dynamic Response

Summary of analysis types	Solution sequence number
Normal modes analysis*	103, 200
Modal frequency response	111, 200
Direct frequency response	108, 200
Cyclic Direct Frequency Response	118
Modal transient response	112, 200
Direct transient response	109
Acoustic analysis	108, 109, 111, 112, 200
Complex eigenanalysis	107, 110
Random response analysis	108, 111
Nonlinear normal modes*	106
Nonlinear complex modes*	106
Response spectrum generation	109, 112
Response spectrum application*	103
DDAM analysis	187
Design sensitivity-modes*	103, 200
Design sensitivity-frequency response	200
Design sensitivity-transient response	200
Design sensitivity-acoustics	200
Transient response-auto time-stepping**	129

Optimization solutions using SOL 200 require NX Nastran Optimization module.

Complete library of elements for dynamic analysis, which includes the elements in NX Nastran Basic plus the following:

- Acoustic elements
- Damping elements
- Nonlinear-elastic elements for transient response

Many types of damping:

- Structural damping
- Material damping
- Variable modal damping (viscous or structural)
- Discrete viscous dampers
- Acoustic barriers and absorbers
- Direct matrix input
- Nonlinear dampers
- Dynamic transfer functions
- Frequency dependent damping
- Structural to viscous conversion

Comprehensive array of eigensolvers:

- Lanczos
- Householder, modified Householder
- Complex Lanczos
- Complex Hessenberg
- Complex inverse power

Dynamic loading with complete generality in the time and frequency domains:

- All static loads can be applied dynamically
- Enforced displacement velocity and acceleration
- Initial displacement and velocity
- Initial displacement from static solution
- Time delays, time windows and analytic and explicit time functions
- Phase angles (real and complex)
- Nonlinear transient loading based on displacement and velocity
- Each load or enforced motion can have a different time history
- Acoustic loading

*Included with NX Nastran – Basic.

**Nonlinear SOLs that can be run as long as the material properties are linear.

Efficient dynamic analysis methods:

- Modal and direct solution methods
- Restarts from previously computed solutions
  - From normal modes to frequency and transient response
  - From frequency response to random response
- Restarts to change loads and analysis parameters
- Capture maximum transient response
- Reduction methods
  - Guyan reduction
  - Component mode synthesis
  - Fast modal frequency response solution

Methods to mitigate mode truncation effects:

- Residual vectors
- Mode acceleration
- Direct solutions

Random response results:

- PSD functions (auto and cross)
- Autocorrelation functions
- Cumulative RMS functions
- RMS
- Zero-Crossing rate
- Relative motion

Efficient solution of large models:

- Sparse matrix solvers for faster speed and minimal disk space available for all analysis types
- Sparse data recovery gives fast solution for limited output
- Automatic internal resequencing for bandwidth reduction
- Parallel and vector processing for faster response calculations
- Superelements
- Fast modal computation using RDMODES

Design sensitivity analysis for assessing changes in dynamic response due to changes in the design:

- Shape and sizing design variables
- Present objective and constraints
  - Weight, volume, eigenvalue
  - Element stress and force
  - Displacement, velocity, acceleration, reaction force
- User-defined objective and constraints
- Sensitivity and optimization for modes, transient response, frequency response, acoustics, statics and buckling all in one run

Ability to interface with numerous programs:

- Geometry can come from CAD and solid modeling programs
- Supported by all popular FE modelers
- Dynamic output can be read by kinematics programs and programs for test-analysis correlation

Advanced dynamic analysis capabilities for analyzing complex phenomena:

- Control systems
- Coupled fluid-structure analysis
- Transfer functions
- Fourier transforms for input loads
- Gyroscopic and Coriolis effects (requires the NX Nastran DMAP option)
- Component mode synthesis
- Residual vectors for accuracy

Batch X-Y plotting for plotting large volumes of data:

- Plot any response versus time and frequency
- Cartesian, log-log and semi-log plots
- Real/imaginary and magnitude/phase plots
- Single or multiple curves per plot
- Single or multiple plots per page
- Multiple curve and frame line styles
- Save plots in postscript format

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