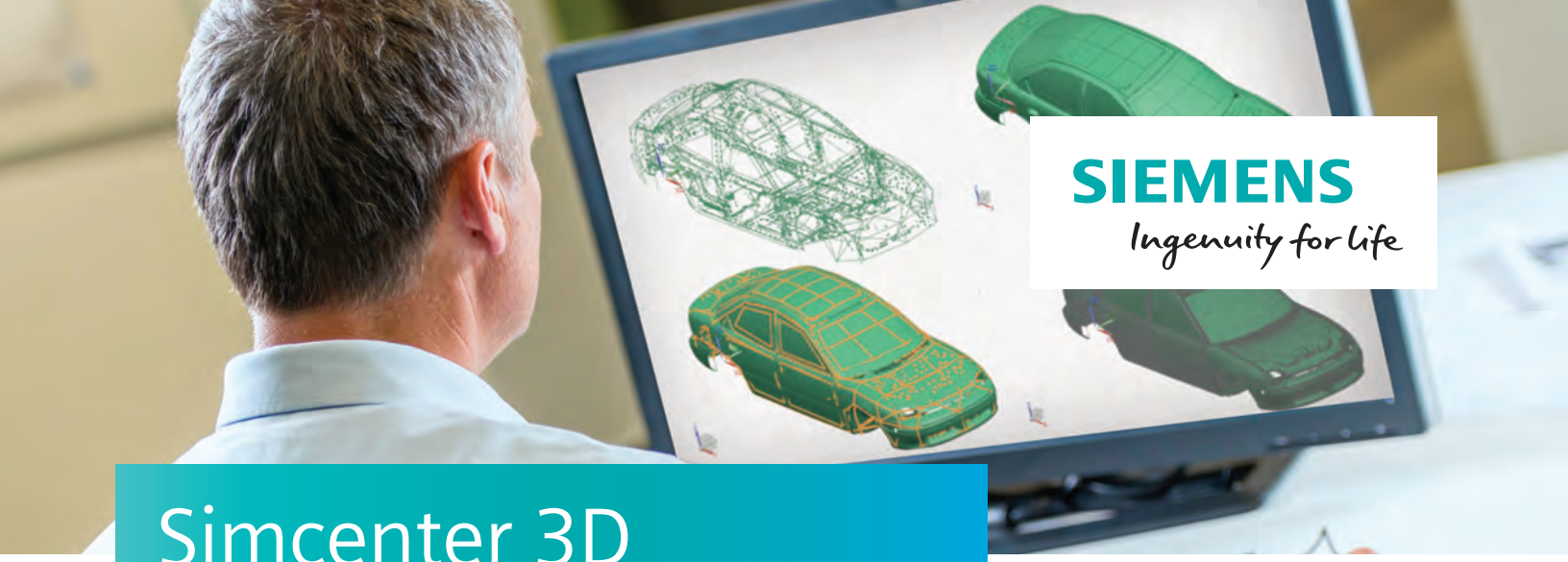


SIEMENS
Ingenuity for life

Simcenter 3D Noise and Vibration Modeling

Innovative solutions for efficient noise and vibration engineering

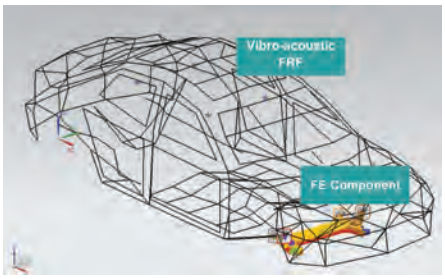
Benefits

- Gain valuable insight into noise and vibration performance using noise, vibration and harshness postprocessing as a diagnostic tool
- Construct system or assembly models using a hybrid assembly of finite element components and components based on test or reduced order models
- Employ reduced representations to preprocess input required for NX Nastran for system level dynamics and vibro-acoustics
- Use frequency response function-based component representation for transfer path or path contribution analysis
- Facilitate re-use of the reduced components or test components in different assemblies

Summary
Simcenter™ 3D Noise and Vibration Modeling software provides noise and vibration pre/post capabilities addressing your need to build, understand, evaluate and optimize the noise and vibration performance of system assembly models.

Hybrid and reduced modeling
Simcenter 3D Noise and Vibration Modeling software allows you to include modal, frequency response function (FRF) and acoustics transfer vector (ATV) component representations in a system assembly. Reduced component representations can then be used in the noise, vibration and harshness (NVH) system for predicting assembly models instead of their full finite element (FE) representation, reducing computational time while maintaining solution accuracy. You can also perform what-if studies, leading to potential productivity improvements. Test measurements are used where FE models cannot be used to accurately model a component, or when FE models are simply not available. For instance, when a supplier wants to include the effect of the surrounding structure, such test components can then be included in the system model to improve modeling fidelity. Modal and FRF components are connected to the rest of the system using springs, dampers or rigid elements by leveraging universal connections technology in Simcenter 3D.

Providing insight into noise and vibration results
Simcenter 3D Noise and Vibration Modeling software offers a wealth of postprocessing tools to study the noise and vibration behavior at the subsystem or system level. This allows you to evaluate the effect of modes, panels, path or grid contribution to the vibration or acoustic response, and helps in locating the sources of issue (modes, path and panel). The results are presented to you in an intuitive manner by establishing a relationship between the results that are automatically presented in different viewports.



Assembly of hybrid components (vibro-acoustic FRFs for body and cavity and subframe FE).

Simcenter 3D
Noise and Vibration Modeling

Integration with NX Nastran
Simcenter 3D Noise and Vibration Modeling software is part of the broader Simcenter 3D offering and is seamlessly integrated with NX™ Nastran® software for solving noise and vibration problems. This can improve productivity.

Component representations

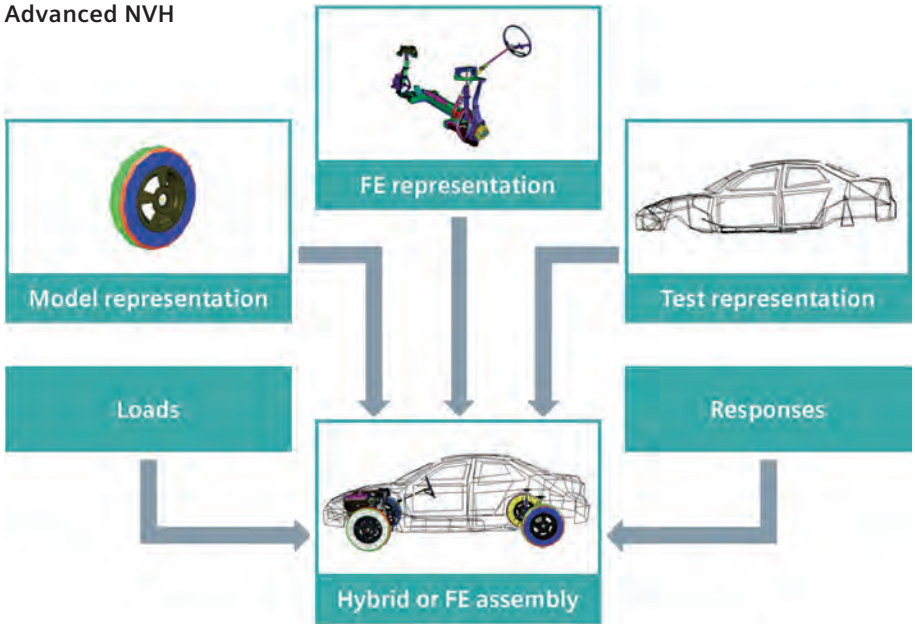
Mode set
A mode set describes the dynamic behavior of a component or subsystem in terms of its mode shapes, (undamped) modal frequency and modal damping:

- Supports modal information from the following data sources: NX Nastran op2, Universal File and LMS Test.Lab data
- Supports selective activation and deactivation of modes
- Supports editing modes – you can edit frequency, modal damping
- Supports display of contour plots on modal data

FRF set
An FRF set describes a component in terms of its frequency response functions or transfer functions:

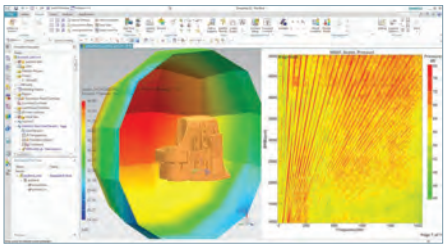
- Supports FRFs from the following data sources: NX Nastran op2, Universal File and LMS Test.Lab
- Supports the following physical data types for input and response: force, acceleration, velocity, displacement, pressure
- Supports activating/deactivating FRFs
- Supports function plots of FRF function data (XY plot, color bars and bar chart plots)

Advanced NVH



ATV set
An ATV set describes an acoustic domain in terms of its transfer functions between the microphones and free faces of the acoustic fluid:

- Supports ATVs generated from NX Nastran
- Automatically displays microphone mesh and fluid surface
- Supports contour plots of ATV data



Creating FRF components
Dedicated solution to create an FRF component:

- Simple solution for creating FRF, including noise transfer functions
- Supports direct and modal frequency response
- Supports force or displacement/velocity/acceleration excitation
- Supports structural responses (displacement, velocity and acceleration) and acoustic pressure response

Noise and vibration diagnostics

Modal contribution scenario
You can include modal contribution results for NX Nastran. This includes defining the vibro-acoustic coupling and the panels. The modal contribution scenario allows users to understand the contribution of a structure of fluid mode to a response and supports the following:

- Visualization of results in color map, XY plot, color bars
- Display of bar charts and vector plots – contribution plots in a single frequency
- Display of modal contribution as a percentage of total response
- Display of partial contributions of modes – selecting contributions from one or more modes

- Display of projected modal contribution
- Selection of top modes for contribution
- Display of total response
- Reduced frequency set for computing partial sum contribution or selecting the top contributors

Panel contribution scenario

You can set up a solution to include panel contribution results for NX Nastran. This includes defining the vibro-acoustic coupling and the panels. The panel contribution scenario allows you to understand the contribution of a panel to a target response with the following:

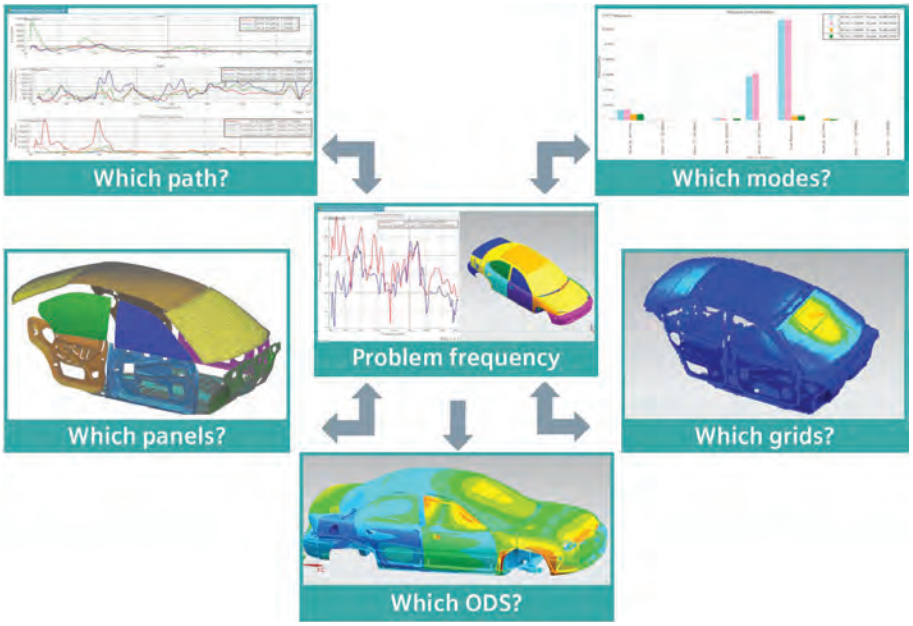
- Visualization of results in color map, XY plot, color bars
- Display of bar charts and vector plots – contribution plots at a single frequency
- Display of panel contribution as a percentage of total response
- Display of partial panel contributions – selecting contributions from one or more panels
- Display of projected panel contribution
- Selection of top contributors
- Display of total response

Grid contribution scenario

You can set up a solution to include grid contribution computations for NX Nastran. The postprocessing scenario:

- Supports the display of grid contribution contour plots for a given frequency, response location and degrees-of-freedom (DOF)
- Enables you to select the mesh from either the NX Nastran op2 file or from the FEM or assembly FEM

NVH results



Order-cut analysis scenario

You can set up order-cut analyses on color map displays together with XY plots, with dependency on frequency and RPM. This new postprocessing functionality supports:

- An order-cut analysis scenario with a waterfall of frequency spectra and order-cut inputs
- Color maps representing the input loading amplitude (force, acceleration, etc.) with respect to RPM and frequency
- Color maps representing the output response with respect to revolutions per minute (RPM) and frequency
- An XY plot representing the output response for a selected order-cut with respect to the RPM
- Automatic interaction between the color map and order-cut analysis plot

Path contribution scenario

The solution allows you to to understand the noise and vibration response by breaking it down to contributions based on the individual path to the response. Each path is identified by its source, which is the loading location and the receiver position in the response location. This allows you to identify key transfer paths and its root cause; for example, it helps answer the following questions at a given frequency:

- Is the input load too high
- Is the transfer function too high
- Is the product of the load and transfer function too high

The path contribution scenario helps you to:

- Automatically create a display of response, load and FRFs in multiple subviewports
- Automatically synchronize the display in subviewports
- Select transfer paths – one or more response nodes (receivers) and one or more excitation nodes (source)

Directivity plot scenario
You can determine the spatial distribution of the sound field radiated at specific frequencies by using directivity plots. The postprocessing scenario for directivity analysis supports:

- Polar directivity plots
- Acoustic pressure, velocity and intensity
- Directivity meshes, which typically are connected to 1D microphone elements forming a circle or an arc
- Plotting results for multiple directivity meshes, multiple frequencies and multiple subcases on the same graph

Duct transmission loss scenario
You can evaluate the transmission loss of a duct by using the three-point method. This postprocessing scenario supports:

- Acoustic pressure at fluid or microphone nodes
- Selection of three microphone points by the user: two nodes for the inlet data and one node for the outlet data
- Overriding of the speed of sound value
- Overriding of the distance between the inlet microphones
- Inlet-over-outlet surface area ratio
- XY plot for the transmission loss in the sound pressure level measured in decibels (dB) with respect to the frequency

Panel transmission loss scenario
You can postprocess transmission loss results in the instance of a panel separating a reverberant room as an acoustic source and an anechoic room as a receiver. Incident power, transmitted power and transmission loss results stored in an NX Nastran file can be picked up and plotted.

Energy distribution scenario
You can understand the distribution of energy in a system model so he or she can discern which components are dominating the response.

- Supports element strain energy and element kinetic energy
- Supports frequency distribution by component with an XY plot
- Supports the energy distribution plot by component per frequency with a bar chart
- Supports the distribution of energy plots by physical property per frequency with a bar chart
- Supports distribution of energy by physical property per frequency with a contour plot
- Supports distribution by component per frequency with a contour plot

Equivalent radiated power scenario
You can set up a solution to include equivalent radiated power (ERP) for NX Nastran. This scenario allows you to visualize the ERP to receive information about the maximal radiation of components and panels.

- Supports XY plot display of ERP
- Supports the display of ERP at a given frequency
- Supports the display of partial contributions of panels to ERP by selecting contributions from one or more panels
- Supports the selection of top panels that contribute to ERP
- Supports reduced frequency set for computing partial sum contribution or by selecting the top contributors

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