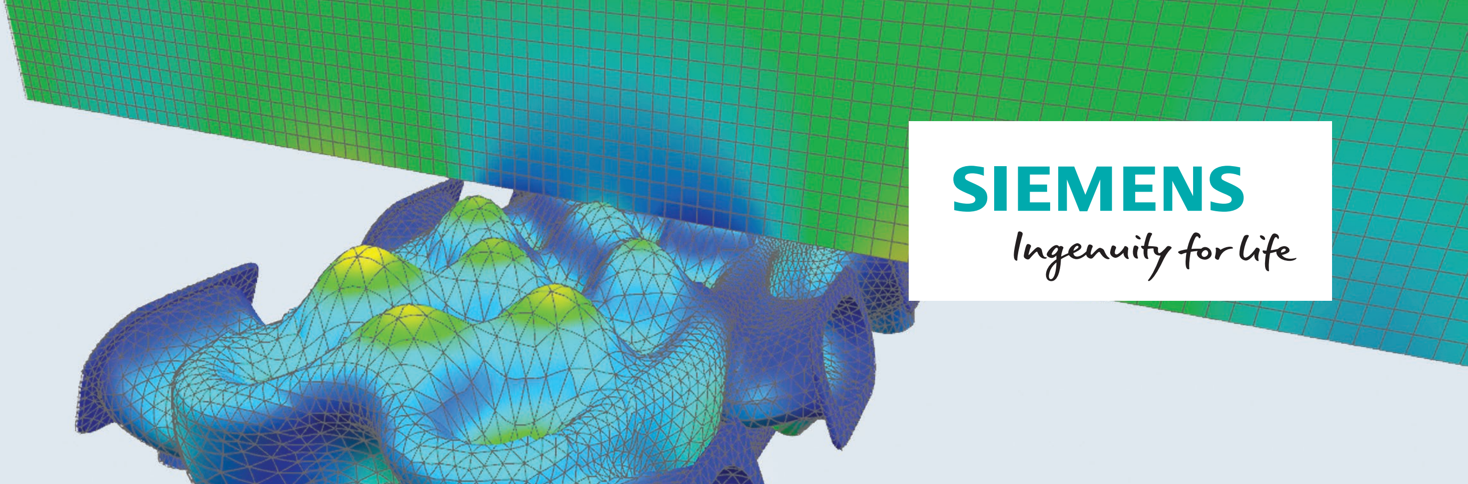


SIEMENS

Ingenuity for life

NX Nastran Advanced Acoustics

Enabling weakly and fully-coupled vibro-acoustic simulations

Benefits

- Perform both weakly and fully-coupled vibro-acoustic simulations
- Simulate acoustic performance for interior, exterior or mixed interior-exterior problems
- Correctly apply anechoic (perfectly absorbing, without reflection) boundary conditions
- Include porous (rigid and limp elastic frames) trim materials in both acoustic and vibro-acoustic analysis
- Request results of isolated grid or microphone points at any location
- Define infinite planes to simulate acoustic radiation from vibrating structures in the vicinity of reflecting ground and wall surfaces

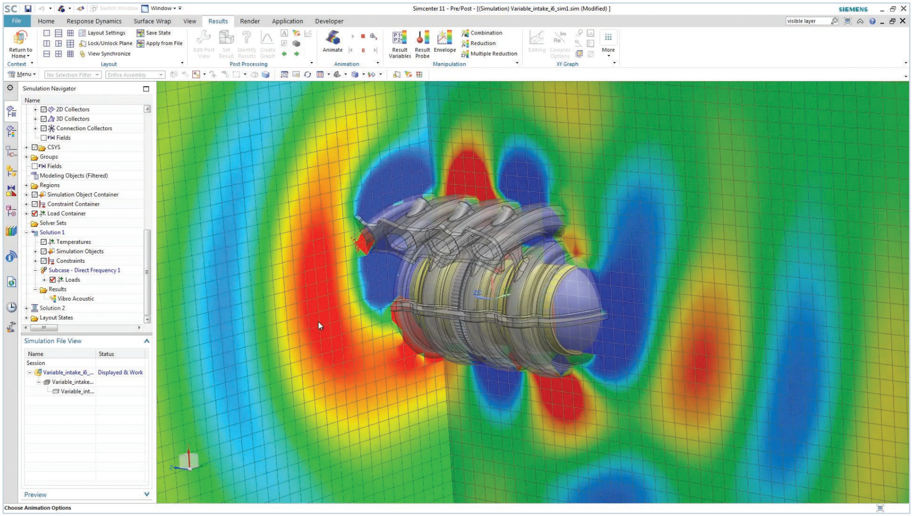
Summary

NX™ Nastran® Advanced Acoustics software extends the capabilities of NX Nastran for simulating exterior noise propagation from a vibrating surface. NX Nastran is part of the Simcenter™ portfolio of simulation tools, and is used to solve structural, dynamics and acoustics simulation problems. The NX Nastran Advanced Acoustics module enables fully coupled vibro-acoustic analysis of both interior and exterior acoustic problems in NX Nastran.

NX Nastran Advanced Acoustics includes automatically matched layer (AML) technology, which facilitates efficient modeling of exterior acoustic domain and duct endings.

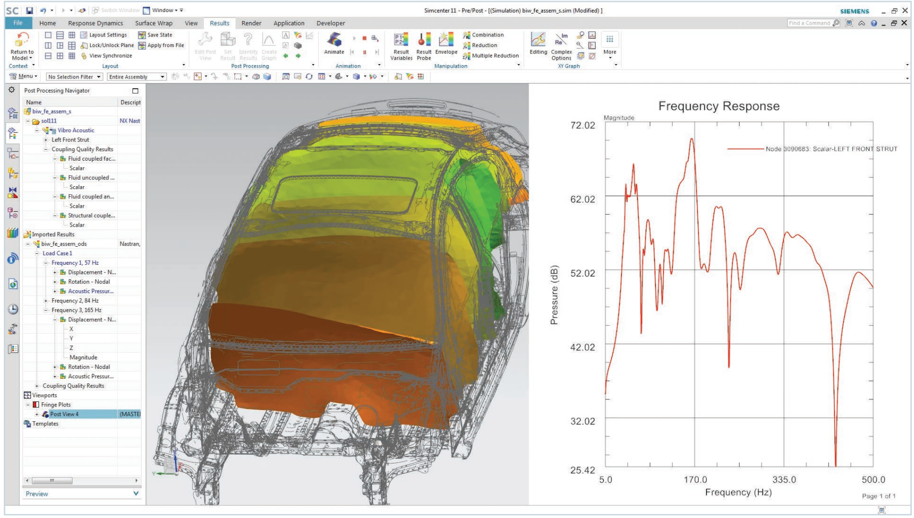
In addition to applying a dedicated radiation boundary condition, analyzing an exterior radiation problem requires predicting acoustic results at locations exterior to the finite element (FE) domain. With AML, NX Nastran supports the calculation of results on microphone meshes outside the meshed fluid.

NX Nastran Advanced Acoustics also supports simulation of acoustic radiation problems in which the radiating component is located close to one or more infinite reflecting surfaces. Such infinite surfaces can be a ground or wall surface, or they can be used to represent the sea surface in underwater acoustics.



NX Nastran Advanced Acoustics

For modeling porous materials, which are used as acoustic absorbers for passive noise reduction, you can apply the following material models: Craggs, Delany-Bazely-Miki and Johnson-Champoux-Allard.



Nonreflecting boundary condition
Using AML technology enables you to simulate a nonreflecting boundary condition, and is applied on the acoustic mesh outer surface (on element faces). During the solving, the AML is converted into a virtual perfectly matched layer (PML) with 3D elements for every solution frequency. In these layers, incident acoustic waves are numerically absorbed, eliminating reflection.

You can use AML for exterior acoustics to model a free (unbounded) field condition. When simulating exterior noise from a vibrating component using finite elements, a limited layer of fluid elements around the structure needs to represent the entire free field. By using AML as a radiation boundary condition on the outer boundary of this layer, you can do this effectively. The AML mimics an infinite exterior continuation of the fluid domain. This technology dramatically reduces the number of fluid degrees-of-freedom (DOF), as a fluid mesh with an AML boundary only requires a thin fluid layer that can remain close to the radiating surface to accurately simulate the free field.

AML is also suitable for duct acoustics when it can be used at a duct-end section to impose anechoic termination, making the duct acoustically infinite, which is typically required for acoustic transmission loss studies.

You can also use nonhomogeneous materials in the AML region to account for gradients in material properties. NX Nastran can also be used to accept the specifications of multiple AML boundary conditions.

Infinite planes
When the sound-radiating structure is located on a hard floor, such as a semi-anechoic chamber, the floor becomes a reflective boundary. Using NX Nastran enables this to be modeled as a symmetry-type rigid infinite plane.

Similarly, in underwater acoustic simulations the water surface can be modeled as a pressure-release or zero-pressure surface. You can use an anti-symmetry-type infinite plane to model such a surface. Reflections from the infinite plane are then accounted for by computing far-field results.

Microphone meshes
Microphone meshes (sometimes also referred to as field-point meshes) define the locations where acoustic results – such as acoustic pressure, velocity, intensity and acoustic power – have to be computed.

You can view results as contour plots on 2D and 3D meshes. You can use a 2D surface mesh to calculate the acoustic output power through the surface. If this one entirely surrounds the radiating structure, the resulting power equals the total radiated acoustic output power of the vibrating structure.

You can also define individual microphones in any position inside or outside the FE domain to plot acoustic pressure curves.

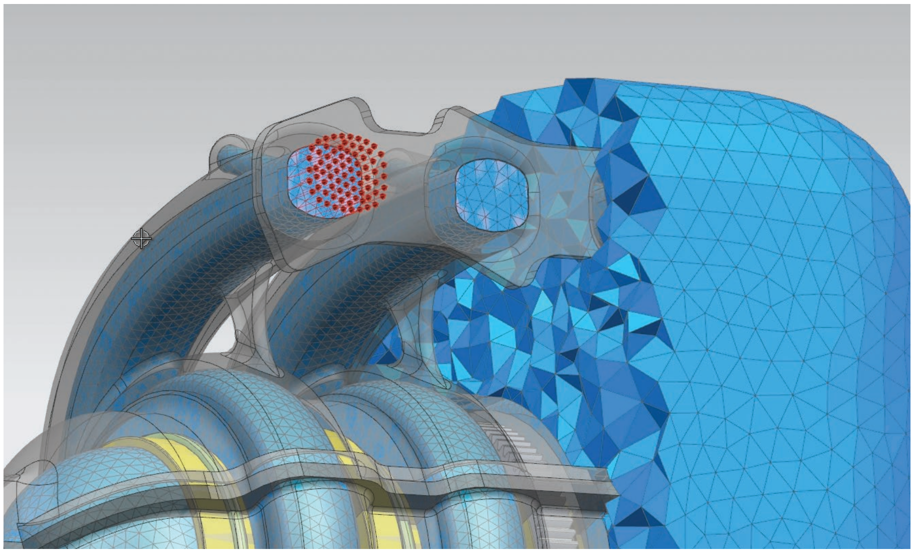
Result types
NX Nastran Advanced Acoustics supports a variety of result types, including:

- Pressure, acoustic particle velocity and acoustic intensity at any microphone location, either inside the FE domain or exterior to the AML region
- Radiated acoustic output power that can be requested on a microphone surface mesh or AML surface

Microphone locations can be referenced as response locations for panel- and modal-contribution analysis.

Rigid and limp porous material support
Porous materials such as mineral wool, glass fiber and high-porosity foams absorb sound in the pores by viscous and thermal dissipation of acoustic energy. The acoustic wave propagation in these materials requires dedicated material models. NX Nastran Advanced Acoustics supports the following:

- Craggs (rigid frame)
- Delany, Bazely and Miki (limp and rigid frames)
- Johnson, Champoux and Allard (limp and rigid frames)



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