SIEMENS

NX Advanced FEM

Integrating geometry and FE modeling to streamline the product development process

Benefits
- Speed simulation processes by up to 70 percent
- Increase product quality by rapidly simulating design tradeoff studies
- Lower overall product development costs by reducing costly, late design change orders
- Efficiently manage large, complex analysis models
- Capture and automate best practices and commonly used processes
- Pre- and postprocess analysis models for the most popular finite element solvers

Summary
NX™ Advanced FEM software is a modern, multidiscipline computer-aided engineering (CAE) environment for advanced analysts, workgroups and designers that need to deliver high-quality performance insights in a timely fashion to drive product decisions. NX Advanced FEM includes a full suite of direct geometry modeling and editing tools, and forms the analysis modeling foundation on which you can pre- and post-process analysis models for structural, thermal, flow, engineering optimization and multiphysics analyses. NX Advanced FEM speeds CAE processes with a bi-directional analysis model to design geometry association that enables users to rapidly update an analysis model when the base design changes. Multi-CAE environments enable analysts to build and export analysis models for industry standard solvers such as Abaqus, ANSYS, LS-DYNA, MSC Nastran as well as NX Nastran® software and the LMS Samcef Solver Suite. Analysts can also import results from these external solvers for postprocessing.

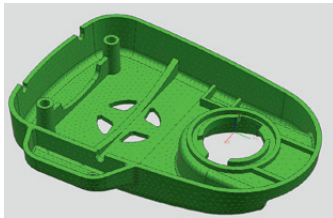### Providing finite element modeling for experienced CAE analysts
Using NX Advanced FEM drastically reduces the time you spend preparing simulation models. NX delivers all the advanced meshing, boundary conditions and solver interfaces that experienced analysts expect and need to perform high-end analysis. However, what makes NX Advanced FEM unique from all other finite element (FE) preprocessors is its superior geometry foundation that enables intuitive geometry editing and analysis model associativity to multi-computer-aided design (CAD) data. The tight integration of a powerful geometry engine with robust analysis modeling commands is the key to reducing modeling time by up to 70 percent compared to traditional FE modeling tools.

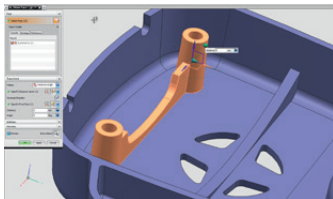### Enabling fast, intuitive geometry editing
NX Advanced FEM is built on the same leading geometry foundation that powers NX. By using NX Advanced FEM, you can rapidly clean up and prepare geometry from any CAD source through direct

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NX Advanced FEM

Shown is an initial analysis model.

Use synchronous technology and select geometry to move interactively.

Simply drag geometry to a new position.
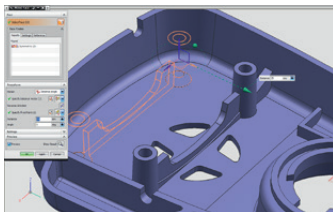

New design ready to be analyzed.

modeling. Geometry edits and the complete analysis model remain associated to the base design, which means you can easily update your analysis model each time the design changes. As a result, the NX CAE geometry editor accelerates your design-analysis iterations and improves your overall productivity.
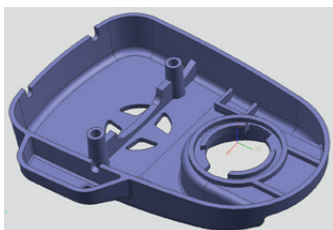
Direct geometry editing with synchronous technology: NX Advanced FEM includes direct geometry editing capabilities powered by synchronous technology, combining the flexibility of direct modeling with the best of dimension- and constraint-driven techniques to provide you with the most control. Analysts can quickly edit geometry in intuitive ways that are not possible in traditional CAE preprocessors or feature-based CAD systems. Direct editing will work on geometry from any source, and analysts can use it to rapidly defeature or modify geometry prior to meshing, create design alternatives for what-if evaluations, or rapidly generate fluid domain volume geometry.

In addition to synchronous technology, NX Advanced FEM delivers a wide range of geometry editing capabilities that are needed to de-feature, abstract and idealize geometry for CAE purposes, such as:

- Geometry healing and repair for gaps and other data inaccuracies

- Mid-surfacing to create surfaces for thin-walled components

- Defeaturing tools (geometry repair, feature suppression, stitch surface, remove hole/fillet and partitioning)

- Non-manifold topology generation for volumes

- Ability to create a surface from an orphan mesh

- Split body and partitioning methods for dividing solid geometry into more manageable sections prior to hex meshing

Rapid design-analysis iterations through associativity: user-defined geometry edits, FE mesh and boundary conditions are all associated to the base design. When the design topology changes, NX rapidly updates the existing analysis geometry, mesh, loads and boundary conditions as required, avoiding the need for the analyst to manually recreate the analysis model. This approach greatly reduces downstream modeling time, which is compounded across a project's many design-analysis iterations.

Multi-CAD support: NX Advanced FEM supports CAD geometry in a number of formats, and all NX Advanced FEM direct editing and idealization capabilities can be used on geometry from all of these formats:

- Direct geometry translators (CATIA V4, CATIA V5 and Pro/Engineer)

- Neutral geometry transfer (IGES, STEP, JT™ data format and Parasolid® software)
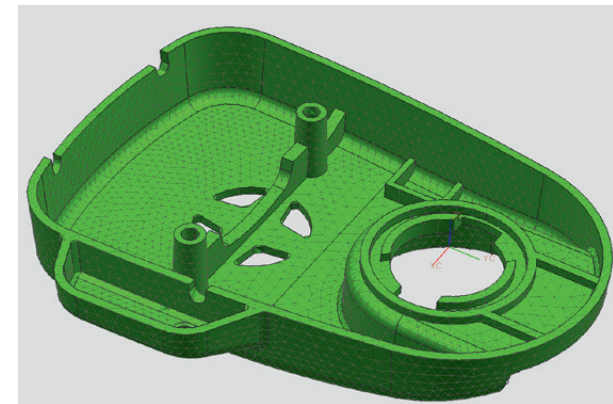
In a matter of seconds you can have associated mesh updates that are ready for immediate analysis.

Delivering comprehensive meshing
NX Advanced FEM includes extensive modeling functions for automatic and manual mesh generation of 0D, 1D, 2D and 3D elements, and also numerous techniques for the application of loads and boundary conditions. The NX Advanced FEM integrated environment is unique because it associates the analysis model to its geometry. User-defined geometry edits, mesh and boundary conditions are all associated to the base design. When the design geometry changes, NX Advanced FEM maintains the existing analysis geometry, mesh, loads and boundary conditions, and rapidly updates them as required, thereby avoiding the need for you to recreate the analysis model. This approach greatly reduces downstream modeling time, which results in huge time savings across a project's many design-analysis iterations.

0D and 1D meshing: you can create 1D elements, such as welds, bolts, rigids and beams, and other elements with ease. NX Advanced FEM also leverages CAD information to help you quickly create beam section properties and facilitate the creation of FE weld connections based on data contained in the CAD assembly.

2D shell meshing: NX Advanced FEM provides a number of tools to help you create accurate FE meshes needed for thin-walled components. These tools can be used in conjunction with mid-surface, and the types of 2D meshing methods include:

- Mapped meshing to control the distribution of elements across a surface

- Free (unstructured) meshing for surfaces with more than four sides

- Dependent meshes to ensure meshes match in contact or symmetric regions

3D solid meshing: thick, chunky components are often modeled using tetrahedral or hexahedral elements. NX Advanced FEM offers the necessary tools to quickly create solid elements, including:

- Automatic best-in-class tetrahedral meshing

- Swept hexahedral meshing

- Pyramid elements needed to smoothly transition from a hex mesh to a tetrahedral mesh

Mesh control and editing: in addition to creating meshes, NX Advanced FEM helps you fine tune and edit meshes to achieve quality criteria and more accurate results. Capabilities include:

- Mesh morphing to modify existing meshes to match new geometry dimensions

- 2D and 3D mesh controls for fillets and cylinders

- Extensive mesh quality checks and reporting

- Local element control for precise mesh generation

- Batch meshing with mesh controls for use in automated processes

Flexibly apply loads and boundary conditions
The geometry engine at the core of NX Advanced FEM provides you with the flexibility to apply loads and boundary conditions either to geometry features or directly to the FE mesh, depending on your needs. Load and boundary conditions can be applied in the following manner:

- On geometry (face, edge or curve) to maintain associativity when design geometry changes

- On FE entities (nodes, elements, element faces and element edges), which is useful when working with imported meshes with no underlying geometry

- To local coordinate system

- To groups for easier management

- As axisymmetric boundary conditions for simplifying the study of revolved systems

- As loads automatically obtained from motion analysis in NX Motion

- As time-varying condition sequences for simulating mission profiles

- As defined by expression, array or table input
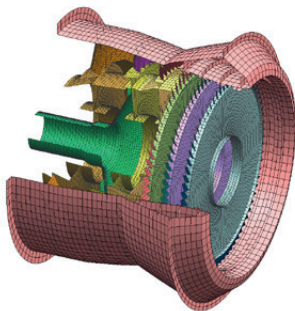
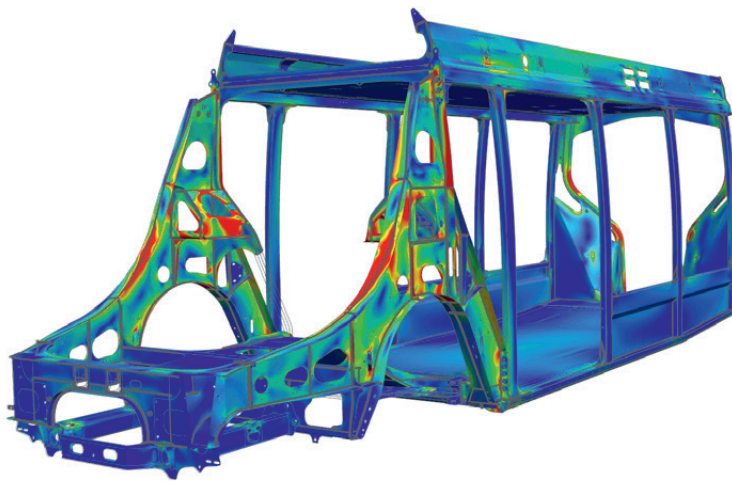*Extensive meshing tools are available for thin-walled parts.*
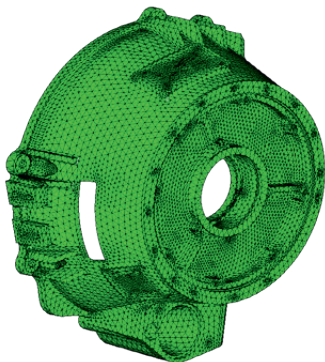
Quickly mesh complex geometry with automatic best-in-class tetrahedral meshing.
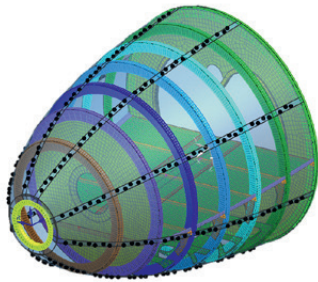
Easily build, connect and manage large FE assembly models.

Facilitating efficient FE assembly management

NX Advanced FEM is unique in the way it creates FE assembly models. Unlike traditional CAE preprocessors that were developed for component analysis and require you to build monolithic analysis models, the NX Advanced FEM assembly FE model (AFEM) management tool creates large FE assembly models by instancing and connecting FE component models together, similar to a CAD assembly. When an FE component is updated later in development, NX Advanced FEM updates all instances of that component within the FE assembly, eliminating the need to rebuild and connect a new FE assembly.
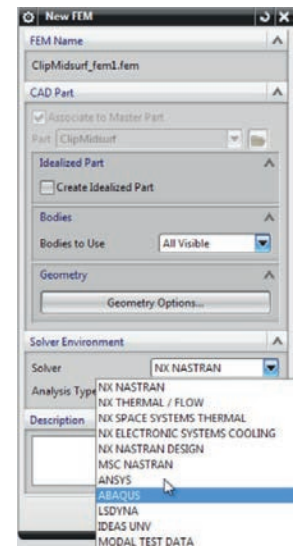
Preprocess with multi-CAE environments

NX Advanced FEM can be used as the primary pre- and postprocessor for Siemens PLM Solvers, NX Nastran and LMS Samcef, or for a number of third party solvers, such as Abaqus, ANSYS, LS-DYNA, and MSC Nastran. This is accomplished through immersive user environments that use the selected solver's terminology, which enables analysts to easily prepare solver-specific analysis models without the need to learn new terminology

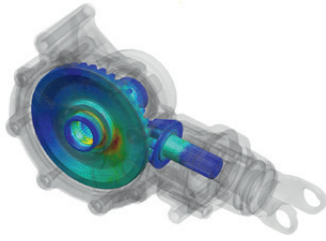*Preprocess analysis models for external solvers.*

Postprocess results and creating reports

For analysis to drive decisions, results must be presented in an understandable form. NX Advanced FEM provides extensive graphics and manipulation capabilities that focus on critical data and present it for review and action. Additionally, the multi-CAE environments of Nastran, Abaqus, ANSYS and LS-DYNA can be used to import result files created by these solvers for easier postprocessing and reporting.

Results displays: NX Advanced FEM includes various ways you can control the display of simulation results, such as deformation, contour plots, iso-surfaces, streamlines, animation and text annotations.

NX Advanced FEM can be used as the primary pre- and postprocessor for a variety of popular solvers.

Robust postprocessing capabilities for graphics, results probing, graphing and reporting.

XY Graphing: graphs can be critical to understanding how results change over time or at various locations of your model, and NX Advanced FEM delivers extensive XY graphing capabilities from basic scatter plots to plots for complex results. Of course, NX Advanced FEM also gives you full control over the appearance of your graphs for reporting purposes.

Reporting and export: with no more than a few mouse clicks, you can easily create and assemble simulation reports inside NX Advanced FEM. Simulation reports can be customized to include boundary conditions, material properties, images and graphs, and can be easily exported for sharing with external audiences.

**Providing a platform for multidiscipline simulation**

The need to use multiple analysis products adds costs and complexity because each analysis product has its own user interface and workflows. In addition, incompatible models and manual file transfers consume time and create errors, which sometimes hinder the multidiscipline studies necessary to correctly understand product performance.

NX Advanced FEM is a modern simulation environment that can be extended to support solutions for more advanced structural, durability, thermal, flow and multiphysics analyses, and the modules shown in the table below are available as add-ons to the NX Advanced FEM environment:

| Analysis type	Available add-on modules for NX Advanced FEM
Durability	NX Durability Wizard NX Advanced Durability
Dynamic response	NX Response Simulation
Laminate composites modeling Laminate composites draping	NX Laminate Composites
Thermal Analysis	NX Thermal NX Advanced Thermal NX Space Systems Thermal NX Thermal/Flow DMP
CFD or flow analysis	NX Advanced Fluid Modeling NX Flow NX Advanced Flow NX Thermal/Flow DMP
Multiphysics	
Coupled thermofluid analysis	NX Electronic Systems Cooling NX Flow/NX Advanced Flow with NX Thermal/NX Advanced Thermal
Coupled thermoelastic analysis	NX Thermal with NX Nastran
Motion-structural analysis (motion with flexible bodies)	NX Motion and NX Motion Flexible Body with NX Nastran
Physical test to analysis correlation	NX FE Model Correlation NX FE Model Updating

Optimizing geometry to drive design

By leveraging the powerful geometry engine within NX Advanced FEM, you have access to a large number of geometry parameters that can be used to drive optimization processes. Design variables can include feature and sketch dimensions and expressions as well as some FE parameters, such as section properties for one-dimensional elements and shell properties for two-dimensional elements. However, geometry optimization is not restricted to designs built in NX. You can import geometry from other applications and define geometry design variables using synchronous technology.
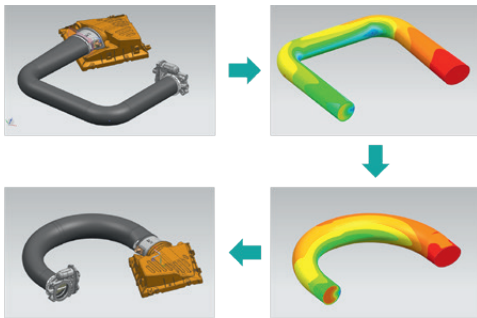
Drive design through simulation-based geometry optimization.

Managing simulation data for the analyst

NX Advanced FEM seamlessly integrates with the entire Teamcenter® software data management portfolio, including the simulation process management module. Simulation data management capabilities work out-of-the-box, and companies can implement a complete environment for managing CAE data, processes and workflow as part of a wider product development environment. This reduces waste by promoting re-use of existing designs and engineering knowledge. It also synchronizes data and makes it readily accessible through data mining, visualization and reporting.
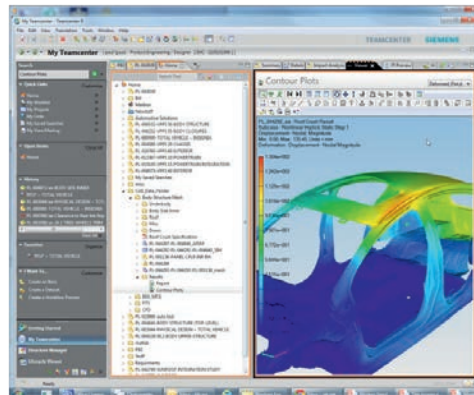
NX Advanced FEM seamlessly integrates with Teamcenter simulation process management.

Capturing knowledge and automating processes

NX Advanced FEM allows engineering organizations to capture the expertise of senior analysts and make it available for others in the organization to use in the form of wizards or templates. CAE processes can be captured and automated using NX Open, an open framework for automation and programming. Analysts can capture the steps in a CAE process using journaling, and then develop scripts and easy-to-use dialog boxes so others can use the same process. Since NX Advanced FEM is built on top of the same platform as NX CAD, designers who use NX continue to work in a familiar environment when they perform CAE work.

Leveraging a scalable and open simulation platform

Siemens PLM Software understands you often need to use other software tools, either developed internally or from other vendors, to get the answers you need to support critical development decisions. That's why NX Advanced FEM is open and flexible enough to allow you to incorporate those tools into your simulation processes. NX Advanced FEM supports a number of commercial CAE solvers through available environments, or you can develop your own interfaces using NX Open.