



Works™

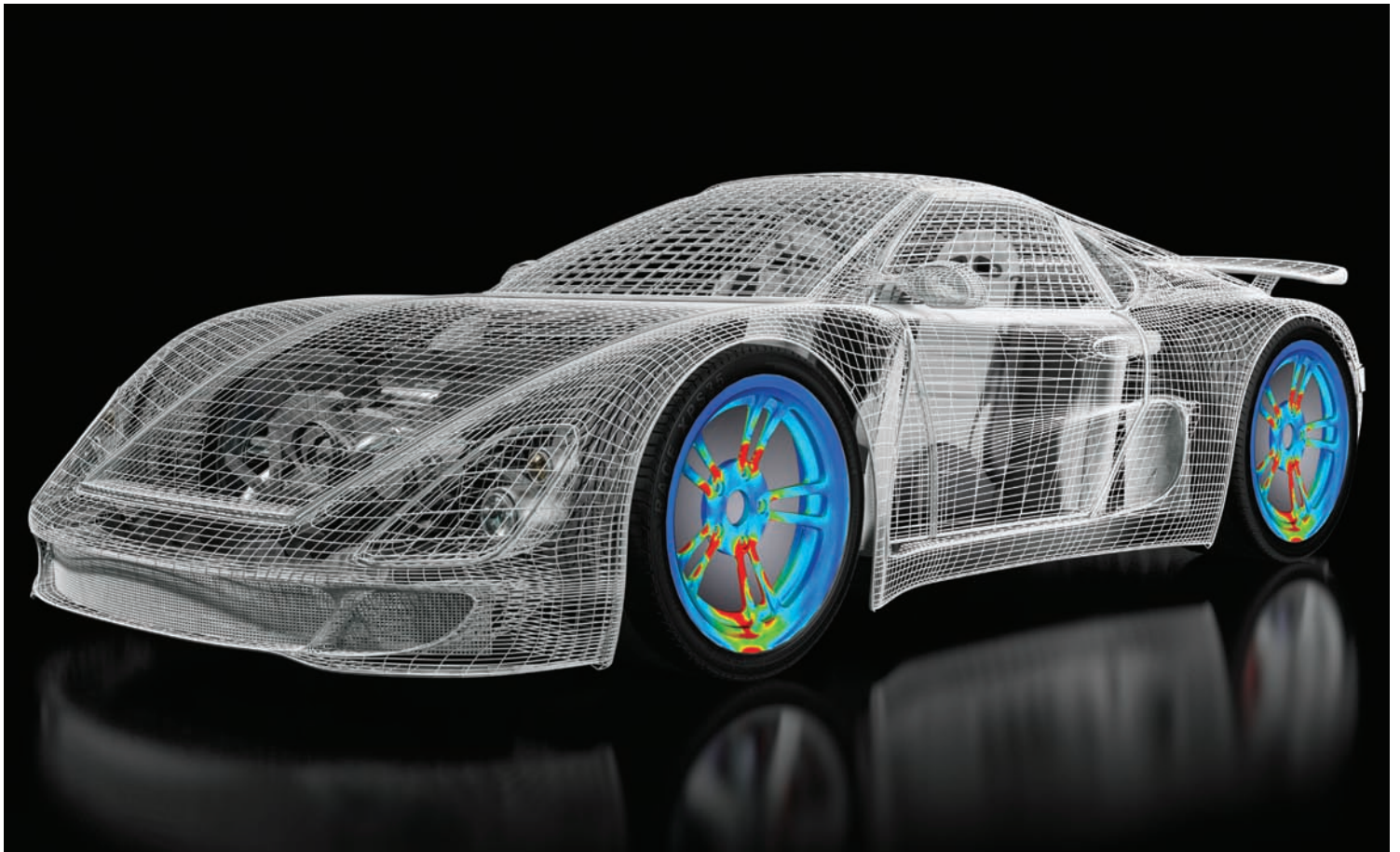
Embedded Nastran for SolidWorks

2. Nastran FEA
in SolidWorks

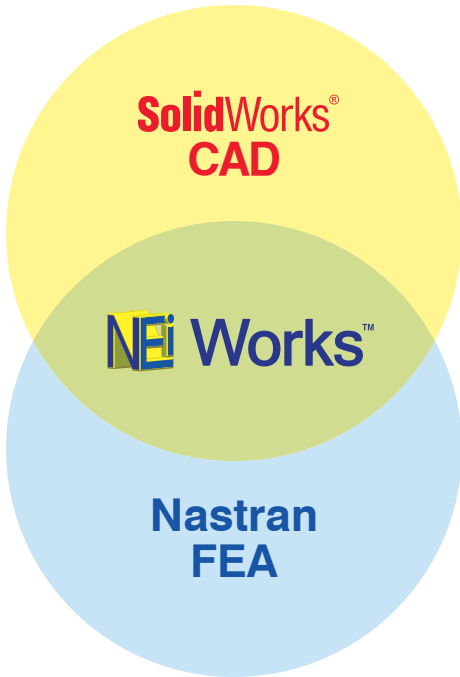
3. Features and Benefits
Highlights

4. NEi Works
Basic

6. NEi Works
Expert



Nastran FEA in SolidWorks



NEi Works embeds high accuracy Nastran solvers within SolidWorks parametric CAD.

Embedded Nastran Finite Element Analysis with Certified Gold Product Status

As a SolidWorks® user, you appreciate the ease of use, integration, productivity and communication tools that let you produce high quality, accurate designs and get them to market faster. Similarly, you want your FEA software to provide the same benefits for your work in engineering analysis and simulation. NEi Works with NEi Nastran delivers on that benefit. NEi Works is embedded in SolidWorks so you work within an environment that is familiar, effective, and proven. Plus, NEi Works has earned SolidWorks' Gold Product Status so you know it has been tested for quality, compatibility, and integration. With NEi Works you get the same look-and-feel, menu, and tree type structures of SolidWorks.

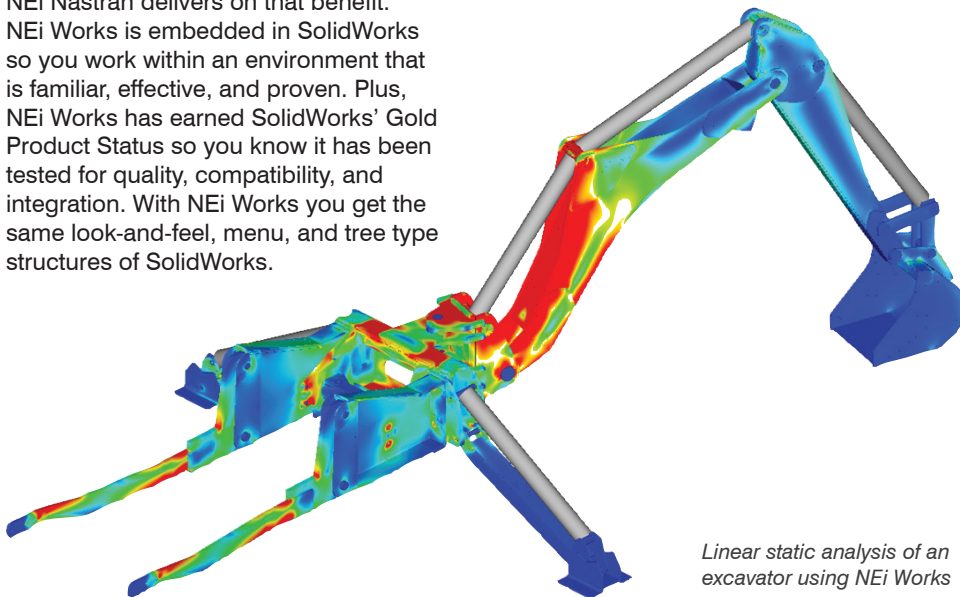
The Nastran Difference

You want to gain insight into different aspects of your design — structural, thermal, dynamic — and verify critical design elements on your desktop before you commit resources to expensive, time-consuming prototypes and test programs. For most of its history, Nastran FEA has been a tool confined to high end analysis in very large corporations because of the cost and sophistication of the hardware and software. But now NEi Software has developed a product that allows Nastran FEA technology to move in a different direction, making it affordable, easier to use, and accessible to a much wider engineering and design community.

"Users experience the familiar environment and ease of use they have come to expect while getting high accuracy analysis capabilities."

SolidWorks Ease of Use with Nastran Accuracy

NEi Works is a breakthrough product. Embedded in SolidWorks, NEi Works integrates highly accurate Nastran FE analysis with SolidWorks' convenient 3D solid modeling. Users experience the familiar environment and ease of use they have come to expect while getting high accuracy analysis capabilities.



Linear static analysis of an excavator using NEi Works

NEi Works can provide a wide spectrum of analysis and simulation tasks depending on the solvers selected and the configuration package. You can start with basic linear statics or move up to the most sophisticated configuration, allowing access to the full power of the Nastran solvers. This is achieved through other pre- and post-processors for high level virtual simulation of nonlinear transient analysis of structural, thermal, and dynamics problems.

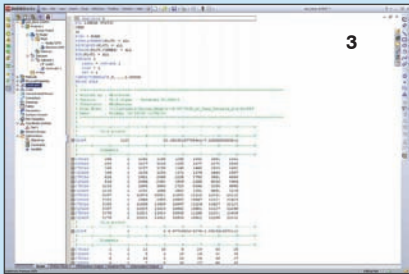
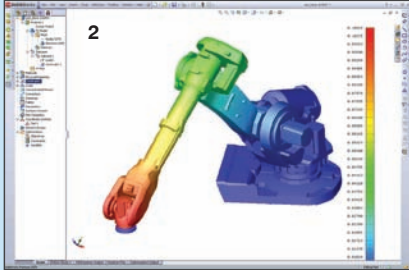
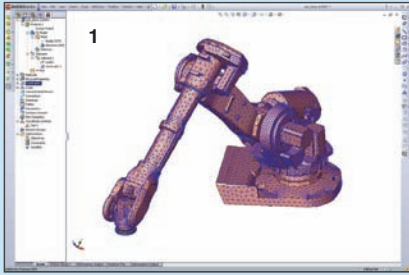
In this age of collaborative design, NEi Works provides you with another important advantage. If you work in an industry where Nastran is an accepted standard, NEi Works lets you share results with the entire community of Nastran users, like NEi, NX and MSC using text files for input data and results via standard OP2 format — an important consideration for communicating with customers, suppliers or design partners.

Recognized, Powerful, Affordable Nastran FEA

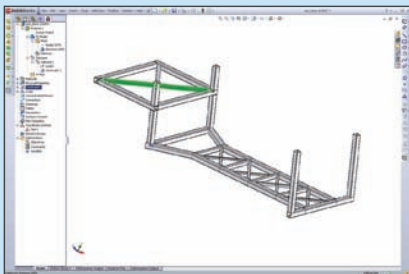
Introduced in December 2004, NEi Works received recognition from *NASA Tech Briefs* magazine, being named as a finalist in its Product of the Year Competition. *Desktop Engineering* magazine also picked NEi Works in its Editor's choice. SolidWorks Corporation's Gold Product certification represents the highest level integration, providing full associativity, sharing the same design data, and automatic updating across applications. Most importantly, SolidWorks users will find NEi Works extremely affordable because it can be purchased in a configuration that matches their work environment. For example, network installations can benefit from sharing solvers over multiple users with multiseat pricing. NEi Works comes in Basic or Expert versions with affordable maintenance and upgrade options.



Features and Benefits Highlights



NEi Works gives SolidWorks designers easy-to-use embedded Finite Element Analysis (1) and highly accurate simulation results (2); it is unique and forward-looking in its ability to share this data with the world of Nastran analysts (e.g. NEi, NX, MSC) via the Bulk Data File (3).



Beam element enhancements have simplified model creation.

How Far Do You Need to Take Analysis?

NEi Works gives you more than a solution to your most immediate design problems; it offers a continuous path from design validation to high-end analysis.

- NEi Works is completely scalable and expandable.
- There is no need to learn and adopt a whole new FEA platform as your analysis and simulation needs grow more sophisticated.
- The NEi Nastran platform can connect designers and analysts by sharing Nastran files and allowing the use of a variety of other analysis oriented pre- and post-processors with the NEi Nastran solvers.
- You can start with NEi Works Basic for exploring the viability of design alternatives and concept validation and move to NEi Works Expert if and when the need for powerful, highly focused analyst tools are needed.

Benefits: Continuous scalable path from design validation to high end analysis.

“NEi Works is a breakthrough product because it can provide a smooth continuous path from design to analysis.”

Nastran FEA

Nastran is the most widely used FEA software in the world. It has been proven over several decades and has become the established standard in aerospace, automotive and maritime industries. Nastran has achieved this level of acceptance because of its accuracy, precision, and the fidelity of its analysis results.

Benefits: Precise, proven results you can rely on.

Continuity and Connection Between Design and Analysis

NEi Works is a breakthrough product because it can provide a smooth continuous path from design to analysis and remove the barriers between these functional groups. Designers can explore “what-if” scenarios easily with full associativity of FEA and CAD data and validate concepts. Models can be shared or passed off to analysts for more intensive examination. The Nastran Bulk Data File and option for unbundled solver use provides maximum sharing of data and software resources.

Benefits: Capabilities that grow with needs, scalable for your organization, the right tools for each functional group.

Tailor Your FEA to Fit Your Analysis Needs

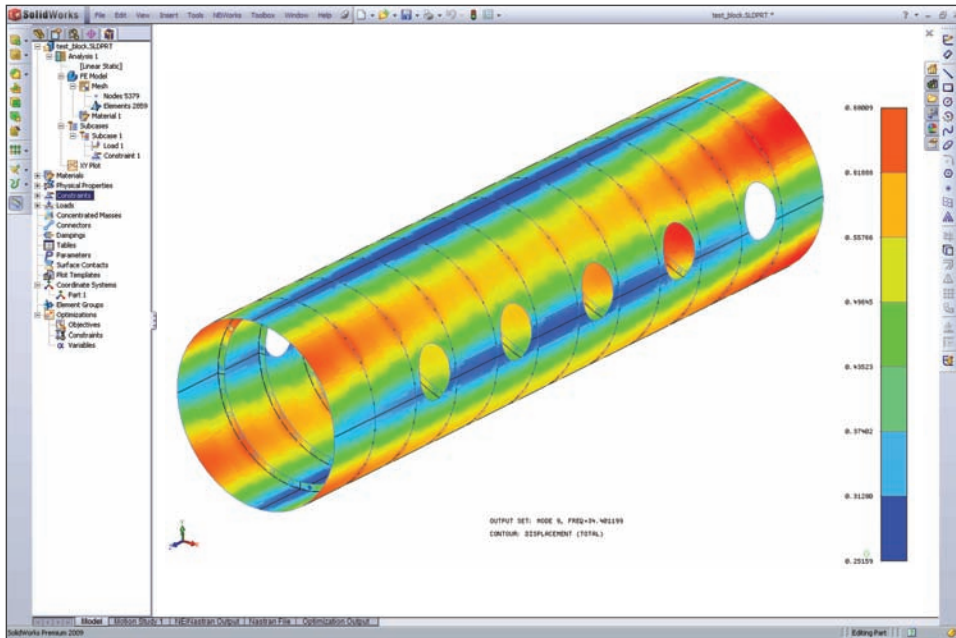
NEi Works comes in Basic and Expert versions with choice of solver packages. Basic gives you the main design validation tools at a low cost entry point. Expert provides the power and flexibility to take the analysis and simulation to the most professional levels of fidelity and accuracy with the option of using unbundled solvers with other pre- and post-processors and tools.

Benefits: Low entry cost, pay for what you need.

Element Library

NEi Works has a complement of elements for solid, shells and beams that allow professional modeling of a wide variety of structures. These include composites with plates and shells and surface-to-surface contact with manual or automated recognition of surfaces.

Benefits: Ability to model a variety of structures.



FEA analysis of a jet fuselage using NEi Works

The Perfect Package to Get Started

NEi Works Basic is the perfect package for getting started in Finite Element Analysis (FEA) because it combines two outstanding technologies at a fraction of the cost of high-end FEA offerings. The highly-regarded, industry-proven Nastran FEA solver is a platform that can grow with your simulation needs, while SolidWorks insures a familiar working environment that combines ease of use with the latest high performance tools for 3D CAD model creation. NEi Works Basic gives product development professionals the most widely used and needed analysis capabilities — linear statics, steady state heat transfer, normal modes, buckling and prestress, plus additional capabilities for handling composite material analysis, performing optimization analysis, and modeling assemblies with contact.

Check out these analysis capabilities to see how NEi Works Basic can bring engineering insight to your design process and help you spot problem areas, optimize performance, and virtually test before building expensive prototypes and fixtures. In short, save time and money while building more innovative, higher quality products.

Linear Statics

Linear statics is one of the most common types of analyses needed by design engineers. You apply loads and constraints to your parametric part and the NEi Nastran solver provides results which can be displayed in a wide variety of formats showing stress, strain, and deformation.

Linear Steady State Heat Transfer

Using the principles of conduction and convection heat transfer, engineers can examine designs for equilibrium temperature distribution.

Normal Modes

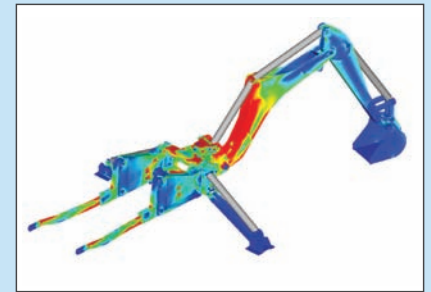
Determines the undamped natural mode shapes and frequencies of structures allowing designers to explore and resolve problems with noise and vibration.

Buckling

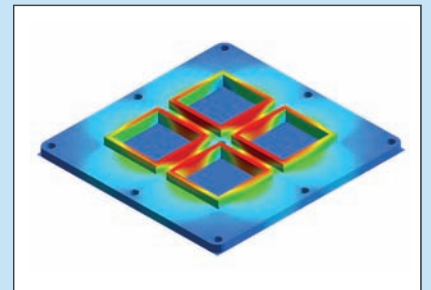
Allows designers to examine structures for sudden failure modes caused by compressive forces.

Prestress

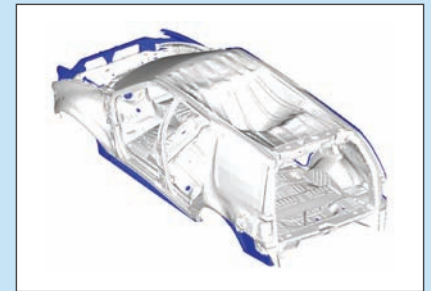
Allows the user to induce an initial stress state on structures such as rotor blades or taut strings.



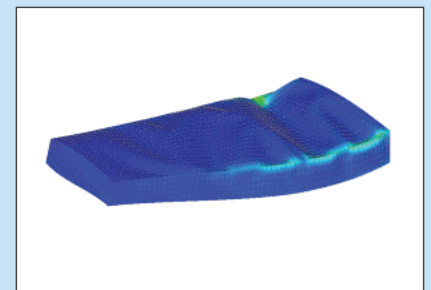
Linear Statics



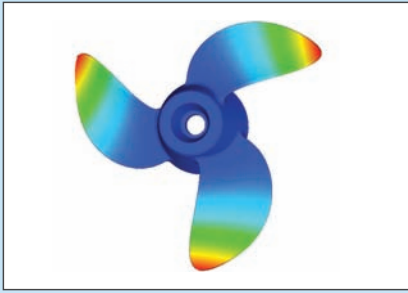
Linear Steady State Heat Transfer



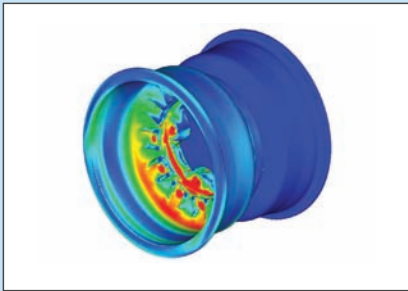
Normal Modes



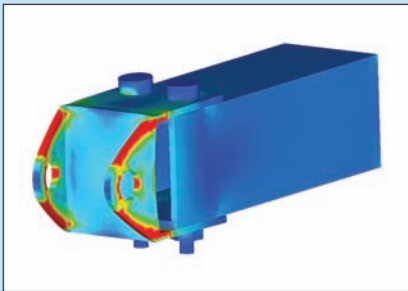
Buckling



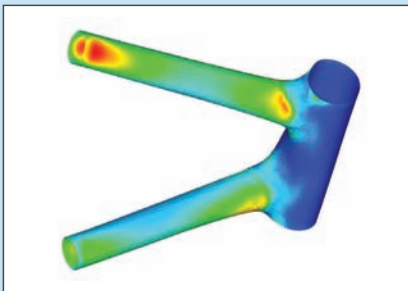
Prestress



Optimization



Assembly Modeling with Contact

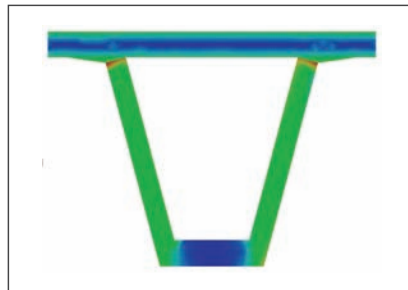


Composites

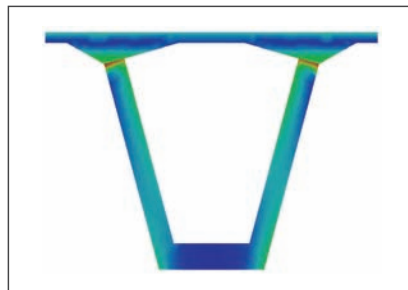
Optimization

Designers need to be equipped with the latest and best technology to meet the demands of global competition. One of the many ways NEi Works meets this need is with Optimization Analysis. This optimization module, developed by Red Cedar Technology, provides computer aided engineering help for stubborn design problems where conflicting parameters make it difficult to find solutions.

- Support for Parameter and Shape optimization using continuous or discrete variables
- Optimization constraints can be implemented for temperature, laminate and shell thicknesses, material properties, von Mises stress, weight, eigenvalues, and displacement
- Optimization objectives for temperature, laminate and shell thicknesses, material properties, von Mises stress, weight, eigenvalues, and displacement can be minimized, maximized, or targeted
- Model parameters and model dimensions can be made as optimization variables
- Optimization can be multi-objective with multiple subcases within all solutions
- Support for 2D (shells) and 3D (solids) elements



Bridge structure before optimization



Bridge structure after optimization

Assembly Modeling with Contact

NEi Works allows designers to go beyond analyzing individual parts. Assemblies with different kinds of contact can be modeled including sliding, friction, and welded, allowing simulations to attain real world fidelity. This sophisticated nonlinear modeling capability is typically an expensive add-on to most solvers, but with NEi Works, it comes standard.

“This optimization module provides computer aided engineering help for stubborn design problems where conflicting parameters make it difficult to find solutions.”

Composites

In addition to a library of materials, NEi Works contains a suite of tools designed to bring engineering insight to the analysis of composites and laminated products. These tools help make the process straightforward and less time consuming.

- Clear, easy input of strength and stiffness terms with access to material libraries
- Ply lay-up definition, in which stacking sequences can be easily entered and modified, and symmetry can be used to reduce entries
- Easy orientation definition created by projecting a cylindrical or spherical coordinate system onto a structure to improve ply orientation
- Laminate property support for both 2D shell elements and 3D layered solid elements
- Post-processing visualizations that pinpoint problems at the ply level and logical paths from stress analysis of a structure to failure index results
- Support for advanced failure criteria including the most modern forms of Puck and NASA Langley LaRC02, as well as strength ratios for easy linear scaling and qualitative analysis
- Simple Material Property and Layup Editors that allow easy composite ply definition while providing advanced features for material property entry

Taking Simulation to the Next Level

NEi Works Expert adds to the capabilities in NEi Works Basic with the following analysis types: nonlinear statics, transient response, frequency response, Automated Impact Analysis (AIA), and nonlinear steady state and transient heat transfer. NEi Works Expert is perfect for taking simulations to the next level since nonlinear is typically the next step in sophistication needed by design analysts. AIA also provides a widely needed simulation with applications ranging from projectiles to drop tests to packaging.

In addition to the analysis capabilities of NEi Works Basic, NEi Works Expert adds the following analysis capabilities:

Nonlinear Static and Nonlinear Transient Response

Allows material nonlinearity (material stress-strain data), contact (opening and closing of gaps and sliding), and large displacement and rotation (large deflection) effects to be captured in analysis models. Additionally, transient and inertia effects can be included.

“NEi Works Expert is perfect for taking simulations to the next level since nonlinear is typically the next step in sophistication needed by design analysts.”

Transient Response

Used to determine the response of a structure through a period of time under the influence of constant or time-dependent loads. Dynamic situations such as impulse loading can be modeled.

Frequency Response

Determines the structural harmonic response based upon frequency-dependent loads or enforced motions such as displacements, velocities, or accelerations.

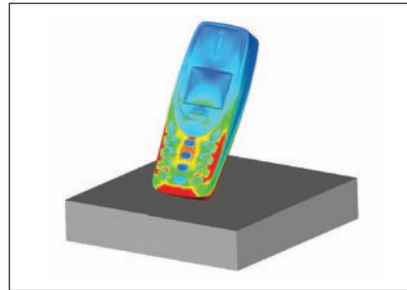
Nonlinear Steady State and Transient Heat Transfer

Finds the steady-state solution to heat transfer models involving radiation, temperature dependent material properties, or other thermal boundary conditions such as convection or heat generation.

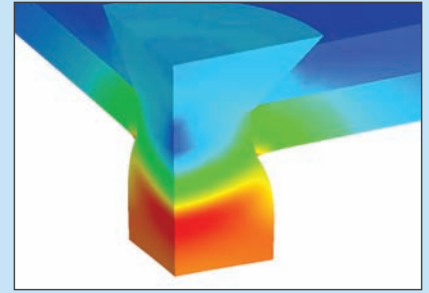
Nonlinear thermal boundary conditions can vary through time. Thermal pulsations in exhaust systems and power fluctuations upon microchips can be modeled.

Automated Impact Analysis (AIA™)

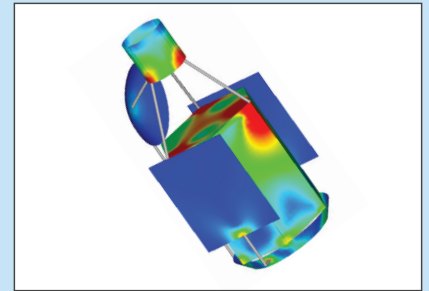
Ideal for performing projectile impacts and virtual drop tests, AIA provides an excellent introduction to the power that automated tools can bring to demanding simulation problems. AIA takes a very complex, time-consuming simulation task and simplifies and automates it. AIA requires a minimum of input data for the analysis — projectile velocity and acceleration. AIA determines the time steps, duration, and complex contact interaction between projectile and target. AIA can provide a thorough and physically realistic simulation of impact because of this comprehensive treatment of the phenomenon. This is much more useful and meaningful from an engineering standpoint than a simplistic imposition of force at a point found in other impact or drop tests providing insight into dynamic, implicit, nonlinear behavior or real world impact problems.



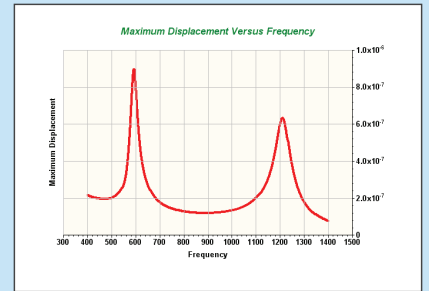
Automated Impact Analysis (AIA) can also be used as a virtual Drop Test as in the case of this cell phone.



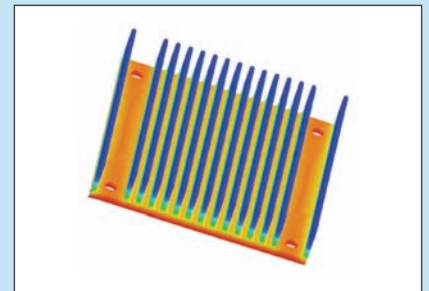
Nonlinear Static and Transient Response



Transient Response



Frequency Response



Nonlinear Steady State and Transient Heat Transfer

General Capabilities

- Full single-window integration between solid modeling and analysis
- Direct use of CAD geometry for analysis
- Direct application of analysis input data to CAD geometry
- 3D visualization of analysis results on original CAD geometry
- FeatureManager™ for geometry, analysis and result visualization data
- Customizable analysis tree
- Dynamic editing of all geometric and analysis features
- Powerful configuration management for easy “what if” design variations (geometrical and physical)
- Comprehensive support for bidirectional CAD data exchange with most major CAD packages
- Comprehensive, context-sensitive HTML-based help system and tutorials
- Query displays real time information on model's nodes and elements
- Nastran Bulk Data File
- FE model file can be saved with only geometric data for smaller file size
- User specified solver path
- Highlight specific nodes and elements on the model

CAD Interoperability

- Native file translators to and from nearly all mechanical CAD products on the market today: SolidWorks®, Pro/ENGINEER®, IPT (Autodesk Inventor®), Mechanical Desktop®, Unigraphics®, PAR (Solid Edge®), CADKEY®, IGES, STEP, Parasolid®, SAT (ACIS®), VDA-FS, VRML, STL, DWG, DXF™, TIFF, JPG, Viewpoint, RealityWave, HSF (Hoops), CATIA®
- Supported standards: ANSI, DIN, ISO, GOSJIS, GB and BSI

Part Modeling

- Feature-based, fully associative, parameterized solid modeling
- FeatureManager™ dynamic design tree (e.g. re-order, drag & drop, etc.)
- Integrated sketching (dynamic referencing)
- Extrudes, revolves, feature patterns, holes, etc.
- Advanced 3D operations, e.g. lofting, sweeping, complex blending, filleting, etc.
- Advanced shelling, midsurfaces
- Advanced surface modeling: lofts and sweeps with guide curves, fill-in holes, drag-handles for tangency control, etc.
- Trimming, extending, filleting, and knitting surfaces
- Translating, rotating, copying, and mirroring surfaces
- Support for creating 3D models from existing 2D data, e.g. 2D-to-3D extrusion, etc.
- Multiple design variations with Configuration Management, DesignTables

Assembly Modeling

- Fully associative: referencing of other parts and maintaining relationships when creating new parts
- Complete range of mating conditions, snap-to-fit SmartMates™
- Locating conflicting mate relationships with Mate Diagnostics
- Dynamic assembly visualization
- Real-time previewing of components, parts
- Easy designing and changing of parts and subassemblies from within an assembly
- Mirrored components to create new parts and assemblies based on existing designs
- Multiple assembly design variations with Configuration Management for easy “what if” design scenarios

Assembly Connectors

- True surface contact
- Automatic contact

Meshing

- Mesh validation checks: Distortion, Jacobian, Skew
- Global and local controls for part geometry with default sizing
- Mesh control on arbitrary user defined regions
- Combined shell and beam/bar meshing
- Sketch line or curve meshing

- Free surface meshing: quads or triangles
- Continuous shell (quad or tri) meshing
- Auto mesh, loads and constraints update with geometry changes
- Mesher status window and progress bar
- Display/hide shell element normals
- Reverse normals for shell elements
- Display/hide beam element orientations
- Display/hide 1D/2D cross-section

Element Library*

- 1D line (CBEAM, CBAR, CPIPE, PBARL, PBEAML)
- 2D linear shell (CQUAD4 and CTRIA3)
- 2D parabolic shell (CQUAD8 and CTRIA6)
- 3D linear and parabolic tetrahedron (CTETRA)
- Composites with plates and shells
- Surface-to-surface contact with manual or automatic recognition of surfaces
- Rigid elements
- Concentrated mass element
- Spring Element: transmits tension, compression also allows damping (CBUSH)
- Rod Element: transmits tension, compression and torsion
- **Cable Element: transmits tension with optional bending stiffness**

Loads and Boundary Conditions*

- Uniform pressure and force on faces, edges and vertices
- Directional pressure and force
- Acceleration loads (gravity)
- Enforced motions: acceleration velocity displacement (rotational and translational)
- Temperature
- Symmetric, antisymmetric, axisymmetric boundary conditions
- Fixed constraints on faces, edges and vertices
- Directional and prescribed constraints
- Thermal constraints
- Thermal body loads
- Initial temperature conditions
- Custom colors and sizes for loads and constraints
- Load defined using edge
- Load variation using arbitrary 3D scale factors
- Conduction
- Convection
- Heat Generation
- Heat Flux
- Rotational Velocity/Acceleration
- **Radiation**
- From output (thermal)

Material Properties*

- Isotropic
- Orthotropic 2D and 3D
- Solid anisotropic materials (MAT9)
- **Hyperelastic materials: Neo-Hookean, Mooney-Rivlin, Ogden, Yeoh, Generalized Polynomial (nonlinear)**
- **Temperature-dependent property support**
- **Nonlinear materials: nonlinear elastic, elasto-plastic, plastic**
- **Hardening: isotropic, kinematic, combined**
- **Yield criteria: Von Mises, Tresca, Mohr-Coulomb, Drucker-Prager**
- **Custom stress-strain data**

Surface Contact

- Automated Surface Contact Generation (ASCG™)
- Automated Edge Contact Generation (AECG™)
- General, welded, slide, rough, offset weld and RBE3 element contact types
- Static friction

Coordinate Systems

- Cartesian, cylindrical and spherical coordinate systems
- Referencing global assembly, part or custom coordinate systems

Analysis Types*

- Linear statics
- Normal modes
- Linear buckling
- Thermal stress
- Prestress static
- Contact analysis in assemblies
- Linear steady state heat transfer
- **Nonlinear statics**
- **Modal and direct transient response**
- **Modal and direct frequency response**
- **Nonlinear steady state and transient heat transfer**
- **Nonlinear transient response**

Composite Analysis

- Various failure theories supported: Hill, Hoffman, Tsai-Wu, Max. stress, Max. strain, NASA LaRC02

Optimization Analysis

- Design objectives to minimize, maximize or reach target values
- Parametrically update geometry dimensions
- Optimize weight, stress, material properties, temperature, eigenvalue, plate and laminate properties thickness

Automated Impact Analysis (AIA™) and Drop Testing*

- **Automatic impact wizard**
- **Acceleration and contact direction input**
- **Time stepping automatically calculated based on natural frequency**

Post-Processing

- Stress, deformation plots
- Principal and directional stress plot
- Strain plot
- Resonant frequencies, mode shape plots
- Temperature, heat flux plots
- Iso-surfaces
- Results across composite laminates
- Export Nastran input deck to other FEA systems
- Customizable material library
- Single and multi-set animations
- Max/min labels
- Slice view provides section views of contour plot
- Post-process selected parts in an assembly
- XY plots can be viewed from tabular data
- Partial results generation for modal and transient analysis types
- Loads and constraints shown on deformed plots

Report Generation

- HTML formatted reports for linear static analysis
- Customizable report format
- Step by step wizard for report generation process
- Includes standard model data

Graphics

- OpenGL graphics taking advantage of the latest computer graphics chips
- 3D dynamic pan, zoom and rotation
- Hidden line and wireframe display
- Light source shading and transparency

Compatibilities

- Part and Assembly geometry is fully compatible with SolidWorks' Parts and Assemblies
- Nastran input file can be sent to any Nastran FE Solver including NEi Nastran, NX Nastran, or MSC Nastran
- Binary results file in OP2 format usable by all Nastran solvers and wide variety of post-processors

Language Support

- GUI: English, Japanese, Italian, French
- Technical documentation: English

* Features marked in blue are only available in NEi Works™ Expert.

About NEi Software

NEi Software is a world leader in Finite Element Analysis (FEA), engineering simulation, and virtual test software. The core product NEi Nastran is a powerful, industry-proven FEA solver that thousands of companies routinely use to perform linear and nonlinear structural stress, dynamics, and heat transfer analysis. In addition, NEi Software's portfolio includes products for impact, kinematics, fatigue, acoustics, optimization, aeroelasticity, and Computational Fluid Dynamics (CFD) with support for a full range of materials from composites to hyperelastic rubber. NEi Software covers the different needs of each stage of the product development process, from designers looking for affordable, easy-to-use, CAD-based simulation for validation and trade-off studies to dedicated FE analysts looking for high accuracy, productivity, and real world fidelity. The website features case studies in aerospace, automotive, maritime, military, civil, petroleum, medical, and consumer products with videos, webinars, tutorials, and options for evaluation.

Global Headquarters

5555 Garden Grove Blvd. Ste 300
Westminster, CA 92683-1886
United States

Phone: +1 (714) 899-1220
Fax: +1 (714) 899-1369
E-mail: info@neisoftware.com
Website: www.NEiSoftware.com

NEi Software EMEA Office

The Old Barrel Store
Draymans Lane, Marlow
Buckinghamshire, SL7 2FF
United Kingdom

Phone: +44 (0)1628-400645
Fax: +44 (0)1628-891701
E-mail: emea@neisoftware.com
Website: www.NEiSoftware.com/emea

NEi Software Asia Office

Shinjuku Park Tower
N30th Floor 3-7-1 Nishi-Shinjuku
Shinjuku-ku, Tokyo, 163-1030
Japan

Phone: +81-(0)3-5326-3062
Fax: +81-(0)3-5326-3001
Email: asia@neisoftware.com



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