



# Nastran

Advanced Finite Element Analysis

## 20 Key Features

**1** Micromechanics Based Composite Laminate Failure Prediction **2** Virtual Fluid Mass Boundary Element **3** Automated Inertial Relief (AIR™) **4** Shape Memory Materials (Nitinol) and Brittle Materials (Concrete) **5** Nastran Input File Design Optimization **6** Adaptive Nonlinear Static and Transient Analysis **7** NEi Nastran Editor GUI **8** Integrated Vibration Fatigue; Comprehensive Fatigue **9** Linear Surface Contact **10** True 3D Nonlinear Surface Contact **11** Automated Surface Contact Generation (ASCG™) **12** Automated Impact Analysis (AIA™) **13** Modal Database Management and Modal Filtering **14** Integrated Modal Assurance Criteria (MAC) **15** Interpolation of Results Data from Other Codes to Nastran Models **16** Advanced 3D Layered Composite Analysis **17** Progressive Ply Failure Analysis (PPFA™) **18** Advanced Failure Criteria for Composites **19** Nonlinear Tension-only Shell and Cable Elements **20** Outstanding Live Technical Support



# 20 Key Features of NEi Nastran

NEi Nastran is a powerful Finite Element Analysis solver with an integrated graphical user interface and model Editor which is used to analyze linear and nonlinear stress, dynamics, and heat transfer characteristics of structures and mechanical components. NEi Nastran represents the latest in FEA technology with one of the fastest iterative solvers on the market along with accurate solutions that have been trusted for over 15 years by companies in all major industrial categories. NEi Nastran is available on a wide variety of platforms including 32-bit and 64-bit Windows and Linux operating systems.

## 1. Micromechanics Based Composite Laminate Failure Prediction

- Higher level accuracy in correlating to real world composite failures, as compared to smeared lamina approaches (Tsai-Wu, Hill, Hoffman, etc.)
- Exact failure mode can be obtained through accessing separate failure index calculations for fiber and matrix
- Proven technology through test-analysis correlations of aerospace applications
- Based upon the well documented Multicontinuum Theory (MCT) which requires only standard orthotropic material information
- Developed for both unidirectional and woven composite materials
- Having access to constituent stress/strain leads to a direct link to composite fatigue life prediction, by coupling MCT with kinetic theory of fracture

## 2. Virtual Fluid Mass Boundary Element

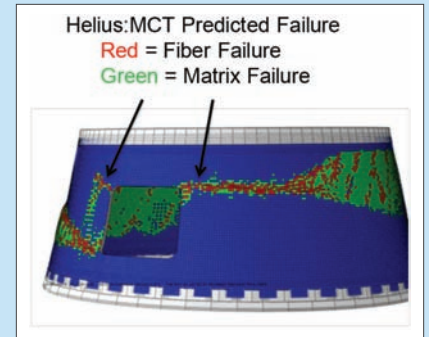
- Boundary Element Approach (BEA) to include Fluid Effects
- Air effects on aircraft structures can be determined
- Wet modes for submerged maritime structures can be calculated for more accurate dynamic representation
- Fluid mass is coupled to mode shapes and the added mass varies from mode to mode

## 3. Automated Inertial Relief (AIR™)

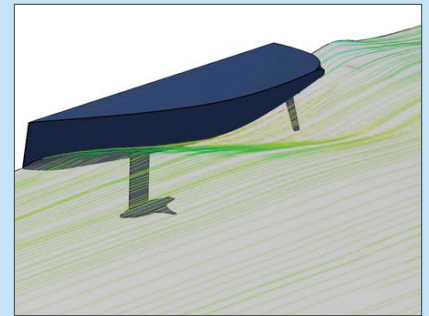
- Easy Method to analyze unconstrained or free-floating structures such as ship or aerospace vehicles
- All that is required is loads and PARAM, INREL, AUTO – no need for constraints or SUPORT entries or PARAM, GRDPNT
- Center of gravity is automatically calculated and internal stabilization elements automatically created

## 4. Shape Memory Materials (Nitinol) and Brittle Materials (Concrete)

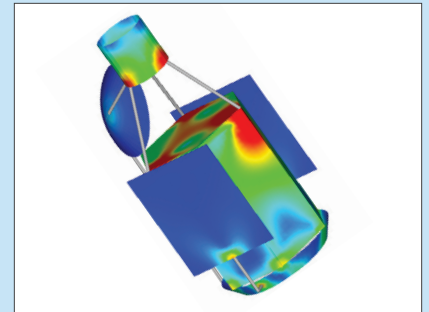
- Advanced nonlinear materials for higher fidelity simulation models
- For applications such as biomedical stents and deployable space structures, Nitinol material model can be employed to obtain shape-memory effects and superelasticity
- For civil applications, concrete material model can be employed to simulate the cracking behavior in tension and crushing behavior in compression
- Greatly improves upon using a standard nonlinear elastic material model to approximate certain specialized nonlinear effects



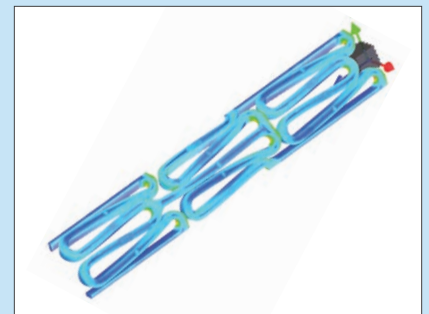
Composite Laminate Failure Prediction



Virtual Fluid Mass Boundary Element



Automated Inertial Relief (AIR)

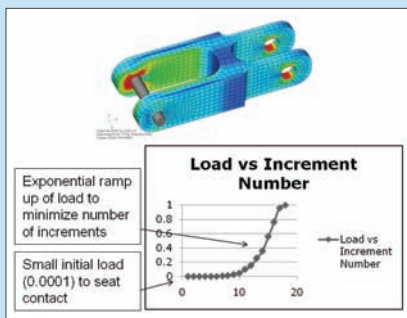


Shape Memory Materials (Nitinol)

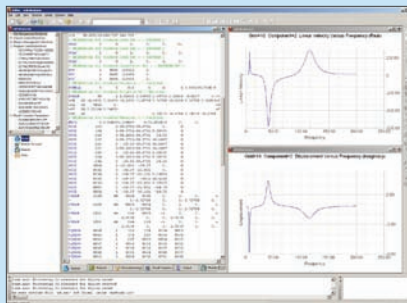
## Customer Testimonial

"I am experienced with several FEA software packages, and have found NEi Nastran to be the most useful in many respects. The pre-processor is intuitive, and even my first model did not require extensive reference to the documentation. The analytic engine was fast, and the results have shown good agreement with our test data."

Badri Hiriyur  
R&D Engineer  
Dietrich Design Group



Adaptive Nonlinear Analysis

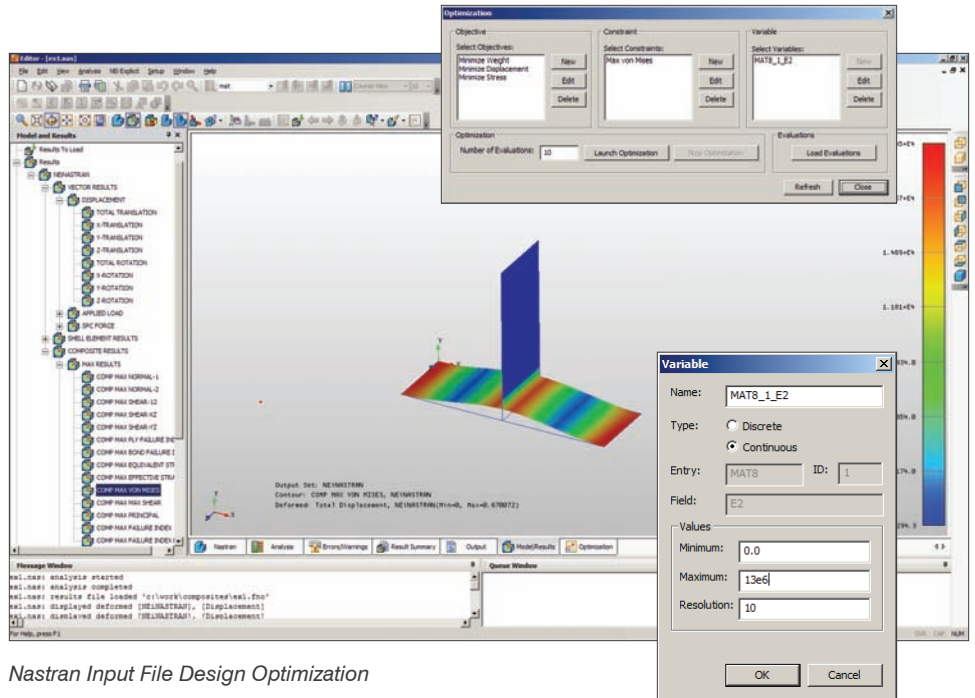


NEi Editor Model Results

## Customer Testimonial

"...ease-of-use features not found in other FEA products, particularly the NEi Nastran Editor, have saved us a considerable number of hours in model editing and in avoiding bad runs."

Dr. Michael Cronkite  
President  
Micron Associates



Nastran Input File Design Optimization

## 5. Nastran Input File Design Optimization

- Parameter optimization integrated into the NEi Editor
- Optimization GUI designed to manage and define optimization constraints, variables and objectives
- Simple right-click definition of optimization variables from within the NEi Editor

## 6. Adaptive Nonlinear Static and Transient Analysis

- Adaptive load increment/time step method for efficient nonlinear solutions
- Number of increments is minimized, based on solution convergence
- Only maximum and minimum number of load increments need to be set
- Nonlinear solutions can be started at a very small load for better stability, without having to run a large number of load increments

## 7. NEi Nastran Editor GUI

- Fully integrated and customizable Nastran Editor controls program operation and provides results summary data via an easy-to-use GUI
- Bulk data files can be modified in an interactive environment
- Special real-time controls allow solution parameters to be changed while running
- Post-processing and results query
- Tabbed windows to give immediate access to all input and output files
- Field markers simplify manual editing and increase productivity
- Complete online documentation and context-sensitive help that actually helps
- Permits batch queuing of jobs for sensitivity and configuration trade studies
- Real time 2D x-y plotting and 3D deformed shape and contour plotting with optional MS Excel Comma Separated Variable (.CSV) file output

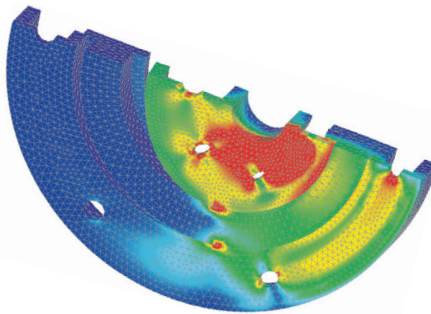
# 20 Key Features of NEi Nastran

## 8. Integrated Vibration Fatigue; Comprehensive Fatigue

- No third party products or costly modules for fatigue and vibration fatigue
- Fatigue life and fatigue damage due to random vibration calculated based on Steinberg's three banded technique
- Allows for quick assessment and predictability of outcome of standard industry vibrational testing
- Greatly improves upon predicting structural failure due to vibration based on RMS (root mean square) outputs and response PSDs
- Fatigue capability typically found in costly specialized fatigue packages in core NEi Nastran
- Stress life (high cycle) and strain life (low cycle) methods included
- Fatigue life and fatigue damage output from uniaxial and complex multiaxial loadings
- Rainflow counting for variable amplitude loadings

## 9. Linear Surface Contact

- True 3D surface contact with closing and opening of gaps in core Nastran linear statics (SOL 101)
- Iterative strategy saves hours of nonlinear run time
- Works with Automatic Surface Contact Generation (ASCG)
- Makes linear gap elements obsolete
- Ideal for large contact models that are initially in contact
- Fast trade studies for bearing assemblies analyzed in minutes



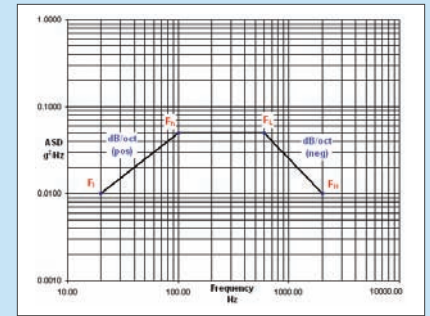
Linear Surface Contact

## 10. True 3D Nonlinear Surface Contact

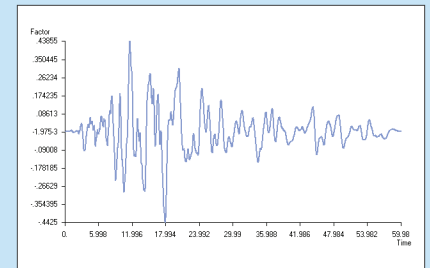
- Free edges contacting surfaces now identified automatically
- Edge to face welding carried out automatically
- No element congruence required
- Offsets and gaps between edges and faces are permissible
- Rapid meshing of complex shell structures now possible
- Ideal for large thin shell fabrications such as ship, aircraft, and automotive structures

## 11. Automated Surface Contact Generation (ASCG™)

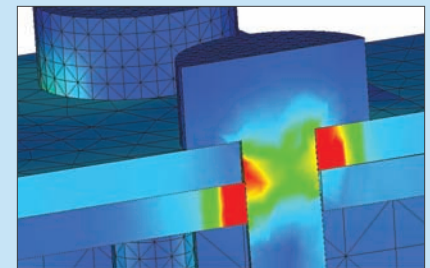
- Solver will search for element faces in contact and automatically setup the contact between discontinuous bodies
- Can be used for automatically welding parts together or automatically defining nonlinear surface contact in complex regions
- No geometry is required
- Legacy Nastran models supported — ability to upgrade from legacy GAPS to surface contact with a single Case Control Command
- Ability to weld parts together through a small gap automatically, which prevents manual definition of multiple master-slave regions with an offset
- Self contact is now available using ASCG



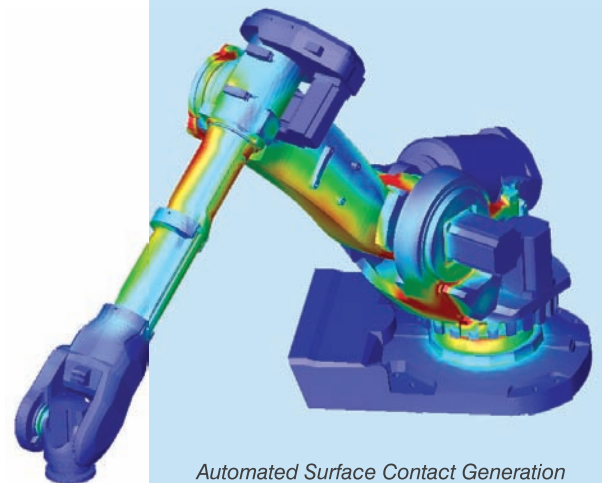
Vibration Fatigue



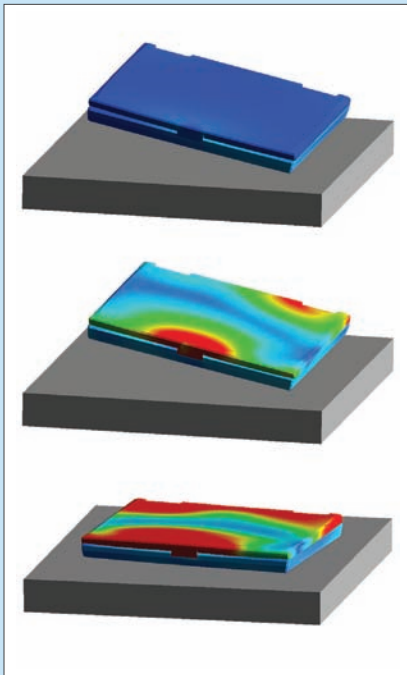
Comprehensive Fatigue



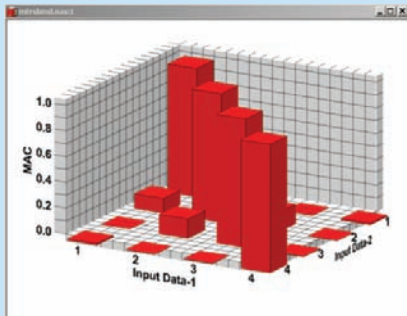
Nonlinear Surface Contact



Automated Surface Contact Generation



Laptop Drop Testing



Integrated Modal Assurance Criteria

## Customer Testimonial

“We have chosen NEi Nastran after an extensive and detailed internal benchmark, comparing the results, the performance, and the features of the solver developed by NEi Software, Inc. with those of our former FEA platform. Full compatibility, accuracy, along with the professionalism and quick turnaround of the tech support from NEi Software and SmartCAE were the main reasons why we selected NEi Nastran as our FEA software for the future.”

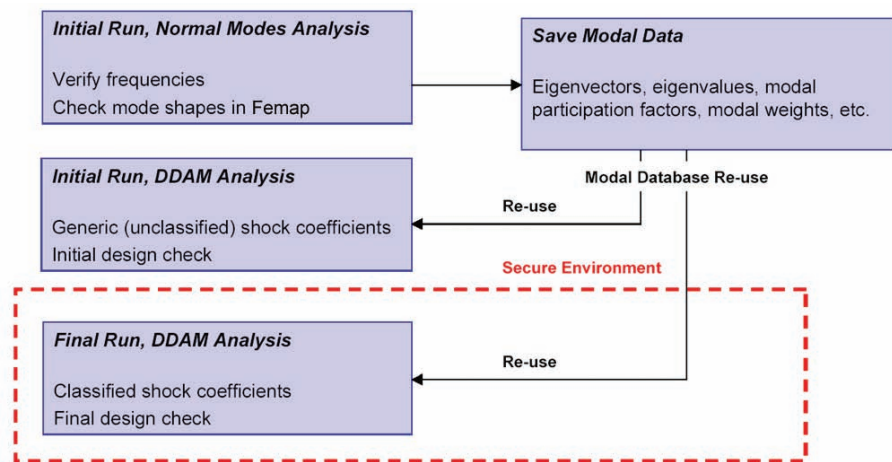
Paolo Marabini  
Minardi F1 Team

## 12. Automated Impact Analysis (AIA™)

- Routine drop testing so there is no manual configuration with every step
- Arbitrary object and target shapes
- Automatic object repositioning
- Uses Automatic Surface Contact Generation (ASCG) to automatically define contact regions
- Automatic natural frequency calculations of object and target allows optimum calculations of time steps and impact duration
- Nonlinear Transient Analysis – all data calculations and data transfer carried out
- Automatic real-time output of x-y data at impact points during analysis

## 13. Modal Database Management and Modal Filtering

- Modal Base filtering option based on modal effective mass
- Modal Data save and re-use option
- Very big savings in CPU time possible with all Modal based response method avoiding re-calculation of modal data
- Simple interface: best usability



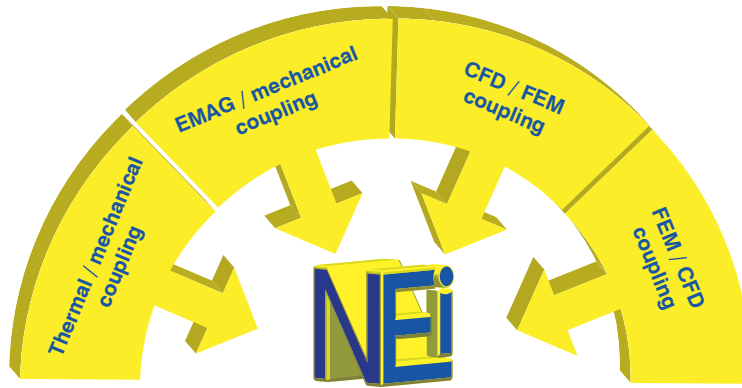
Application Workflow Example: DDAM

## 14. Integrated Modal Assurance Criteria (MAC)

- Correlation carried out by NEi Nastran in a normal modes analysis
- No third party software required
- External or test data can be in CSV, DMIG or MDB format
- Non-MDB (Modal Database) data will be automatically converted to MDB for re-use
- Automatic mapping of test to model grid positions
- Interpolation of test eigenvalue shape to model
- MAC and ORTHO-MODE correlation supported
- Text output in the Model Results Output File
- Graphical support is included in the NEi Nastran Editor
- Future developments include FRF correlation

## 15. Interpolation of Results Data from Other Codes to Nastran Models

- 2D or 3D interpolation of input, temperature, displacements, forces, moments, and pressure
- Allows load transfer across different models / disciplines
- Accurate and user-controllable 2D / 3D polynomial interpolation through least-squares approach



Interpolation of Results Data from Other Codes to Nastran Models

## 16. Advanced 3D Layered Composite Analysis

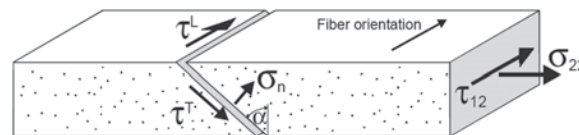
- Composite layups can be directly applied to solid elements
- CHEXA and CPENTA support layered material definitions using the PCOMP Bulk Data entry
- Overcomes the limitations of Classical Laminate Theory, which include the failure to take into account local design details such as jointed regions and T-connections
- Transverse shear and the through thickness normal stresses are included as a direct result of the triaxial stress state in the fully 3D orthotropic material
- Mapping of 3D ply layup from existing 2D PCOMP data
- Conversion of MAT8 (2D orthotropic) to new MAT12 (3D orthotropic)

## 17. Progressive Ply Failure Analysis (PPFA™)

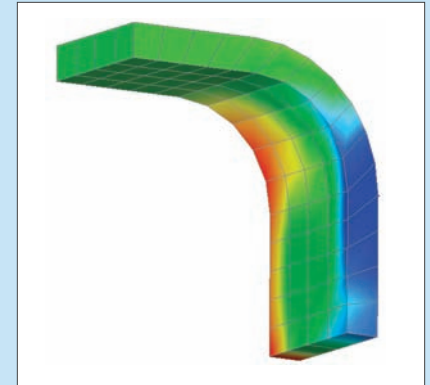
- Proper representation of reduced stiffness of failing composite parts
- Simulation of incomplete failure
- More accurate damage assessment
- Enables substantially more optimized composite designs when designing to ultimate load, by considering Last Ply Failure as well as First Ply Failure

## 18. Advanced Failure Criteria for Composites

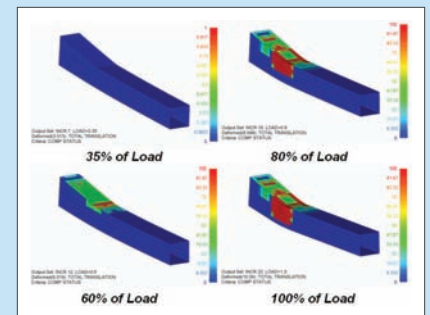
- LaRC02 set of criteria
- Developed by NASA
- First Ply Failure
- Physically based
- Hashin, Puck approach
- No additional material properties required compared to Tsai-Wu
- Failure mode taken into account
- Extensive validation (WWFE)



Advanced Failure Criteria for Composites



Solid Composites

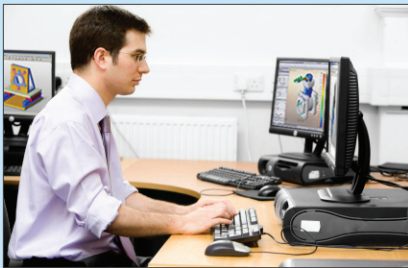


Progressive Ply Failure Analysis

## Customer Testimonial

“Analysis is a breeze with NEi Nastran, Femap and the built-in Editor. What is more, technical support is superb. The staff is courteous, responsive, knowledgeable and always willing to work hard to help resolve any problem. I am thoroughly impressed. I shall ever remain grateful to my colleague who introduced me to NEi Nastran.”

Dr. Umesh C. Tahbaldar  
President  
DEVEE Engineering

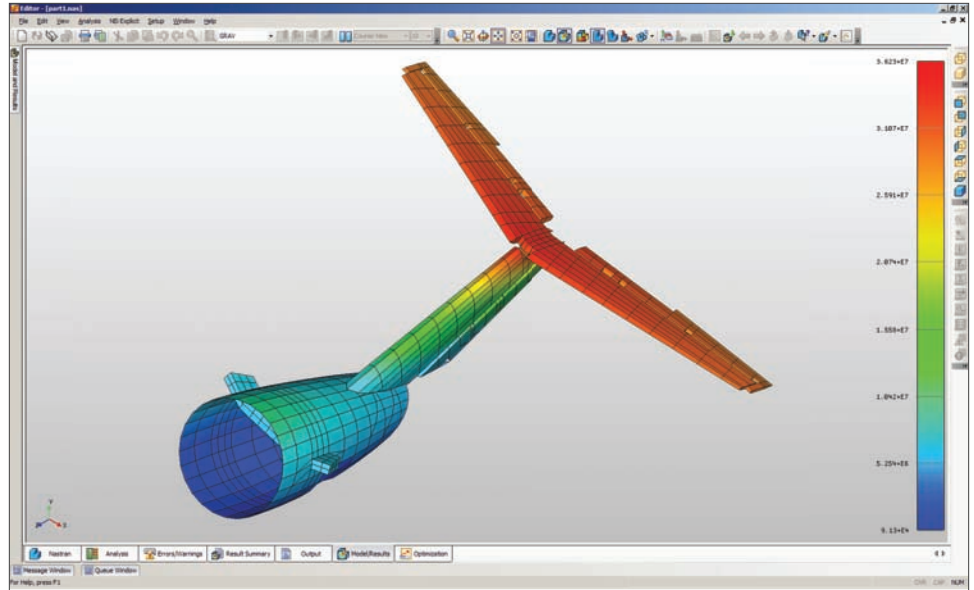


*Live Technical Support*

## Customer Testimonial

“We have found the NEi Nastran product and service to be excellent. Program enhancements are added frequently and the level of technical support is terrific. We have tried other products in the past, but the NEi Nastran is superior to any we have seen.”

Lee Williams  
Senior Mechanical Engineer  
Tread Corporation



*Nonlinear Tension-Only Shell*

## 19. Nonlinear Tension-only Shell and Cable Elements

### Nonlinear Tension-only Shell Element

- Tension-only membrane reverts to a shear panel in compression
- Designed for analyzing semi-monocoque aircraft structures
- Controllable compression stiffness scale factor
- Currently used by Cessna Aircraft for production design work

### Nonlinear Tension-only Cable Elements

- Allows initial slack or preload
- Ultimate tensile stress can be specified above which the cable fails
- Supports temperature dependent material properties

## 20. Outstanding Live Technical Support

- Web based support includes unlimited access to the NEi Nastran customer Knowledge Base
- Email support is a 24 hour turnaround service
- Telephone support is available 7AM - 5PM PST M-F
- Mentoring support provides advice to customers on finite analysis techniques, analysis strategy, meshing, model debugging, and more
- Maintenance updates include documentation corrections and bug fixes and are provided free of charge
- Version updates are new releases with significant enhancements and additional functionality
- Consulting services can be provided at an additional charge, and include complete analysis of your projects from start to finish

---

## 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](mailto:info@neisoftware.com)  
Website: [www.NEiSoftware.com](http://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](mailto:emea@neisoftware.com)  
Website: [www.NEiSoftware.com/emea](http://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](mailto:asia@neisoftware.com)



NEi, NEi Works, NEi Fusion, and the NEi logo are trademarks of NEi Software, Inc. Nastran is a registered trademark of NASA. All other trademarks are the property of their respective owners. Copyright © NEi Software, Inc. 2010. All rights reserved.

BROCKEYF20100505