

# NX Nastran Advanced Nonlinear – Solution 601/701

## fact sheet

Siemens PLM Software

[www.siemens.com/nx](http://www.siemens.com/nx)

### ► Summary

The NX™ Nastran® Advanced Nonlinear software solution enables you to analyze models with nonlinearity from contacting parts, material nonlinearities and/or geometric nonlinearities (that is, large deformations). An add-on module of NX Nastran – Basic, the Advanced Nonlinear solver is an integration of the well-known and highly regarded ADINA solver into NX Nastran as Solution 601 for implicit solutions or Solution 701 for explicit solutions.

### Benefits

Reduce design risk by using simulation to save time and cost compared to physical build-and-break test cycles

Accelerate your innovation through rapid iteration and numerous “what-if” studies

Use the same models already built and analyzed linearly with NX Nastran – Basic

Improve confidence in final designs by virtually investigating your product’s performance under all possible operating conditions

Obtain more accurate solution results than linear analysis when standard linear assumptions are not valid

### Features

Surface contact

Material nonlinear behavior

Geometric nonlinear behavior

Robust solution methods

Easy transition from linear to nonlinear analysis

Static and transient dynamic analysis

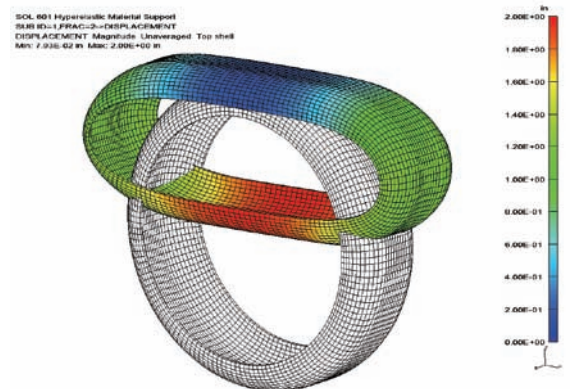
Restart capabilities

Parallel processing

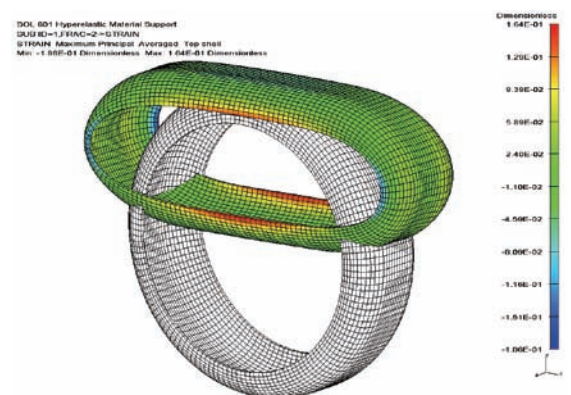
Implicit and explicit solver options

Geometric nonlinear effects need to be simulated when stiffness properties or loads change significantly as the result of deformation. Analysis of snap-through buckling is an example in which geometric nonlinearity effects are important. Material nonlinear effects should be modeled when the material properties cannot be considered linear for the loading conditions considered. Example usages are for analyzing hyperelastic (rubber) materials or analyzing metals that exhibit plastic behavior because they are stressed beyond yield limits. Advanced contact capabilities allow you to simulate surface contact using either shell or solid elements. Many mechanical simulations involve parts coming into contact under load. With the advanced Solution 601/701 surface contact capabilities, the solver determines the extent of surface contact and load transfer across the contacting surfaces as part of the solution. NX Nastran Advanced Nonlinear also has a very robust solution algorithm and efficiently obtains converged solutions for some of the most difficult and intractable nonlinear models.

The integration of the ADINA solver into Solution 601/701 is transparent to the user because the input and output formats are based on NX Nastran formats. Thus, to the user, the experience and usage of Solution 601/701 is completely Nastran-centric.



*Hyperelastic materials: displacement results from a tire model being squeezed between two plates.*



*Hyperelastic materials: strain results from a tire model being squeezed between two plates.*

## Major capabilities

### Contact:

- Shell and solid element face contact
- Edge contact for axisymmetric modeling
- Single and double sided contact
- Self contact
- Several friction models
- Tied contact
- Several contact algorithms
- Rigid target contact for metal forming
- Compliant (soft) contact
- Contact surface offsets
- Gap elements
- Contact pressures and force results

### Material nonlinear:

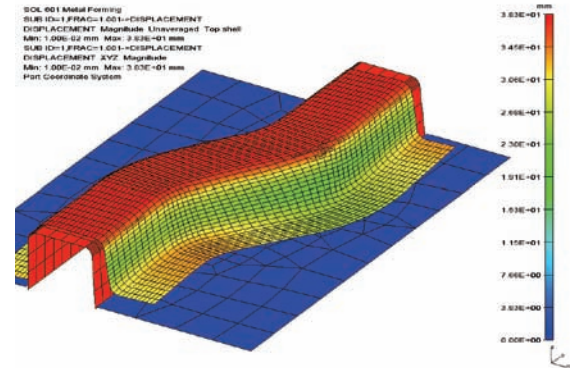
- Hyperelasticity models
  - Mooney-Rivlin
  - Ogden
  - Hyperfoam
  - Arruda-Boyce
- Gasket material model
- Gasket pressure and state results
- Nonlinear elastic
- Elasto-plastic
- Thermal elasto-plastic
- Creep
- Plasticity
  - Von Mises yield criterion
  - Isotropic hardening
  - Kinematic hardening
  - Mixed hardening
- Rupture
- Strain measures: engineering, Green-Lagrange, logarithmic
- Stress measures: engineering, Cauchy

### Geometric nonlinear:

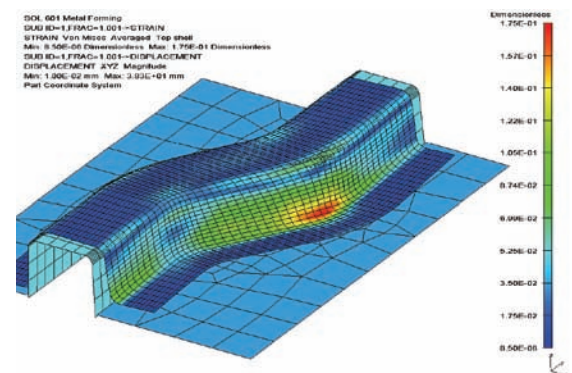
- Large deformations
- Large strain
- Snap-through analysis (post-buckling)
- Follower forces

### Other modeling capabilities

- Glue connection
- Element Birth and Death



Displacement results from a metal forming example. A planar sheet is formed into an S channel.



Strain results from a metal forming example. A planar sheet is formed into an S channel.

*Robust solution methods*

- Full Newton iterations, with or without line searches
- Load displacement control (LDC) method
- Automatic time stepping (ATS) method
  - Low-speed dynamics effect option
- Energy, force and deformation convergence criteria
- Dynamic solution with Newmark method for direct implicit integration
- Sparse solver and iterative multi-grid solver
- Stiffness stabilization for static solutions

*Easy transition from linear to nonlinear analysis*

- Add only a few nonlinear-specific entries to the linear model
- Input and output formats are similar
- Supports many advanced NX Nastran features
  - Elastic isotropic, orthotropic materials
  - Composites
  - Axisymmetric modeling
  - Plane strain modeling
  - Material temperature dependence
- Supports many load conditions
  - Bolt preload
  - Concentrated loads
  - Follower loads
  - Pressure and distributed loads
  - Inertia loads
  - Enforced motion
  - Applied temperatures
  - Initial conditions for displacement, velocity and temperature

*Static and transient dynamic analysis*

- Model set-up is the same for static and dynamic analysis
- Doesn't require separate licenses for static and dynamic analysis

*Implicit and explicit solutions*

- Implicit solver for static analysis and low speed dynamic analysis
- Explicit solver option for impact simulation or metal-forming simulation
- Can switch from implicit to explicit and vice versa with restarts

**Contact**

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