# NX CAE Overview

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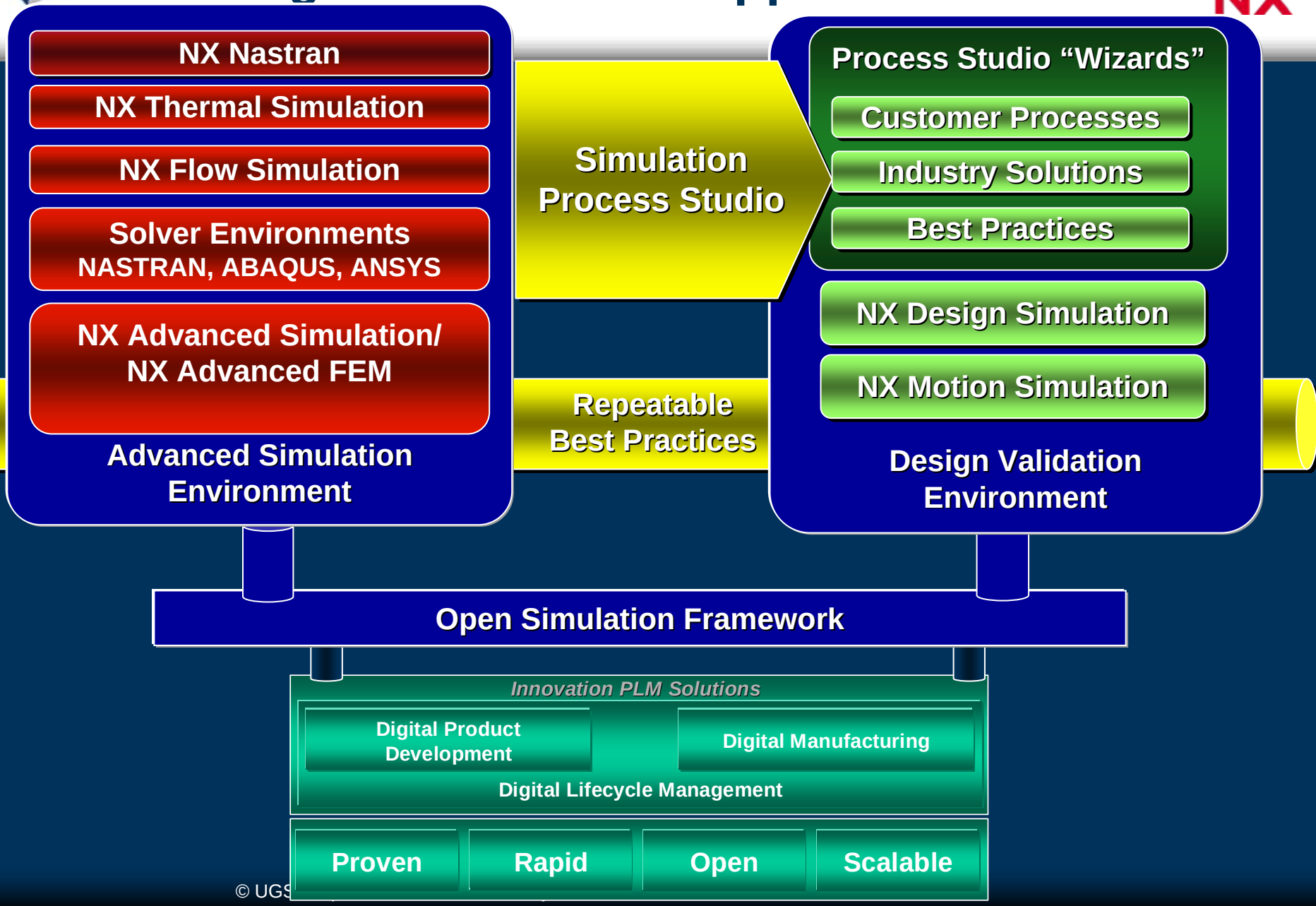
# UGS Digital Simulation Applications Portfolio

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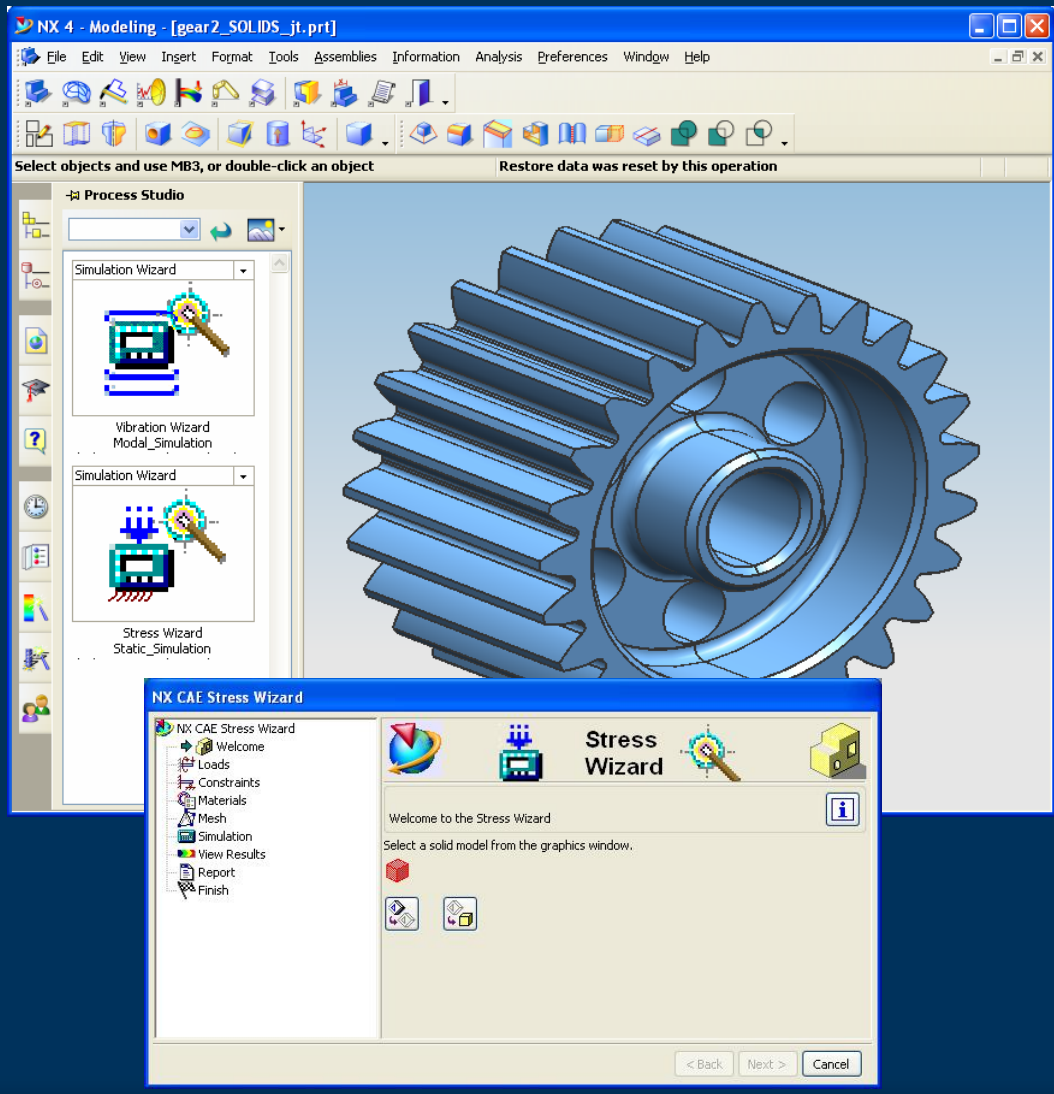
# Simulation Everywhere

- New Wizards
  - Stress / Vibration
  - Powered by NX Nastran
  - Launch from modeling
  - For Designers
  - Simple with guidance
  - Scalable Sim/Fem
  - Scalable XML
- Available NX4.0.1



# NX 4.0.1 Wizard Demonstration

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# Simulation Process Studio

- Roles

EXPERT
•Develops the Workflow

DESIGNER
•Uses the Wizard

.XML File

AUTOMATION ENGINEER
•Creates the Wizard

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# Simulation Process Studio Demonstration

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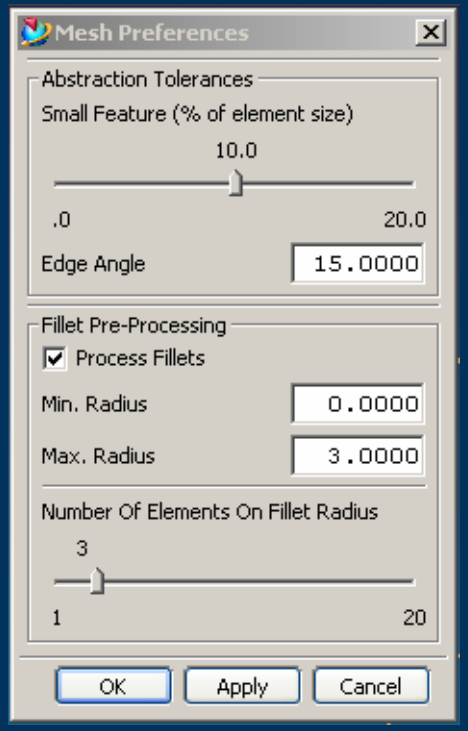
# NX Advanced Simulation : CAE Topology

- CAE Topology
  - What is it?
    - An abstracted layer of CAE specific topology with CAE specific modeling tools, over and above that provided by CAD
  - What does it do?
    - Automatically simplifies geometry by removing irregular and tiny features to allow effective CAE meshing
  - Why is it valuable?
    - Reduces the time to mesh and the number of elements generated (reducing solve time) while improving element quality and results accuracy

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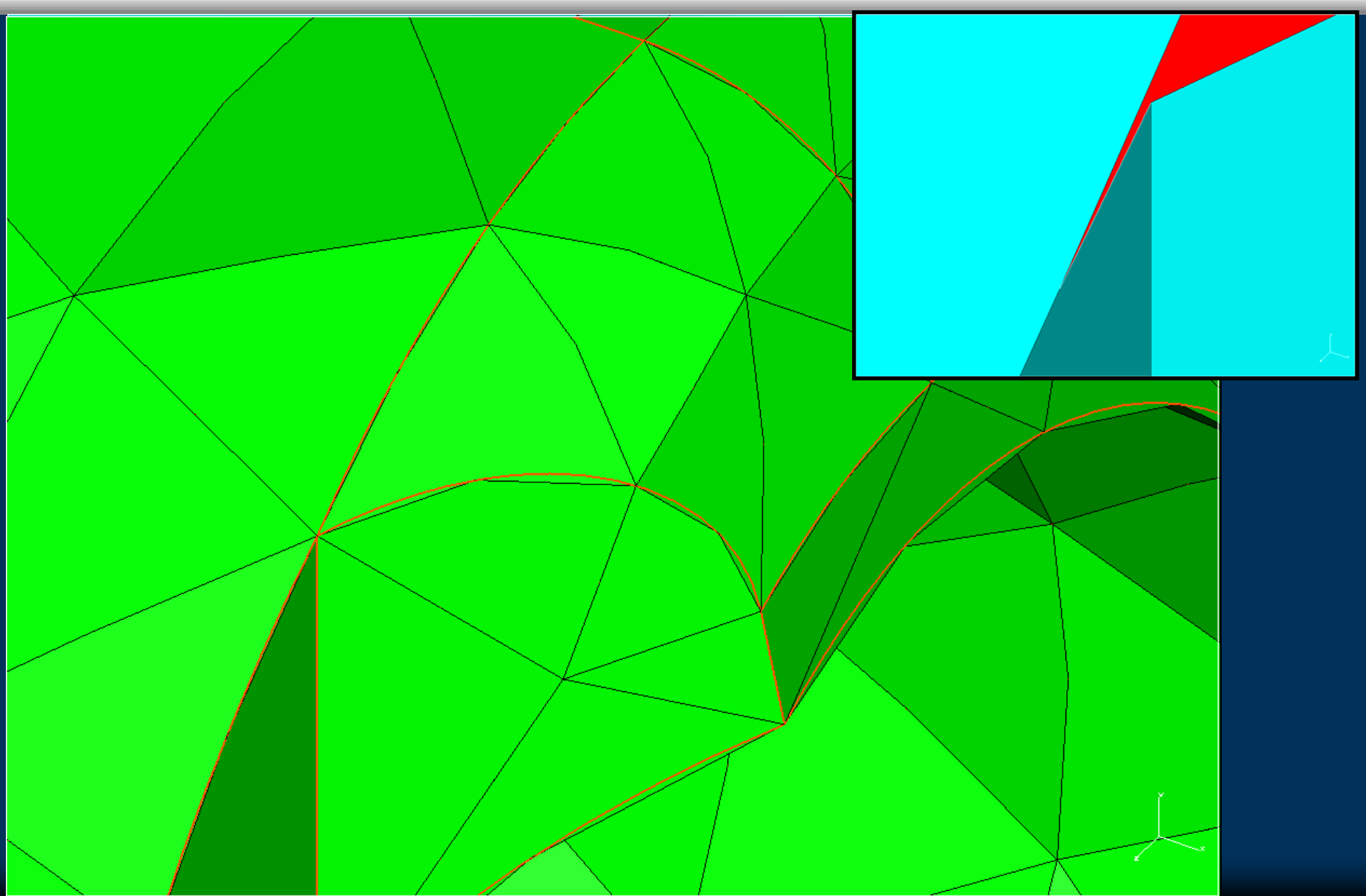
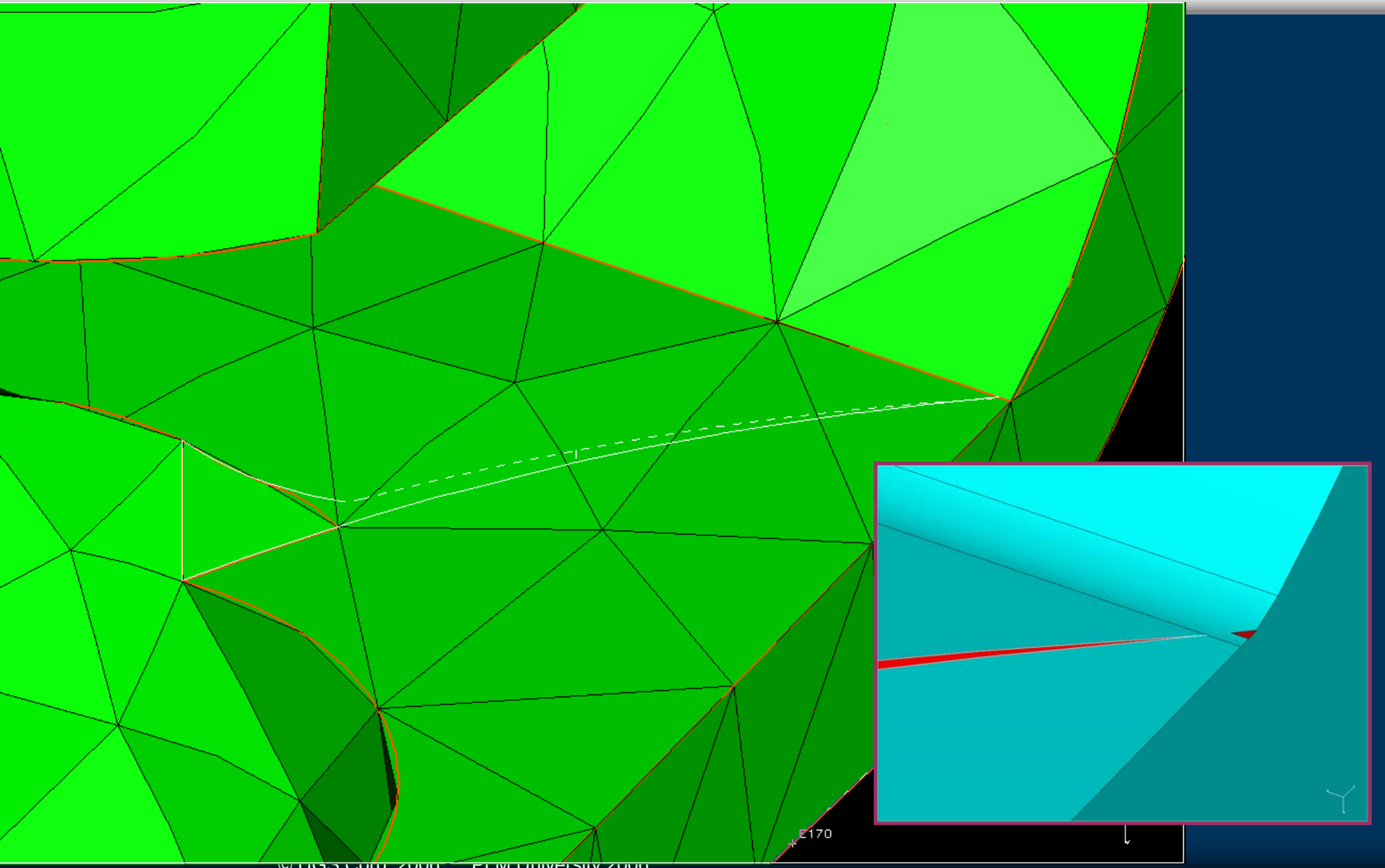
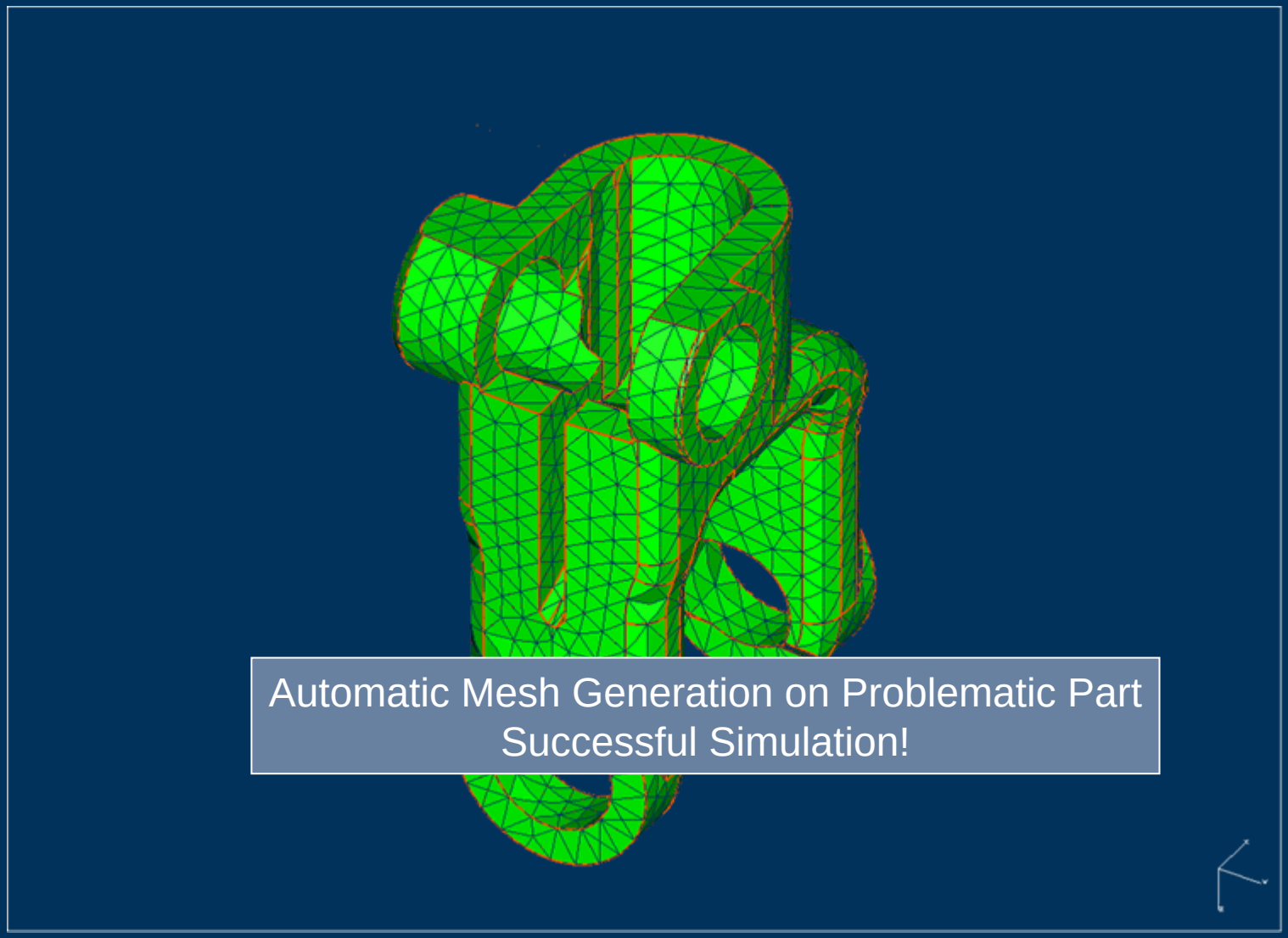
# Simulation Driven Geometry Abstraction



# Simulation Driven Geometry Abstraction



# Simulation Driven Geometry Abstraction

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# Meshing Demonstration

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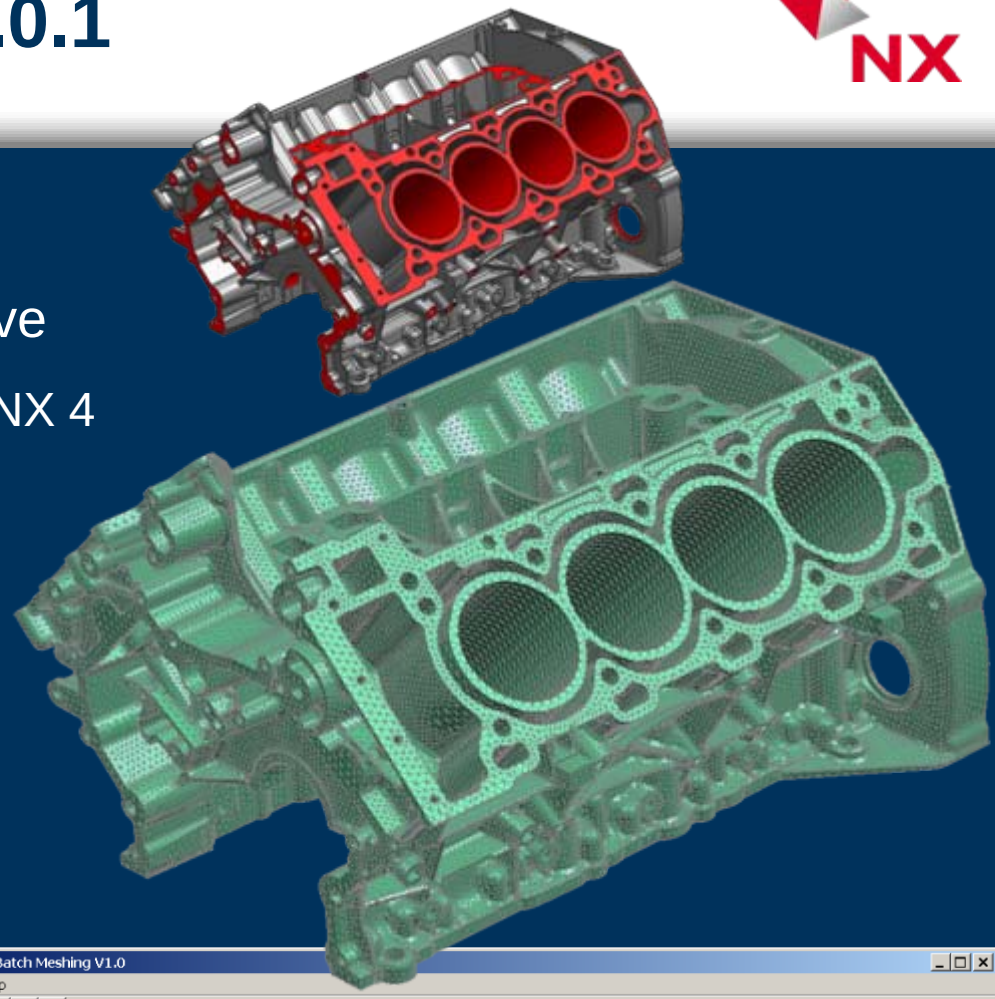
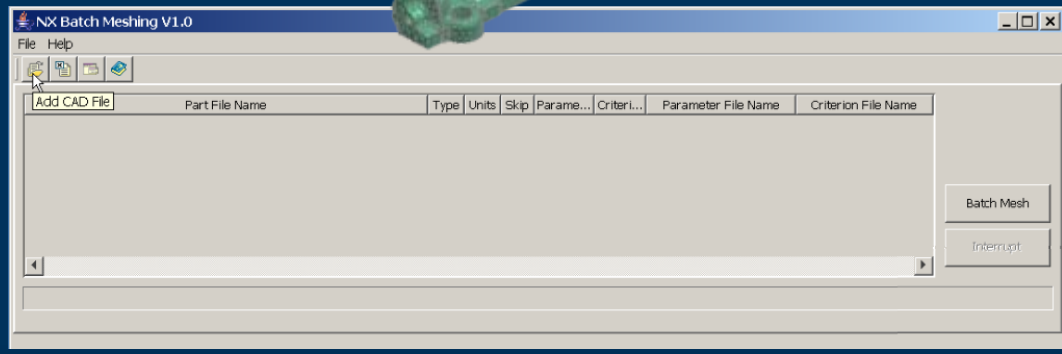
# Batch Meshing NX4.0.1

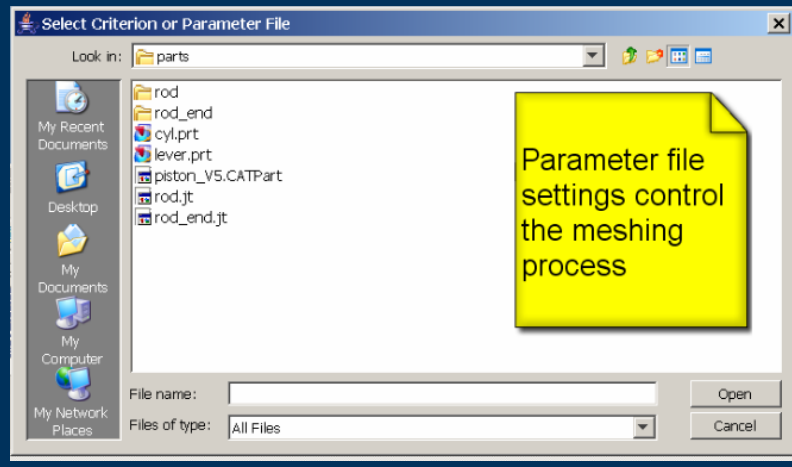


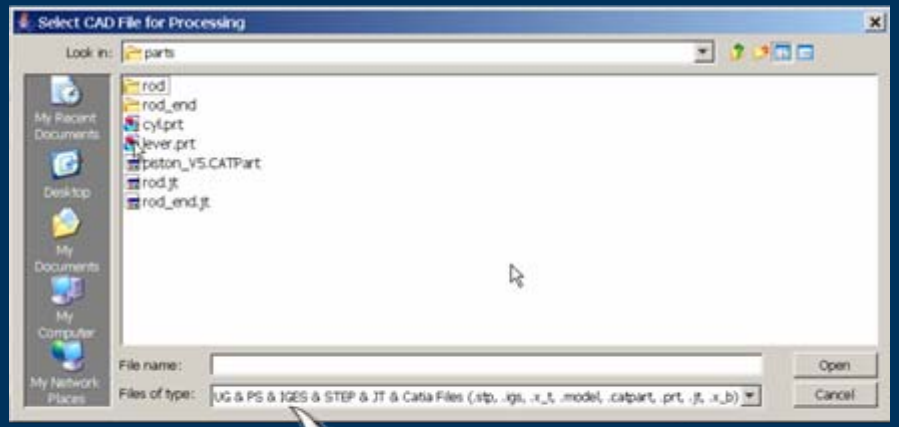
- Request to UGS to participate in Powertrain Batch Meshing initiative
  - Provided 14 components to test NX 4 capabilities
  - Batch Workflow
    - CAD translation (CMM, JTXT)
    - CAD Model Check
    - CAE Automatic Tet Mesh
    - Export Nastran Bulk Data Deck
- Develop batch processing engine
  - Available with NX4.0.1



# Batch Meshing NX4.0.1

- Java Front End
  - Drives NX Open Batch Meshing program
  - Selection of files for processing
  - Parameter file for mesh definitions
  - Output
    - NX Nastran Bulk Data files
    - NX .fem files




Supported CAD Files: NX, I-DEAS, JT Precise, Parasolid, CATIA, etc.

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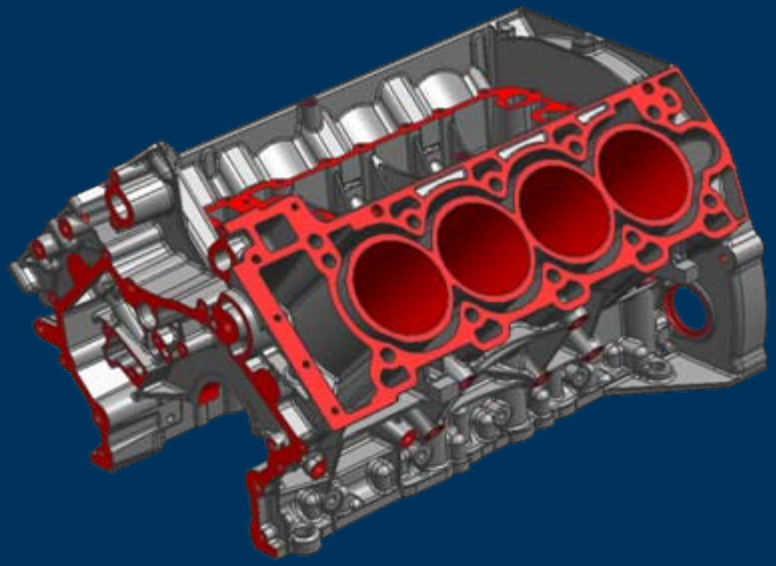
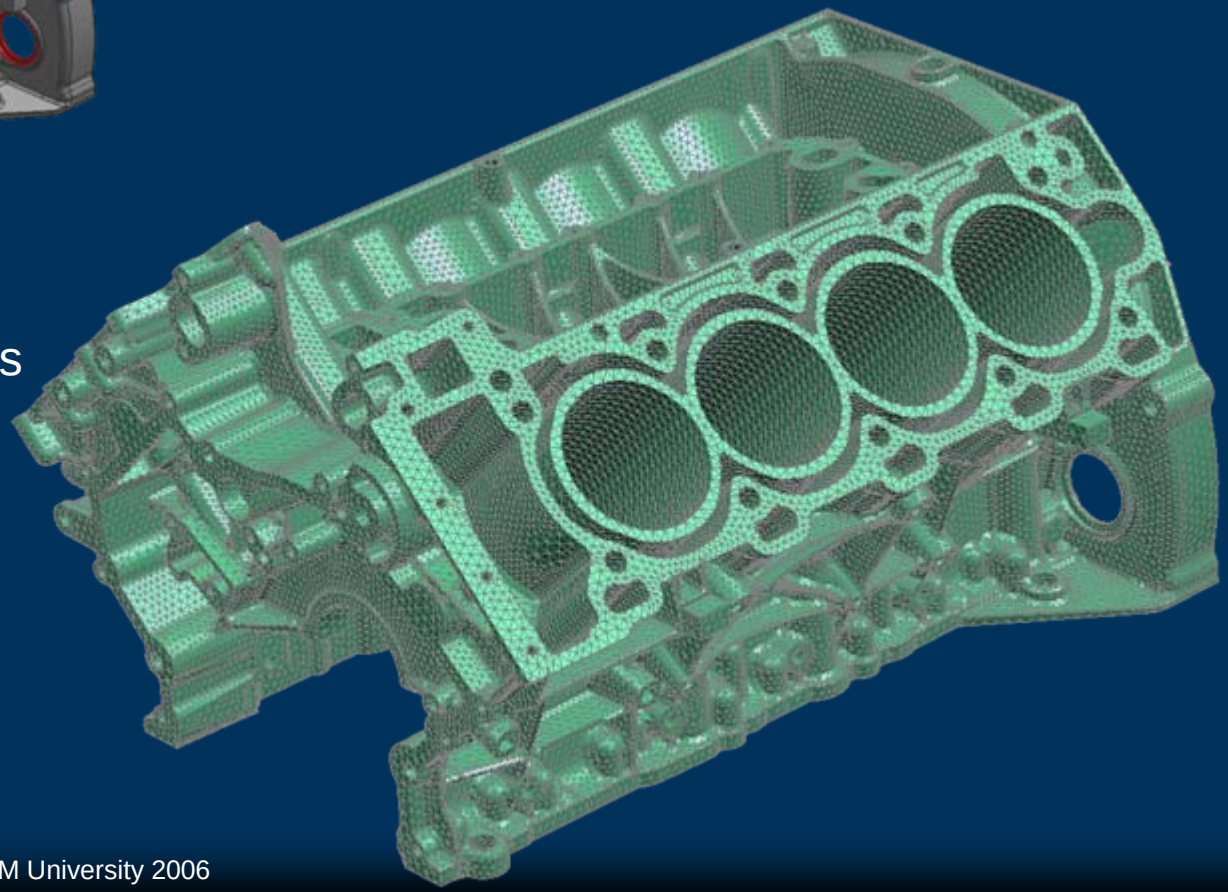
# Block



- Timing
  - Mesh Generation and write of NBD ~ 2hrs
  - 659K Tet 10 Elements 1.6 M Nodes



- Element Quality – No failures for NX Nastran
  - Extreme Values
    - Aspect Ratio – 19.7
    - Jacobian Ratio– 9.97
    - Jacobian Zero - .014
    - Tet Collapse – 76.5

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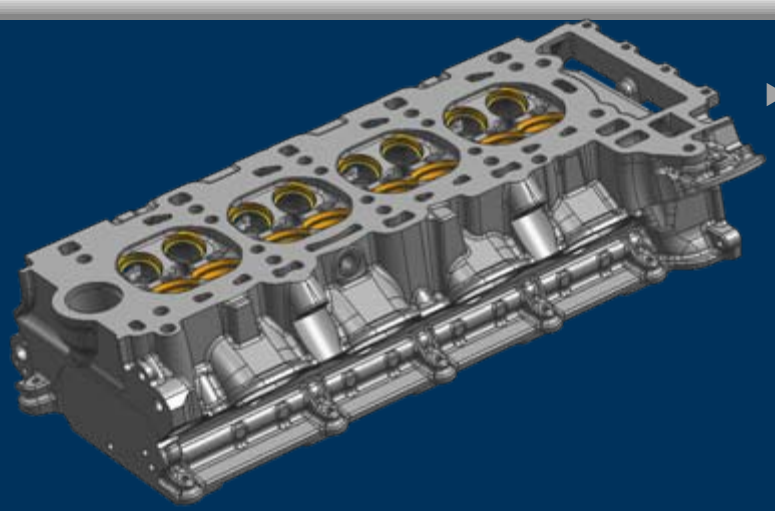
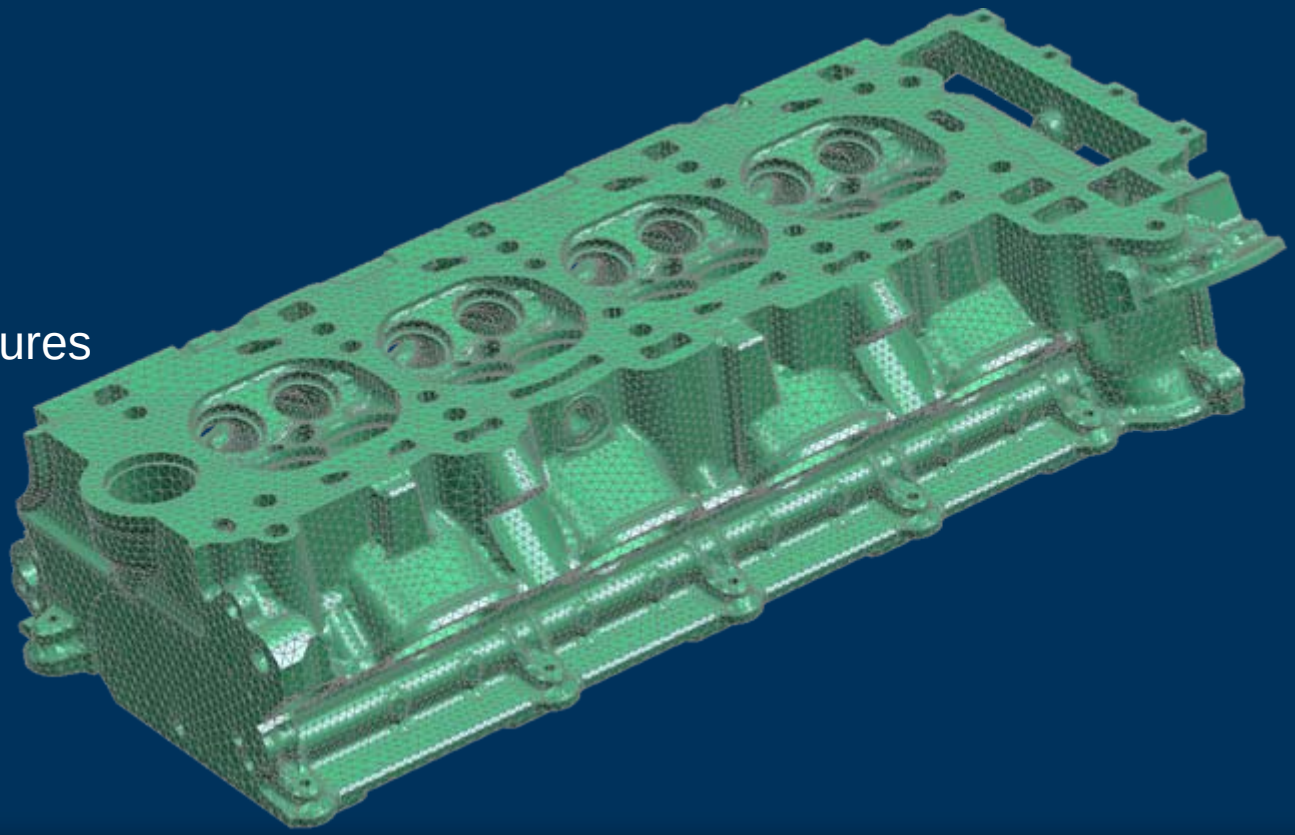
# Head

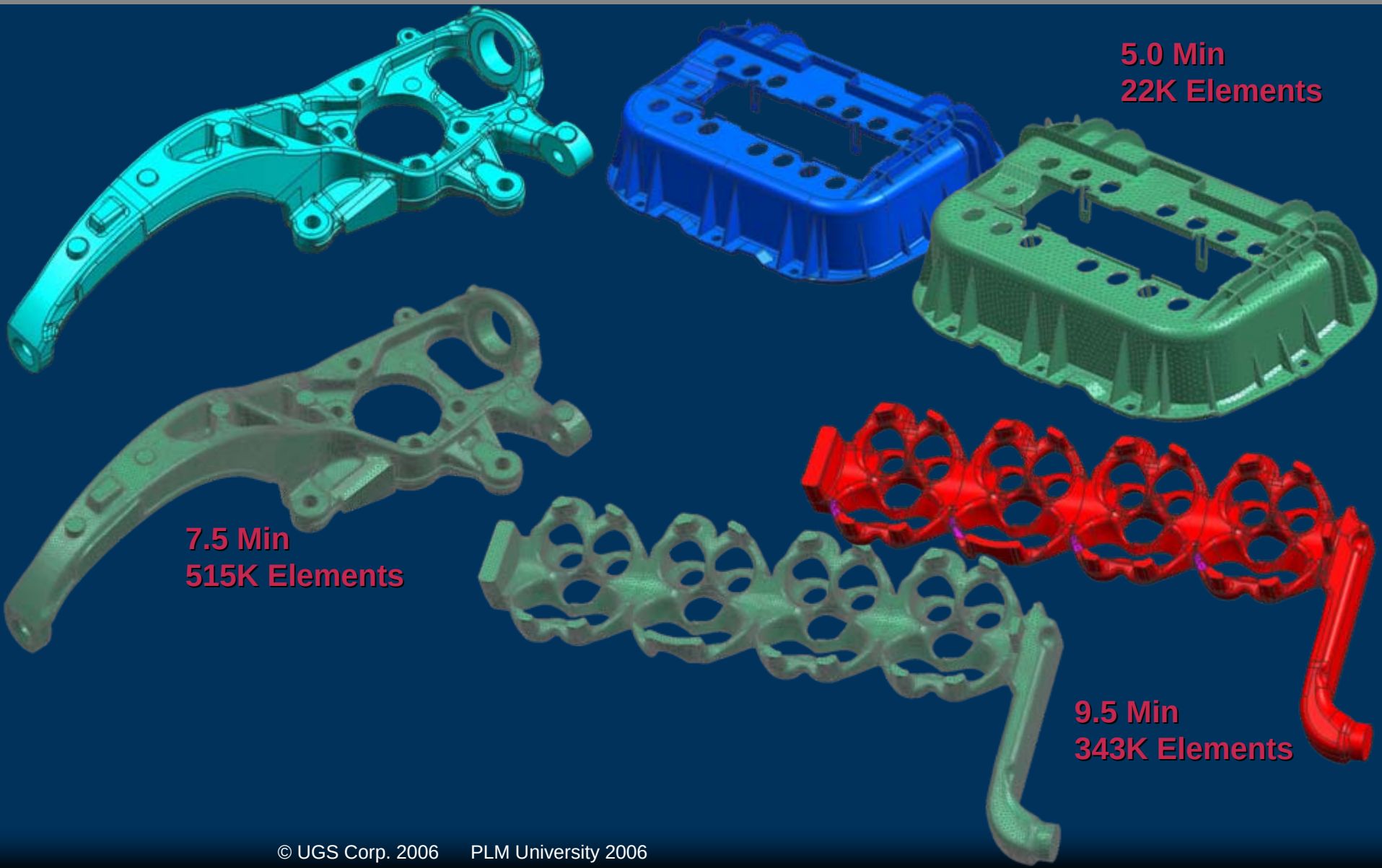


- Timing
  - Mesh Generation and write of NBD ~ 48 min
  - 392K Tet 10 Elements 681K Nodes



- Element Quality – No failures for NX Nastran
  - Extreme Values
    - Aspect Ratio – 8.0
    - Jacobian Ratio– 9.97
    - Jacobian Zero - .262
    - Tet Collapse – 44.5

# Other Examples

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# Batch Meshing Demonstration

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# Advanced Nonlinear Solution

NX4 Starts initial support of NX NASTRAN advanced nonlinear

- Transient loading
- Large displacement/strain
- Nonlinear material (stress/strain)
- Solution time step definition
- Surface-surface contact
- Transient results post processing

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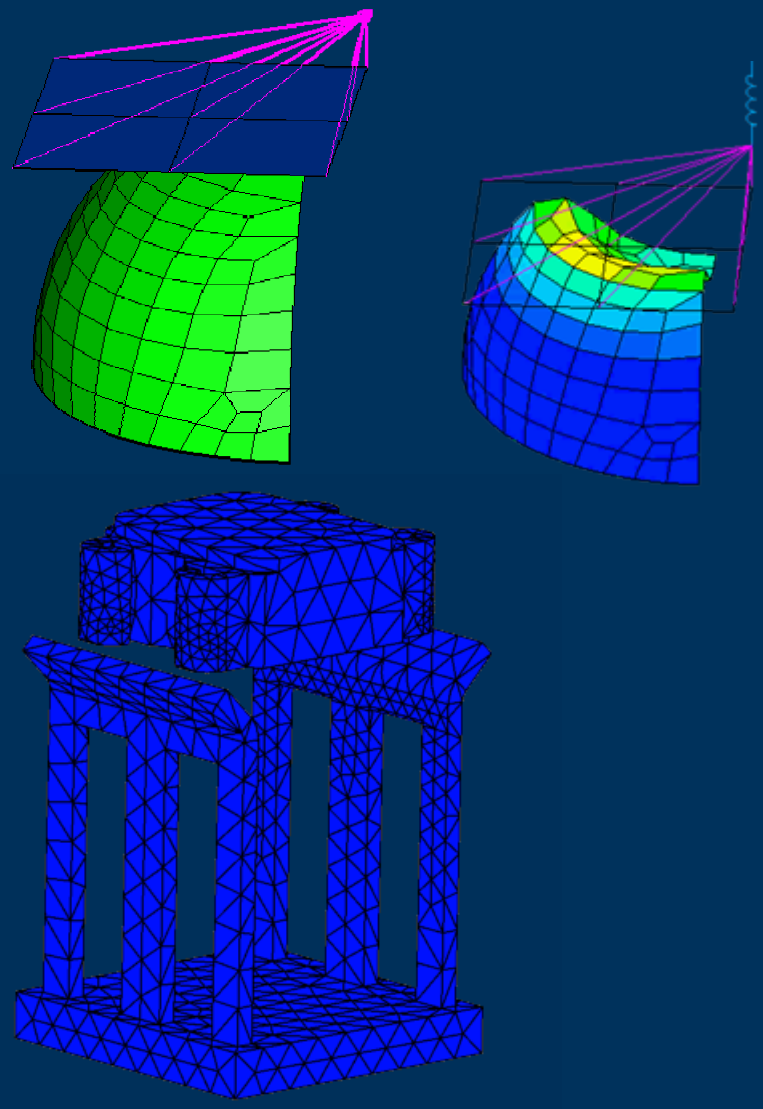
# NX 4 Advanced Simulation
# Advanced Non-Linear Analysis

- **NX Advanced Simulation non-linear capabilities support**
  - Advanced non-linear structural solver
  - Non-linear capabilities: surface-to-surface contact, large displacement, large strain
  - Material non-linearity
- **Why it is used:**
  - Predict structural response for systems that involve parts coming into contact and/or undergo large deformation.
- **What it can be used for:**
  - Consumer Electronics
    - Bend and twist analysis
  - Industrial equipment
  - Aerospace
  - Consumer goods
    - Fasteners
  - Automotive components
    - Powertrain bolted connections
    - Connector clips



# Advanced Nonlinear Solution Demonstration

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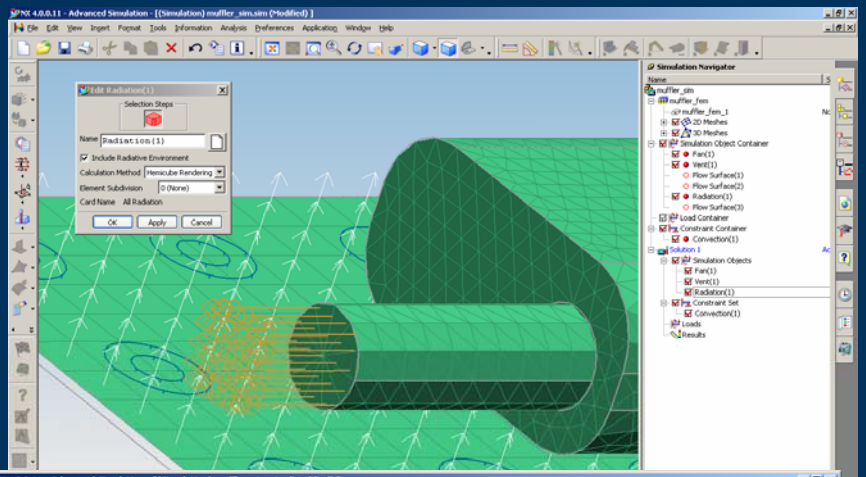
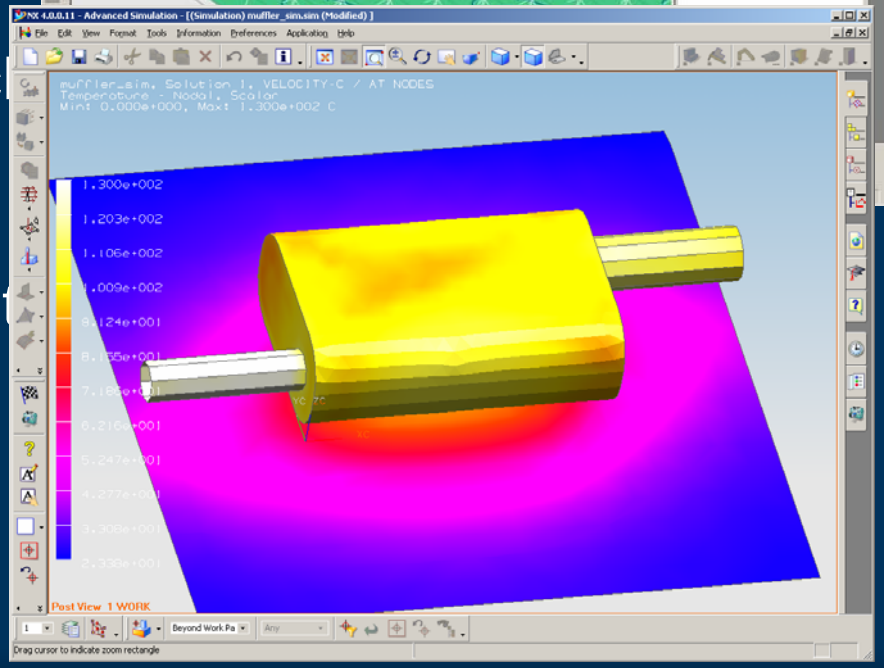
# NX 4.0 Thermal Simulation Solution
# NX Thermal

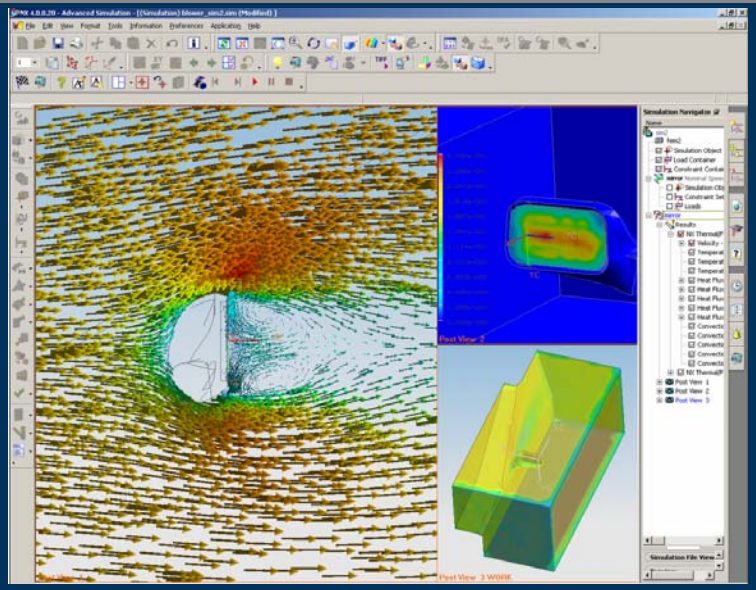
- **Why it is used:**
  - Predict heat flow and temperatures in complex systems subjected to thermal loads
- **What it can be used for:**
  - Electronic boards and high-tec equipment
  - Industrial equipment
  - Aerospace detailed component
  - Consumer goods
  - Automotive components
  - …



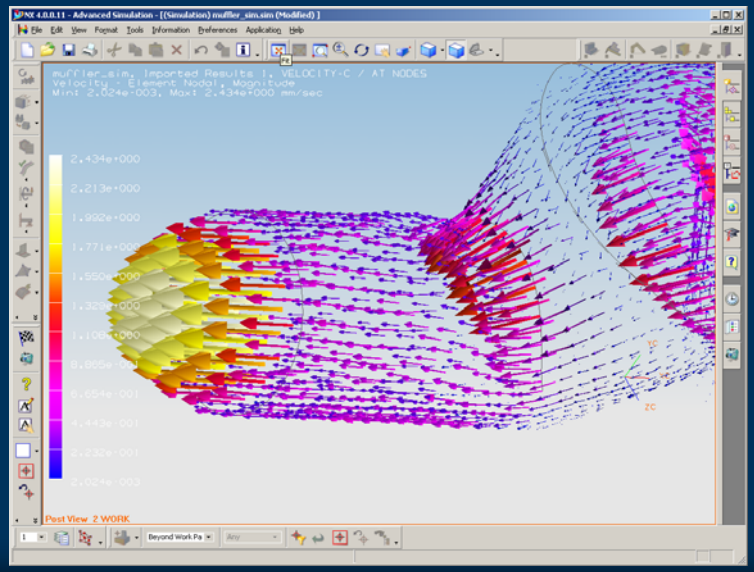


# NX 4.0 CFD Simulation Solution
# NX Flow

- **Why it is used:**
  - Predict flow rates, pressure gradients, and motion of fluid in complex systems, predict recirculation areas causing hot spots

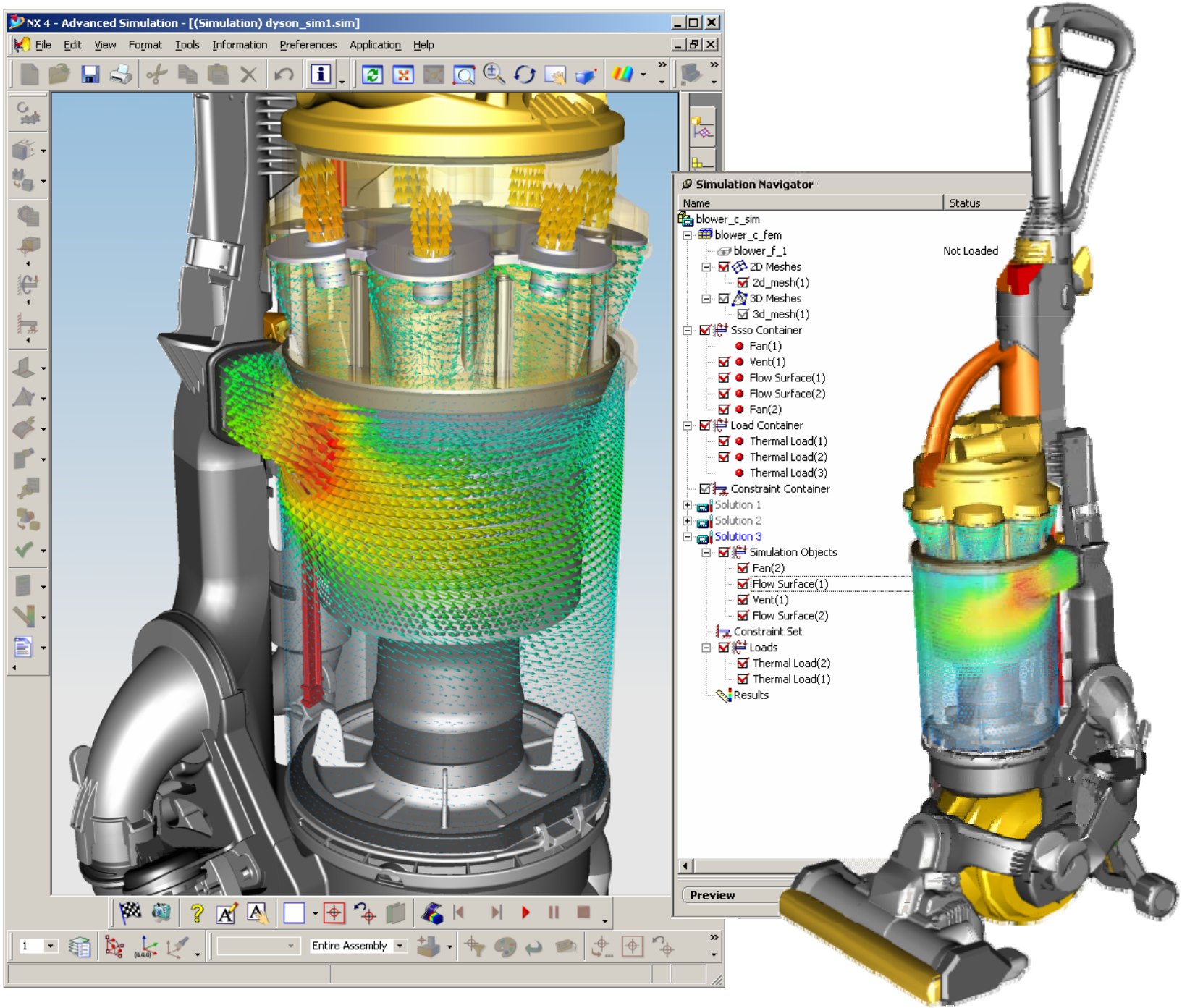


- **What it can be used for:**
  - Automotive
  - Industrial Equipment
  - Aerospace/aeronautic
  - High-tech electronics



# Consumer Air Flow Simulations

## NX Flow



# NX Flow Demonstration

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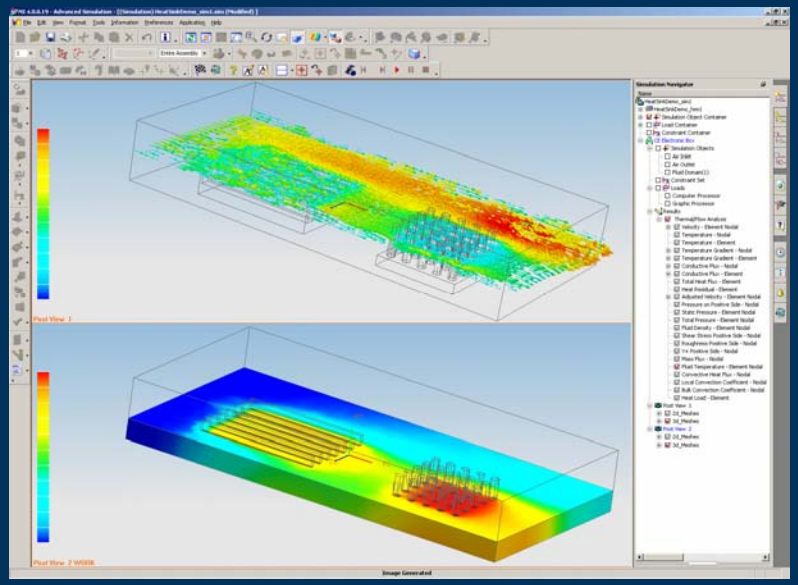
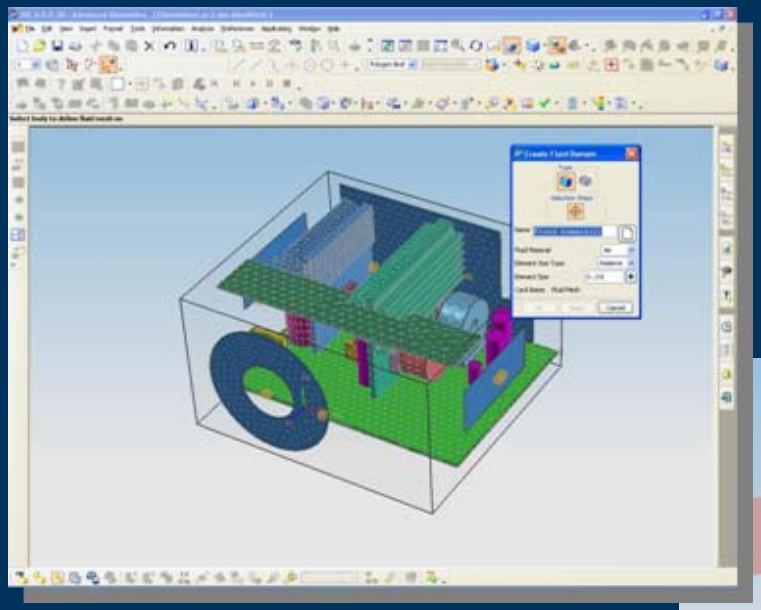
# NX 4.0 Advanced Simulation Target Solution
# Coupled Thermal/Flow

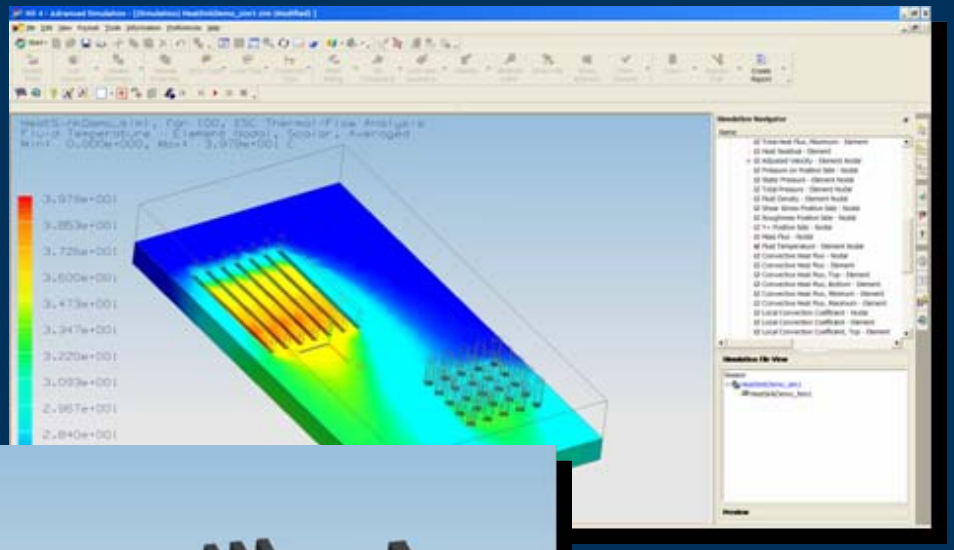
- **True Thermo-fluid Solver Coupling of NX Thermal & NX Flow** [at no additional cost]
  - The combination of NX Thermal and NX Flow products enables coupled thermal/flow analysis
- **Why it is used:**
  - Predict interaction of fluid flow and heat transfer, typically for evaluating cooling of equipment or strong thermo-fluid interactions; including robust and reliable coupling of CFD and thermal radiation
- **What it can be used for:**
  - High-tech consumer electronics
    - Electronic box
    - Computer equipment
  - Consumer goods
    - Appliances
  - Industrial Equipment
    - Drying equipment, piping systems, valves
  - Automotive
    - Air flow through exhaust system
    - Engine cooling

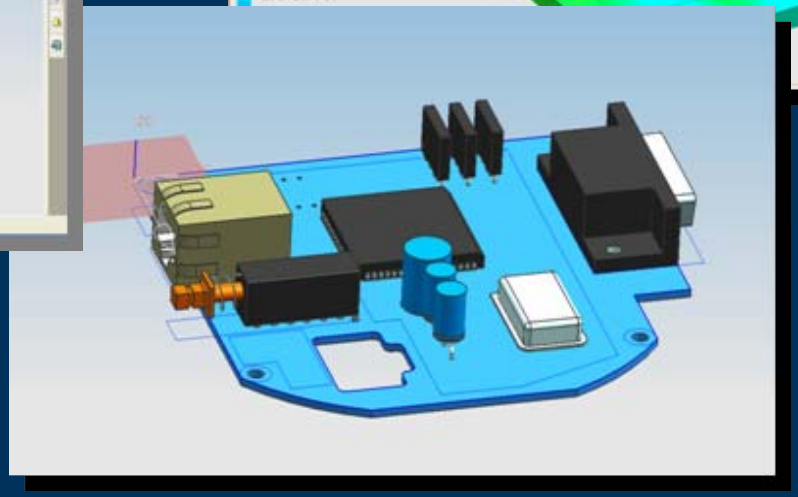


# Coupled NX Flow / NX Thermal for high-tech electronics thermo-fluid simulations

- Enclosures, subsystems, power supplies, PC boards, multi-chip modules, components, heat sinks

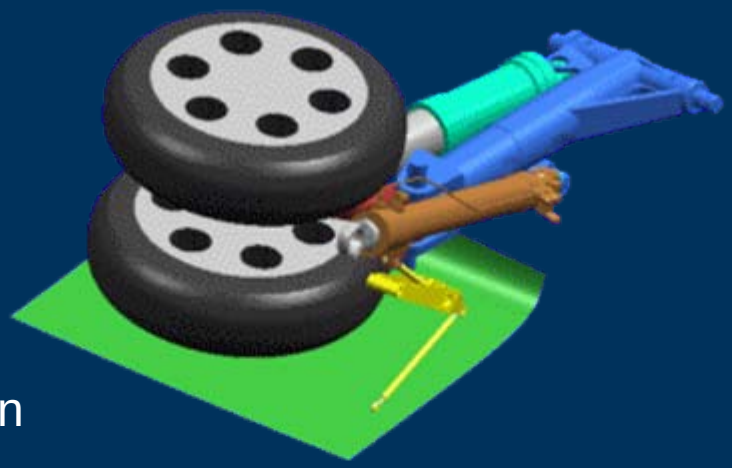






# Motion Simulation

- Why Motion Simulation?
  - Integrated mechanism solver within NX
  - Uses MSC.ADAMS® solver
  - Can be used for…
    - Motion studies
    - Packaging
    - Finite element load generation
  - Solution can be…
    - Kinematic – all degrees of freedom constrained
    - Dynamic – links can be underconstrained, Newton's Laws determine motion



# Motion Simulation Demonstration

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# Appendix

NX 4 CAE Details

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# NX 4 Extends Solver Environments

## Environment - Linear Static, Buckling, Normal Modes & Thermal

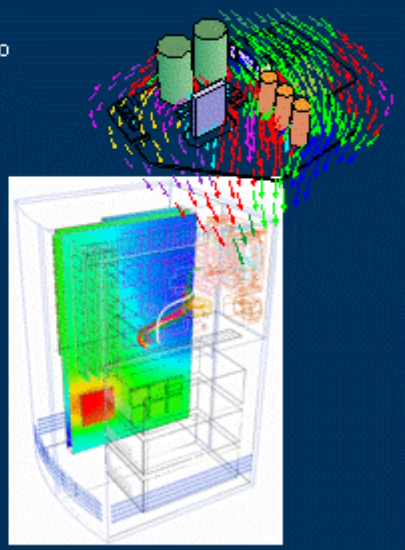
## Environment - Non-Linear Analysis

## Environment - Thermal Analysis

## Environment - Flow

## Environment - Coupled Thermal/Flow

- **Capabilities**
  - Combination of thermal and flow products to allow coupled thermal/flow analysis
- **Why it is used:**
  - Predict interaction of fluid flow and heat transfer, typically for evaluating cooling of equipment
- **What it can be used for:**
  - Electronic box
    - Computer equipment
    - Consumer electronics
  - Consumer goods
    - Appliances
  - Industrial Equipment
    - Drying equipment
  - Automotive
    - Air flow through exhaust system
    - Engine cooling



# NX 4 CAE Highlights

- Meshing
  - Seamless geometry abstraction based upon user defined meshing criteria
  - Sophisticated unwrapping techniques for shell meshing
  - Fillet detection and fillet mesh control
  - CAE geometry layer
    - User control of geometry abstraction
    - Quickly edit geometry for meshing or boundary conditions purposes
  - More robust 2D free meshing
  - More robust 3D swept meshing
  - More robust mesh mating

# NX 4 CAE Highlights

- Linear static surface-surface contact via NX NASTRAN
- Large displacement and surface-surface contact via NX NASTRAN advanced nonlinear
- Expanded set of loads and boundary conditions
- Import/export of FEM data – NASTRAN, ABAQUS, ANSYS

# NX 4 CAE Highlights

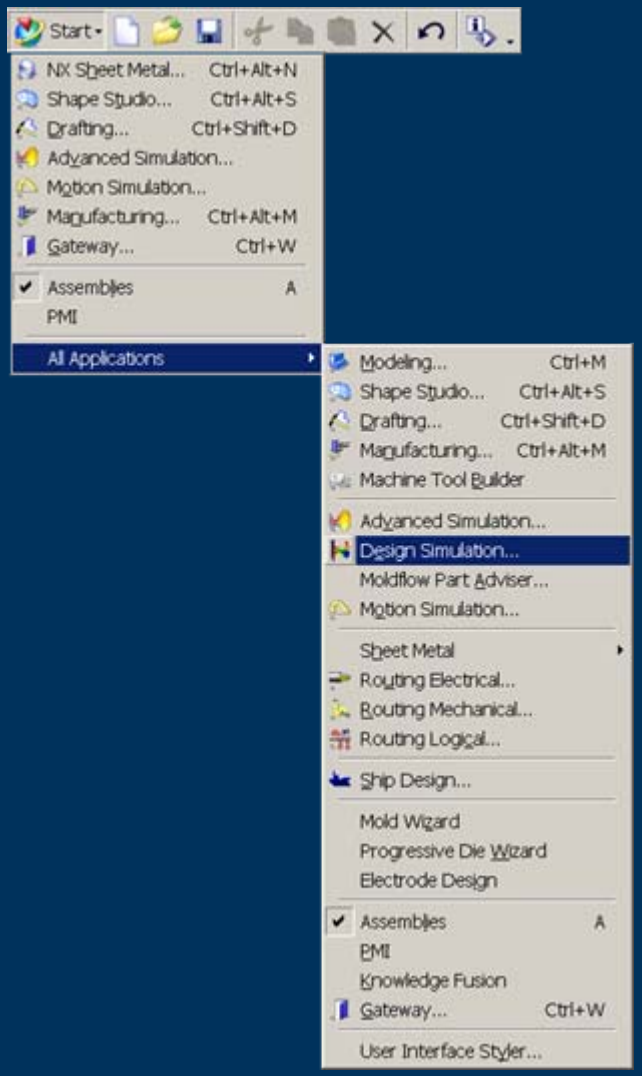
- Transient loads and boundary conditions, solver specific modeling (loads, post, etc.)
- Arrow post processing plots in support of flow analysis and other vector results
- Transient results post processing
- Model size enhancements
  - Pre and post processing support of models with millions of elements/DOF
- Selected display tools
- Improved graphics – nodes and elements

# NX 4 CAE Highlights

- Design Engineer CAE – product split
  - Advanced Simulation / Design Simulation
- Simulation Process Studio authoring enhancements
  - Provide a more usable tool with extended capabilities that results in a wider variety of user defined automation of CAE processes
- Motion
  - Mechanism definitions stored in external files and accessible for use in other motion simulation models (export/import)
  - Extended knowledge fusion support
- XY Graphing
  - Transient, frequency domain results from NX NASTRAN
  - Motion drivers

# NX 4 CAE Highlights

- New designer level product
  - Focused on making analysis easier for novice CAE users
    - Neutral language avoids CAE specifics
    - Geometry based only
    - Linear statics, steady state thermal
    - NX NASTRAN solver
    - No manual CAE topology capabilities
- Scalable to advanced analyst product

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# NX 4 CAE File Structure

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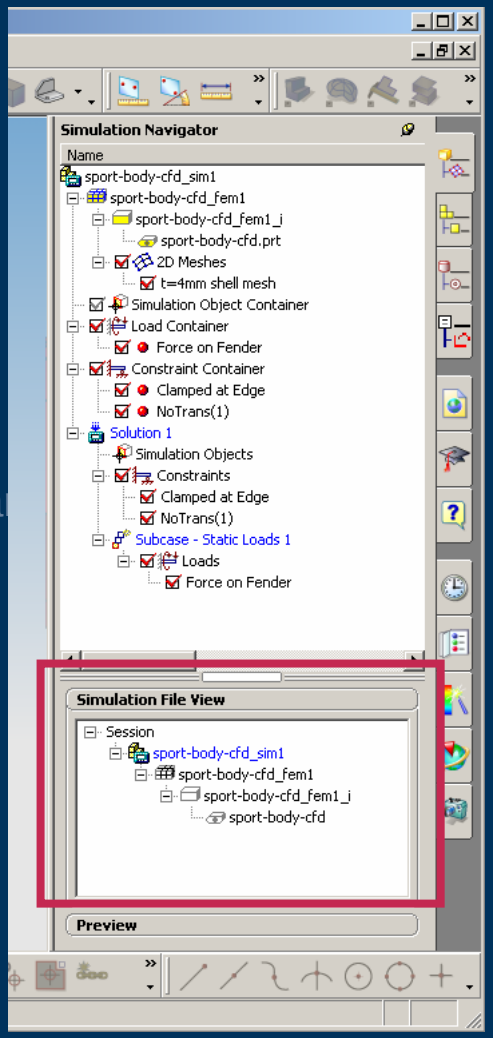
# What's New in NX4 – File Split

- No more Scenarios in Structures
  - Multiple work parts
    - Master Part
      - CAE user may not have write privileges to this
    - Idealize Part
      - Instance of the Master Part
      - CAE user can idealize this (remove features, pa
    - FEM Part
      - CAE geometry layer for creating the mesh
    - SIM Part
      - Loads, Constraints, Solution setup, overrides
- Simulation File View manages parts in session

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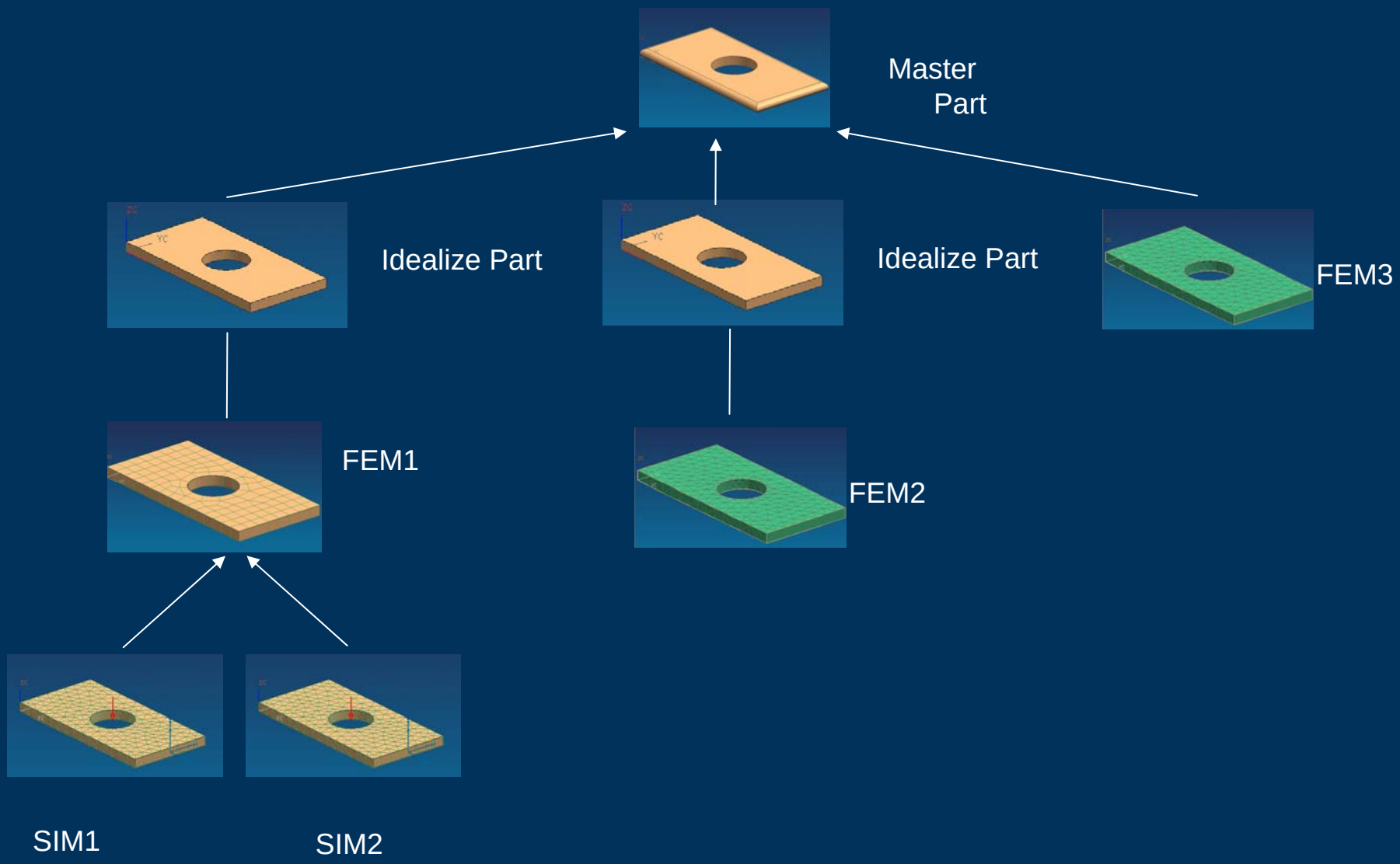
# Working with Multiple Parts

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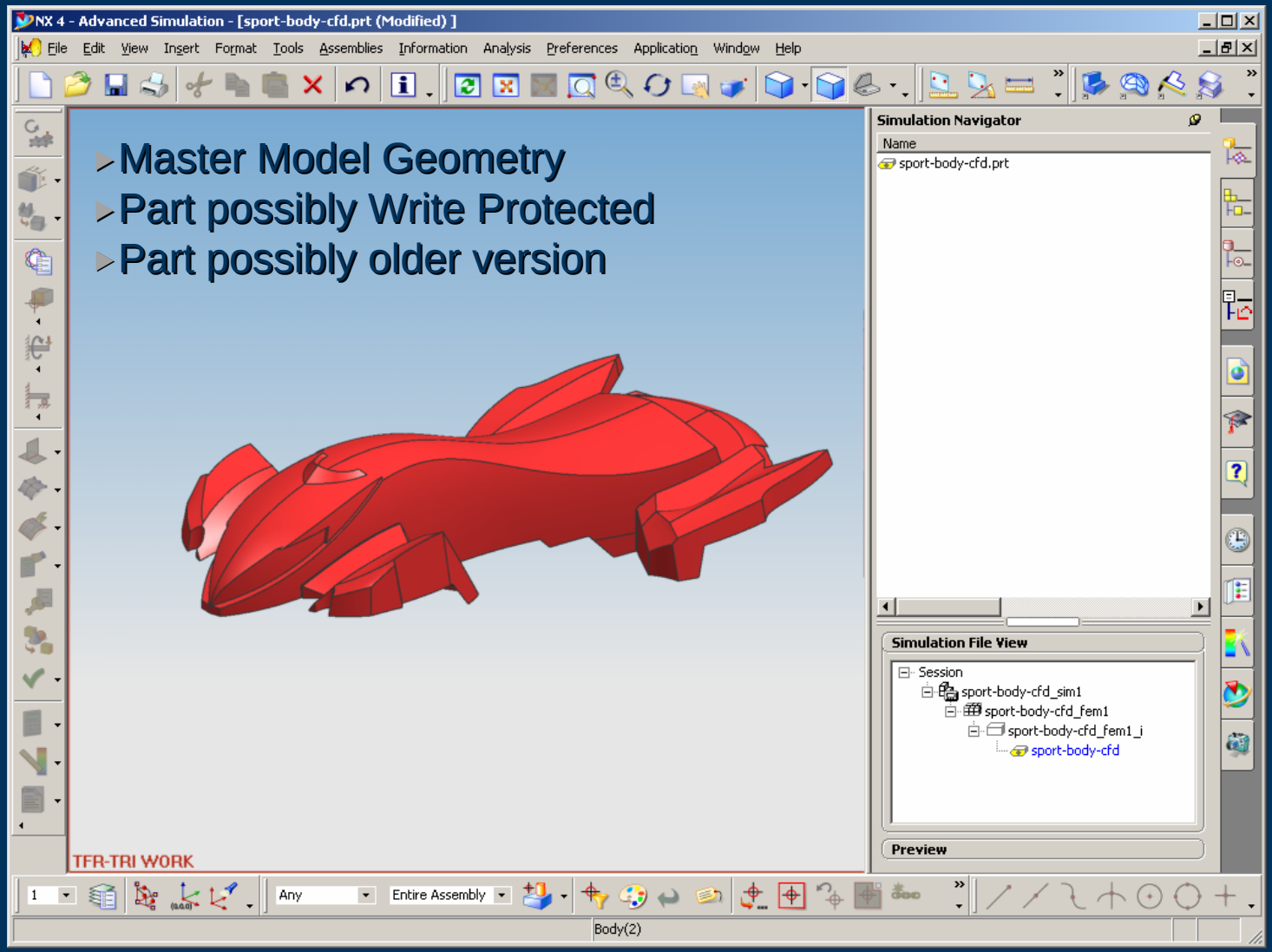
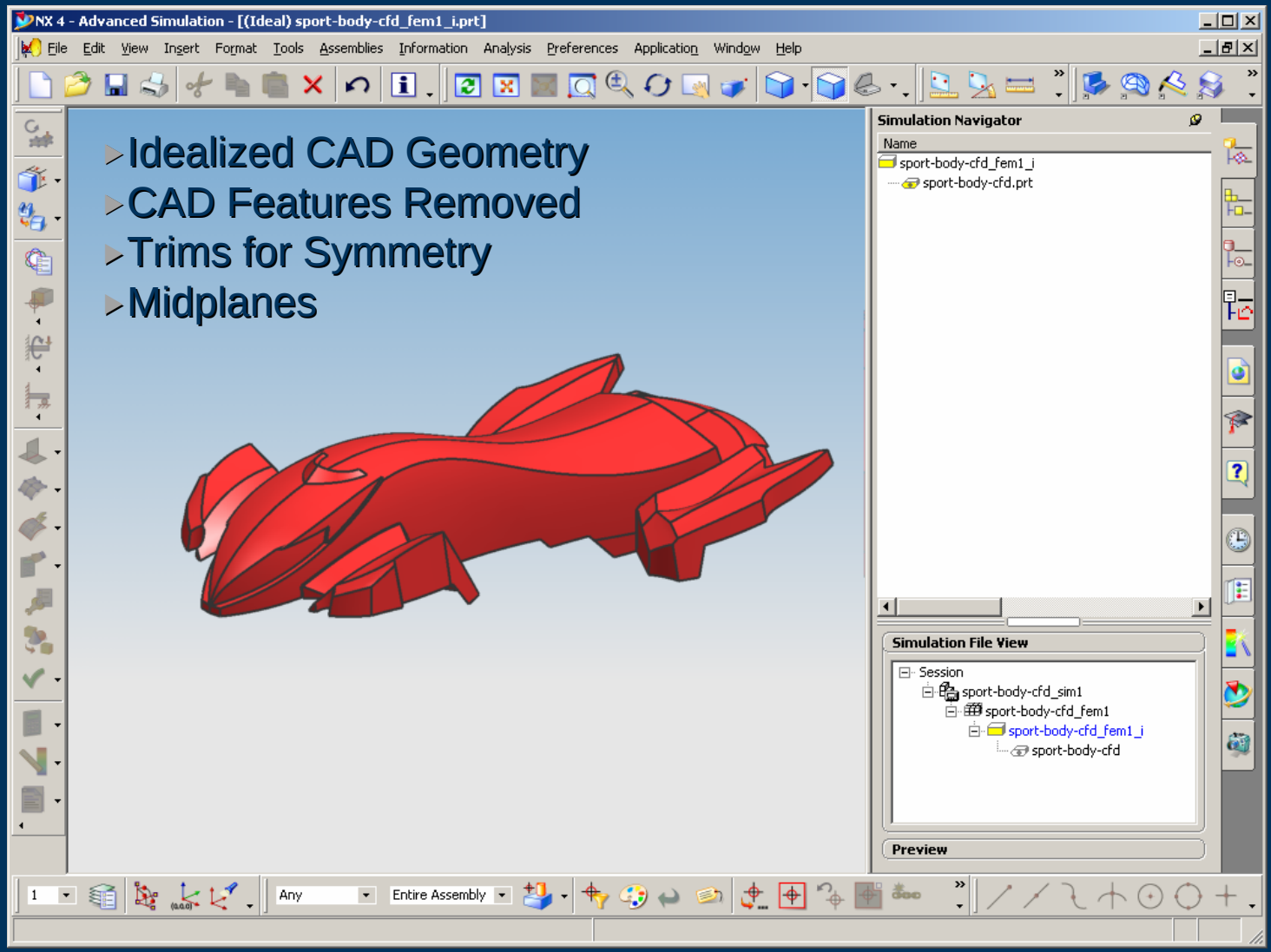
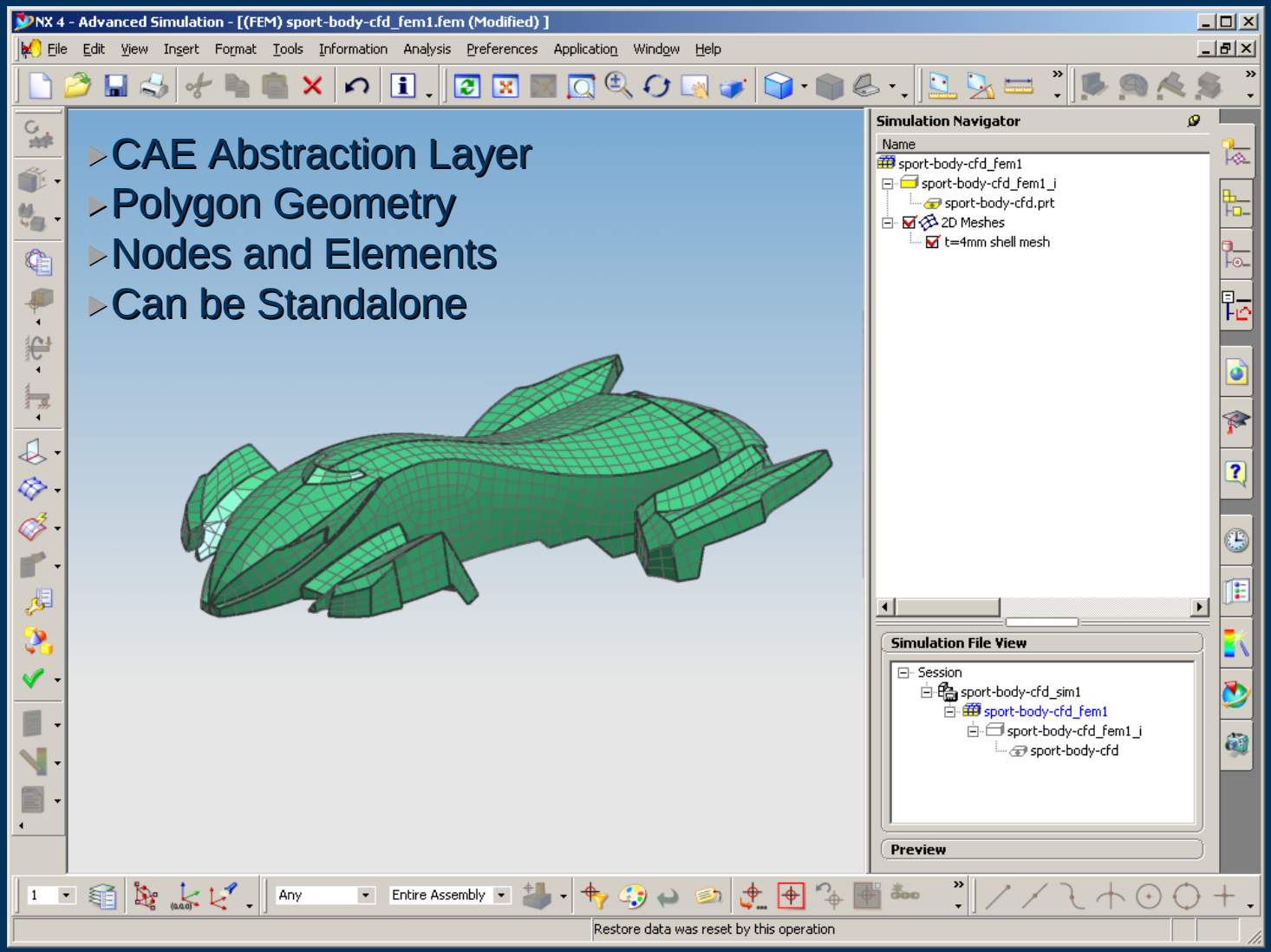
# File Structure - .prt file (Master)



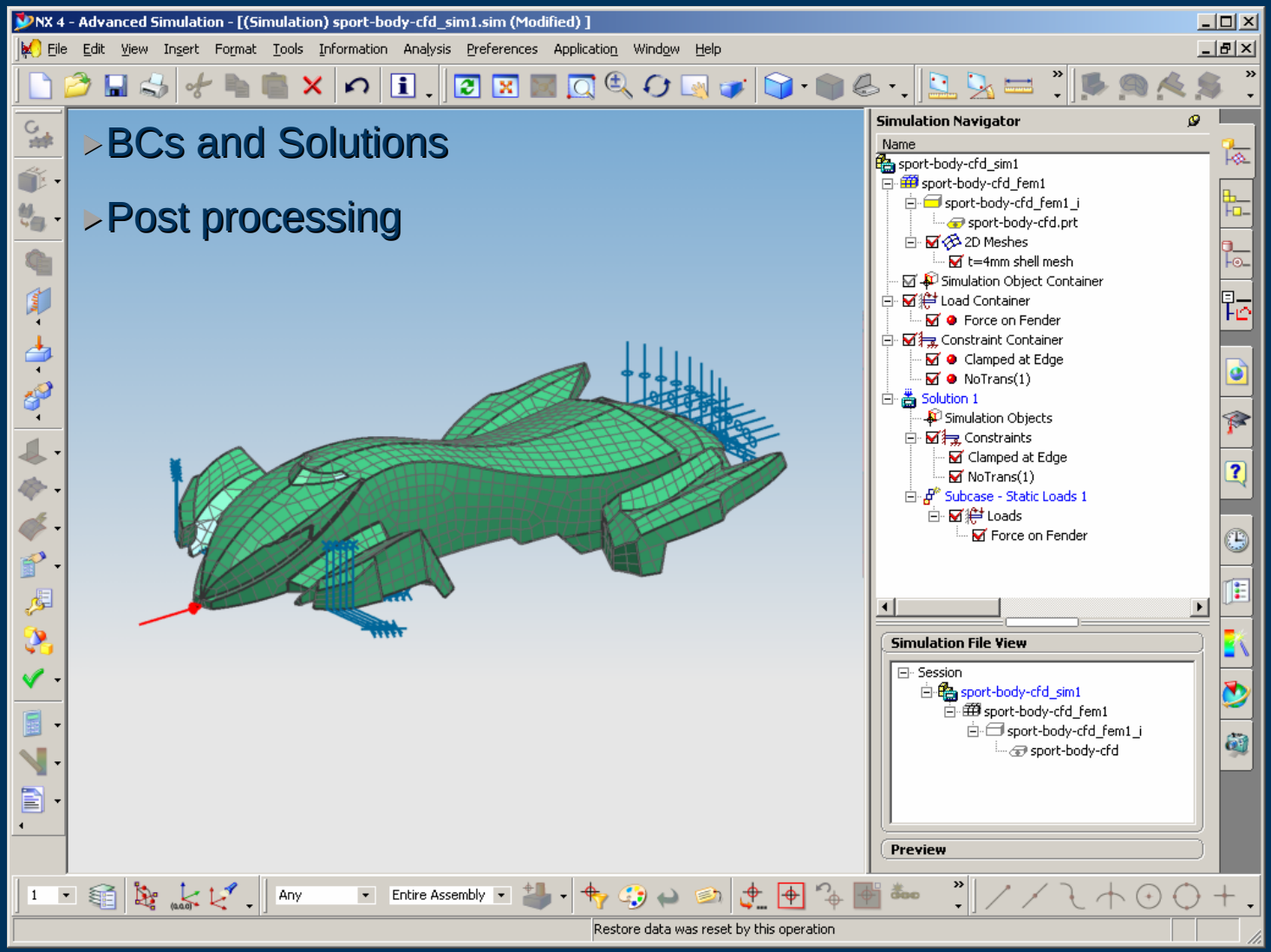
# File Structure - .prt file (Idealized)



# File Structure - .fem



# File Structure - .sim



# Working with Multiple Parts

| Part / Capability | Master Part | Idealized or Master Part | FEM | SIM |
|---|---|---|---|---|
| De-feature | Yes, if modifyable | Yes | | |
| Idealize | Yes, if modifyable | Yes | | |
| Create Mesh | | | Yes | |
| Physical Properties | | | Yes | Yes (override) |
| Material | Yes, if modifyable | Yes | Yes | Yes (override) |
| Abstraction Commands | | | Yes | |
| Connections | | | Yes | |
| Loads | | | | Yes |
| Constraints | | | | Yes |
| Solutions | | | | Yes |
| Meta Solutions | | | | Yes |

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# Distributed File Architecture Benefits

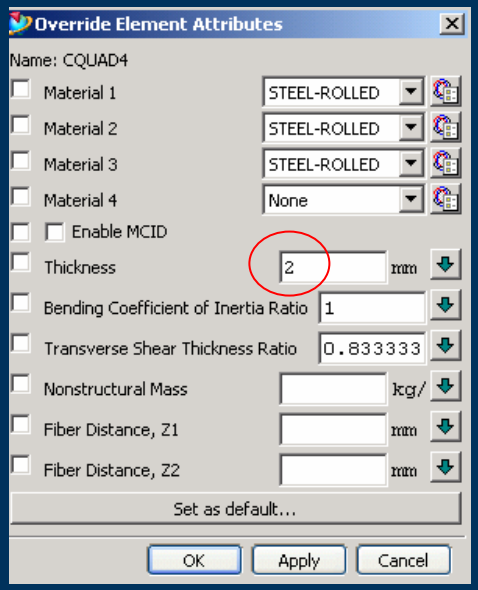
- Direct open of SIM, FEM
  - FEM and SIM are “real” NX Parts
  - Preview to see what is being opened  (also in TcE)
  - Double click from Windows to open
  - Drag-and-drop FEMs and SIMs into NX
- FEM re-use – multiple SIM, same FEM
- FEM and SIM versioned independently
  - Allow concurrent development of SIM and FEM
  - Allow for distributed FEM and SIM development

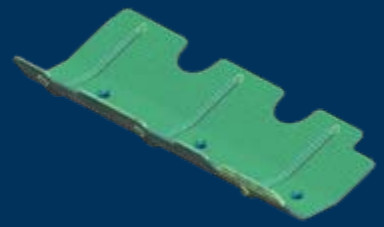
# Distributed File Architecture Benefits

- Navigator displays data pertinent to the active file (FEM, SIM, PRT)
- SIM overrides available (FE Studies)
  - Material, physical, associated element data, etc.
  - Display options (mesh display, FE display)
- Create FEM without CAD data
  - Import FEM data
- Load FEM without CAD data loaded
  - Save memory for the mesher, create bigger meshes on 32bit machines
- Laying foundation for assembly FEMs

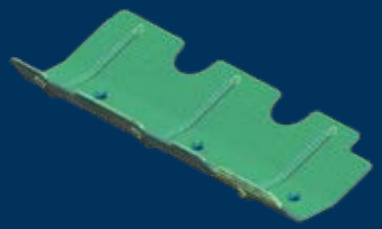
# Distributed File Architecture Benefits

- The SIM supports overrides (FE Studies)
  - Override display options (mesh display, FE display)
  - Override Element Attributes:
    - Material
    - Physical Properties

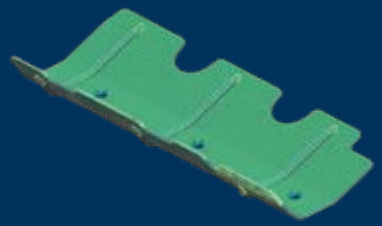


FEM1 – no thickness set



SIM1 – 2mm steel



SIM2 – 2.5mm steel

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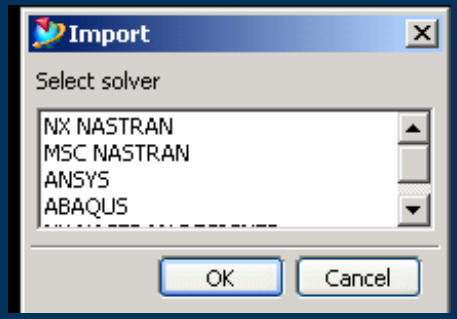
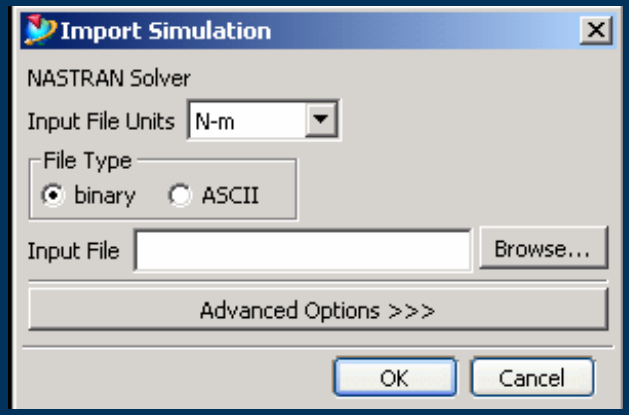
# Distributed File Architecture Benefits

- Larger Models, Better Performance
- NX 4 FEM database architecture designed for easy manipulation of large models
  - Pre/post support for millions of DOF
  - Ever shrinking element sizes and less CAD idealization
  - Increasing assembly model sizes
  - 64-bit solver executables set the bar for pre/post
  - 64-bit pre/post supported in NX where applicable

# Import/Export solver decks

- Import:
  - Import creates a new FEM and SIM.
  - Nastran *.dat and *.op2
  - Abaqus: *.inp
  - Ansys: *.inp
- Export:
  - Export from FEM or SIM
  - Nastran
  - Abaqus: *.inp
  - Ansys: *.inp

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# NX 4 CAD Geometry Idealization

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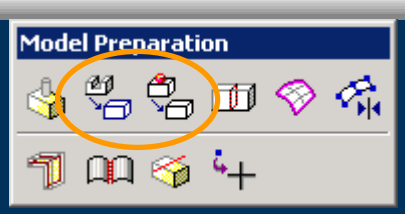
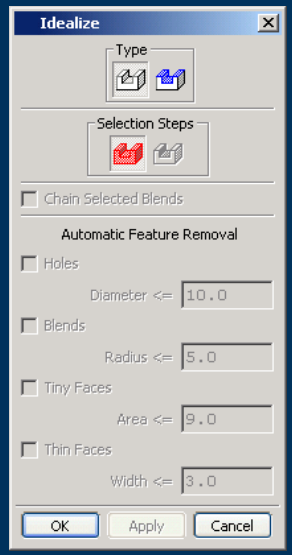
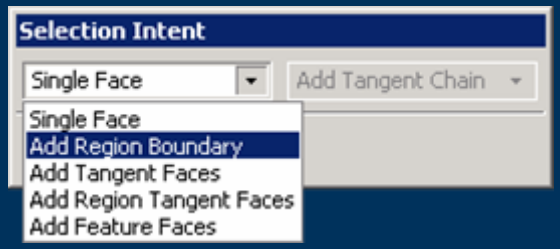
# Idealize

- Idealize Geometry commands work on promoted copy of Master Model without affecting it
  - Plane cuts for symmetrical bcs
  - Midsurfacing
  - CAD feature removal (holes, blends)
    - Doesn't need part history
- Defeature Geometry command
  - The "Defeature Feature"
  - Lets you pick a geometric feature, typically a boss, using Selection Intent, then removes the faces and closes boundary
  - Selection Intent provides a mean of selecting a group of faces with a similar characteristic

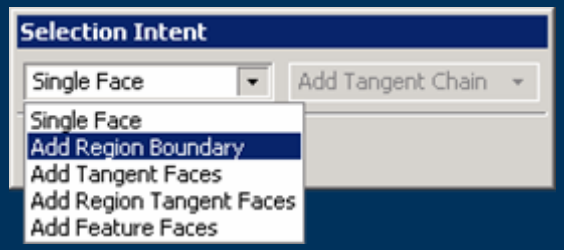


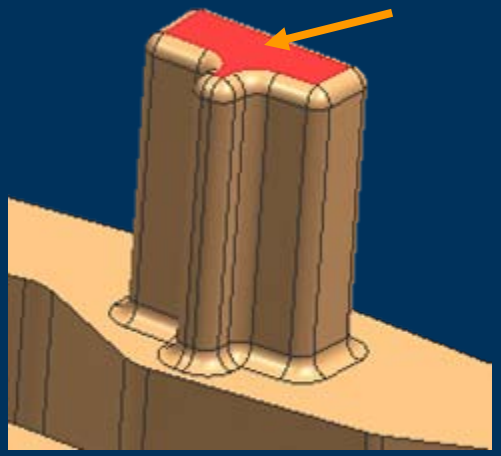



# Idealize Example

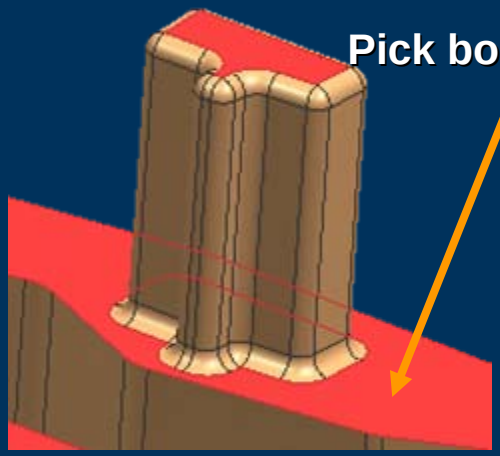
- Using Defeature Geometry with Selection Intent

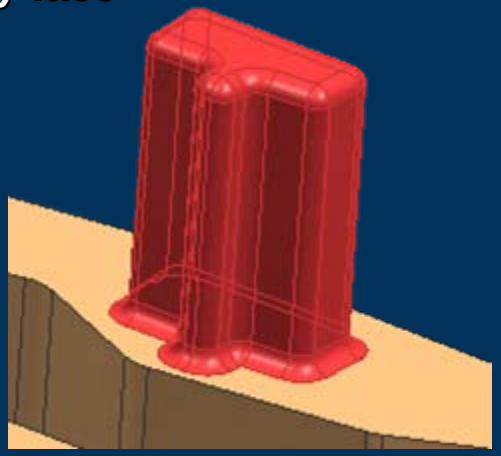



**Pick outermost face as seed**



**Pick boundary face**





**Click middle mouse button to see selected faces**

**Resulting "Defeature"**

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# NX 4 CAE Meshing

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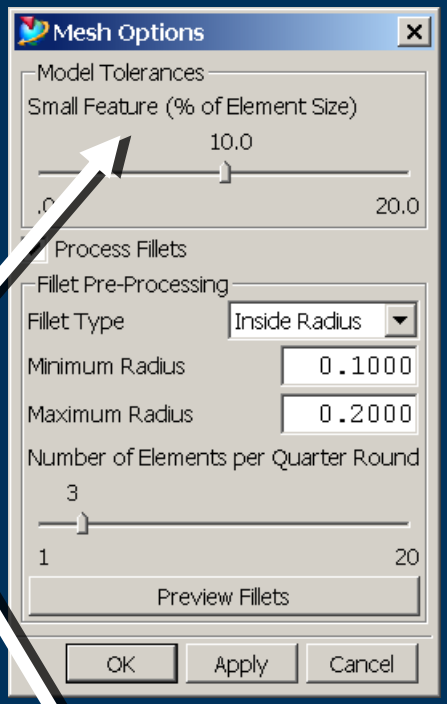
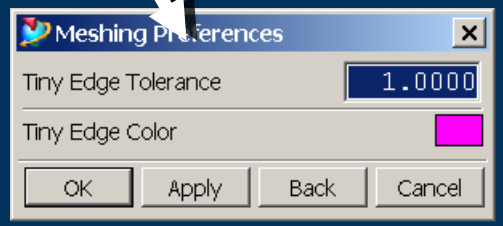
# Meshing “Smart Abstraction”

- Topology abstraction is automatically done during mesh generation
  - Abstraction tolerance is a user controlled percentage of element size or meshing tiny edge tolerance (which ever is smaller)
  - Local/global abstraction dictated by local/global meshing
- Optional fillet detection and fillet mesh size



# Meshing “Smart Abstraction”

- Smart Abstraction, what is it doing?
  - Starts with tessellation from Parasolids
  - Stitches tessellations to make watertight
    - A watertight solid may not have watertight tessellations if a self intersecting surface is present, this will also show up in shading
  - Collapses geometry depending on element size or tolerance
    - Won’t modify face with BCs defined
  - Uses I-deas TriQuaMesh 2D surface meshing to surface coat
    - No surface curvature limitations, it looks at surface curvature, if too extreme it uses NTI flattening
    - Will reduce element size if needed to succeed
    - If you are having trouble meshing, you can manually 2D mesh a surface to seed the 3D mesher
  - Uses I-deas Delauney 3D tet meshing to fill volume

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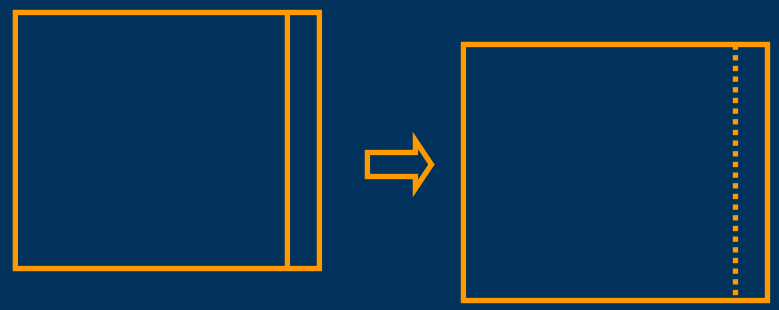
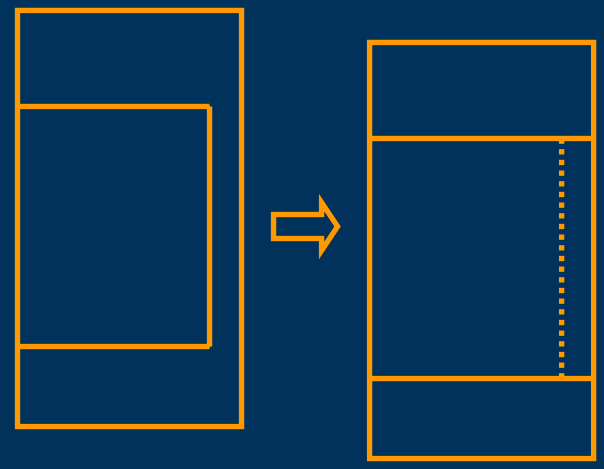
# Meshing “Smart Abstraction”

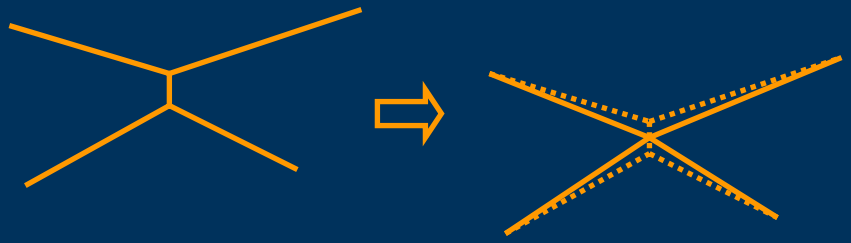
- Smart Abstraction, what is it doing to the geometry?
  - Looks for small (for meshing at least) geometry and fixes
  - Small geometry size is set by user



**Auto Merge Slivers**



**Auto Pinch Isthmus Surfaces**



**Auto Collapse Connectors**

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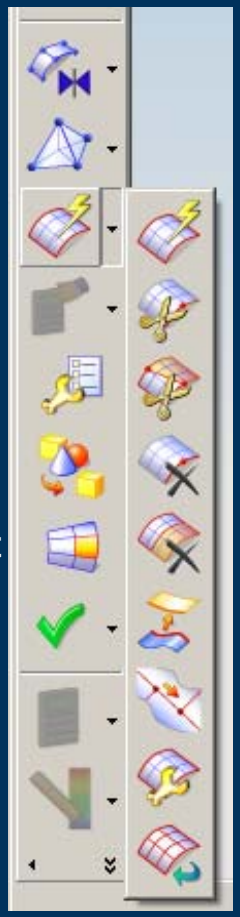
# CAE Topology

- CAE topology acts as layer between CAD and mesh
  - CAD acts as reference for CAE topology
  - Meshing performed on CAE topology
- NX 3 solid free meshing employed automated abstraction techniques
  - No user control or access to CAE topology
- NX 4 provides access to manual abstraction tools
  - Improve mesh quality by eliminating problem geometry
  - Define boundaries for loads and constraints

# NX – I-deas Comparison

- No need to Auto Create, sections are already there



- Auto Heal – Auto Merge Section, Auto Collapse Short Curve and Auto Collapse Narrow Area all wrapped into one
- Split Edge – Add Connector
- Split Face – Add Curve
- Merge Edge – Remove Connector
- Merge Face – Remove Curve
- Match Edge – Replace Curve
- Collapse Edge – Replace Connector
- Face Repair – Patch Create
- Reset

- Show Only
- Display Adjacent

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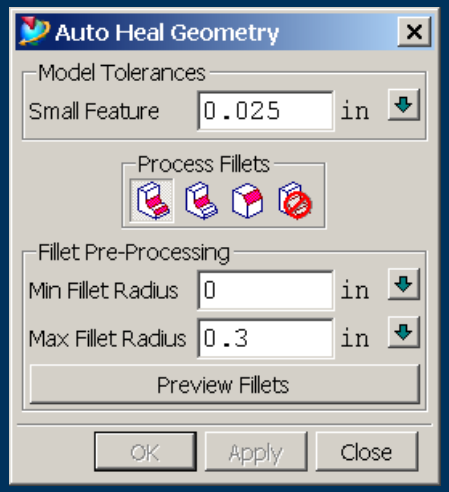
# CAE Topology Toolbar Commands

- "Auto Heal" automatic abstraction command
  - This step is done during meshing, but hidden to user
  - Tolerance is a length rather than percent of element size
  - If done here first, meshing will not abstract again



# CAE Topology Toolbar Commands

- Split edge
  - Enforce a node where the edge is split
  - Vertex (end of edge) selectable for boundary conditions
- Split face
  - Enforce a mesh feature line where face is split
  - Split face selectable for meshing, boundary conditions
- Undo capabilities within command via cancel on command toolbars

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# CAE Topology Toolbar Commands

- Merge Edges
  - Combine two edges into one
    - Primarily for creating larger mesh boundaries
- Merge Faces
  - Combines two faces into one
    - Primarily for creating larger mesh areas
    - Default automatically merges edges connected to edge being removed
- Undo capabilities

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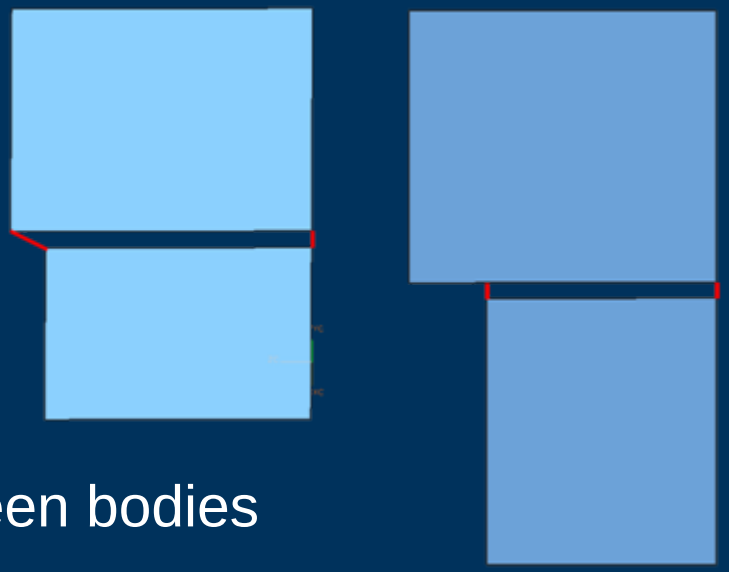
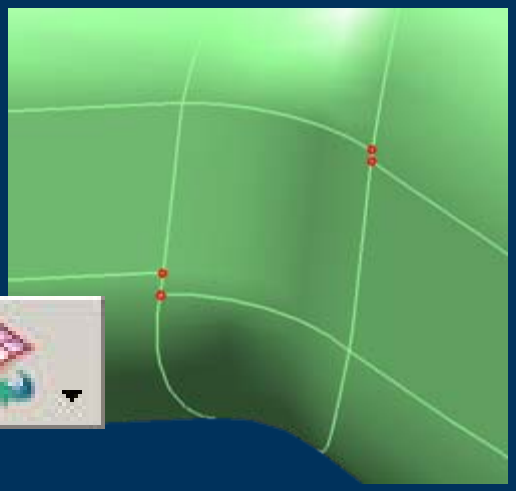
# CAE Topology Toolbar Commands

- Match Edges
  - Sews unstitched faces
    - Match edge 1 to edge 2
    - Project edge 1 into edge 2
  - End result is a stitched mesh between bodies



- Collapse Edge
  - Manually remove short edges
- Undo capabilities



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# CAE Topology Toolbar Commands

- Face Repair
  - Create mesh faces from loops
  - Needed if Parasolids tesselation fails
- Reset
  - Returns selected CAE faces back to original state
    - Original state is a 1-1 match of CAE faces to CAD faces
  - ***It's very important to consider using Reset before remeshing or CAD modifications***

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# Workflows for Solid Meshing

- Verify you have a watertight solid body
  - Use CAD tools for repair if needed

- Just Mesh It
  - Meshing will automatically abstract everything the same amount
  - Works very well
  - Once this is done, part is abstracted, *even if mesh is deleted*
    - Need to Reset before doing additional abstractions

*Or*

- Use Auto Heal to selectively control abstraction on groups of faces

*And/Or*

- Use Merge and Split commands to manually control abstraction
  - Use triangles to seed mesh if needed

- Use Model Check to look for large Aspect Ratios
  - NX Adv Sim “Tet Collapse” = NX Nastran “Aspect Ratio”
  - Keep below 100, display labels to highlight bad spots and fix
- May need to Reset before updating CAD
  - CAE model regeneration may fail if abstractions are present
- Nastran complains about just a few elements?
  - Manually delete them from the deck, often “Postage Stamp” elements

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# Workflows for Solid Meshing

- For very large solid models, Just Mesh It
  - Watch for it struggling during “Surface Remeshing in Progress”
  - NX 4 will highlight bad surfaces, these are usually due to bad topology in the CAD model
  - Rather than repairing bad topology using CAE abstractions, it may be easier to use CAD tools to boolean in a small body or surface to patch it
    - This can be done on the Idealize part
  - Patch doesn’t have to be precise, if small faces remain, the mesher will ignore them
  - May need to “seed” faces with 2D triangles prior to volume mesh

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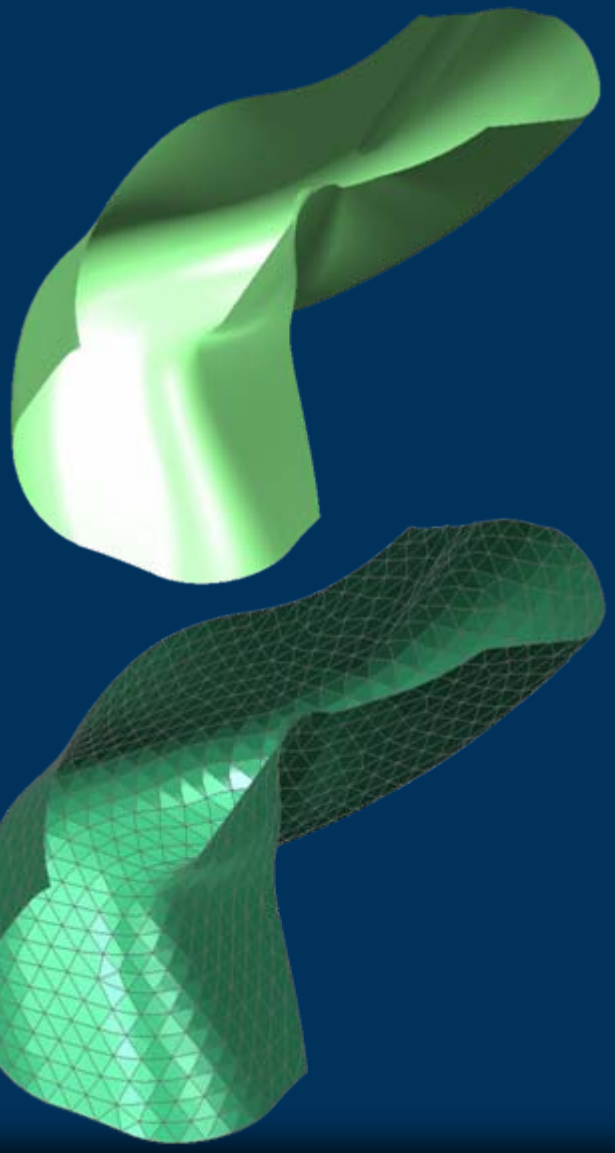
# Highly Curved Surface Mesh Techniques

- NX 4 delivers a 2D mesher that relies on a set of domain generation techniques
  - Parameter space, maximum area plane
  - Unwrapping
- NX 4 follows a progression to generate a suitable mesh



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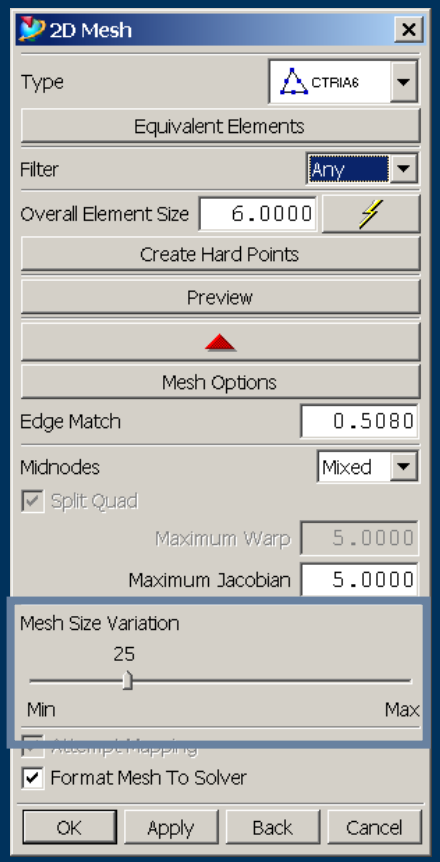
# 2D Meshing Enhancements

- Surface curvature effect
  - Mesh Size Variation active in NX 4 surface and solid meshing
    - Increasing slider results in more elements along curved surfaces
    - Maximum reduction is 0.1 * element size
    - Intent is to produce a better quality mesh
- Mapped meshing with triangles

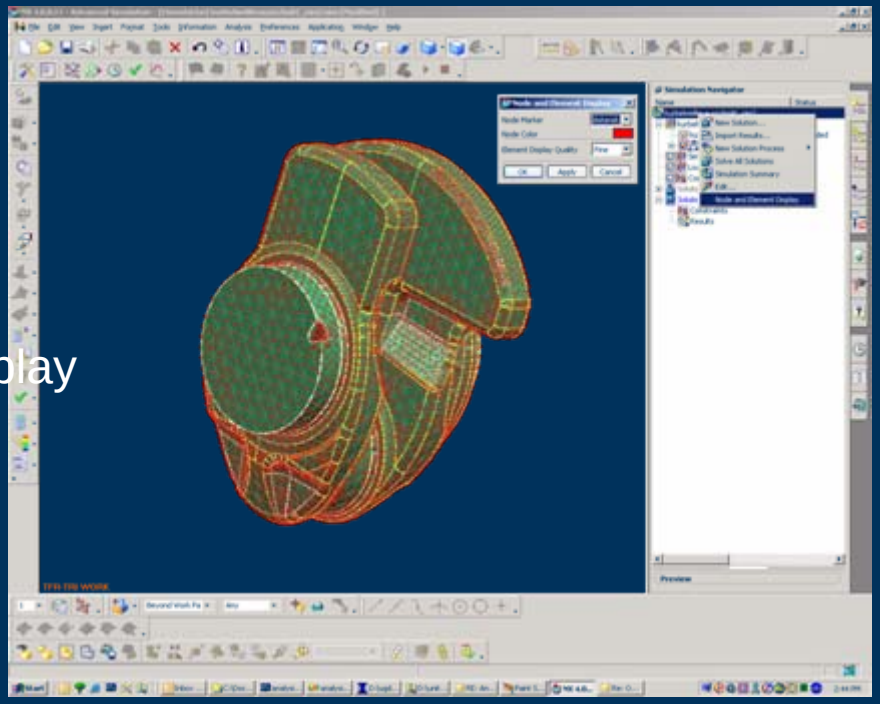


# Meshing Robustness

- NX 3 3D swept meshing limited to source and target CAD edges having a 1-1 mapping
  - No longer a limitation in NX 4 since a single CAE edge can represent multiple CAD edges
- Mesh mating improvements
  - Now managed in Simulation Navigator
  - Mesh mating producing better results
    - Imprint of overlapping faces onto each other

# Node and Element graphics

- Improved graphics:
  - Node graphics (not in NX3)
  - Better element graphics (3 quality settings)
  - More control over graphics
  - Enabled through navigator
- Set node and element graphics from:
  - FEM or SIM node
  - Preference / node and element display
- Node Graphics:
  - Shape / color
- Mesh graphics:
  - Element display Quality



# NX 4 CAE Boundary Conditions

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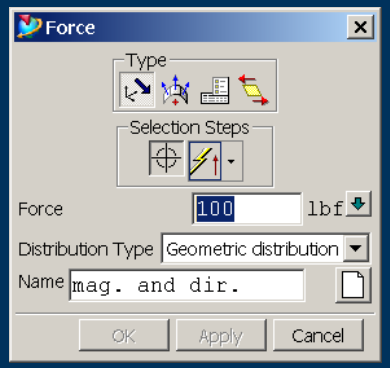
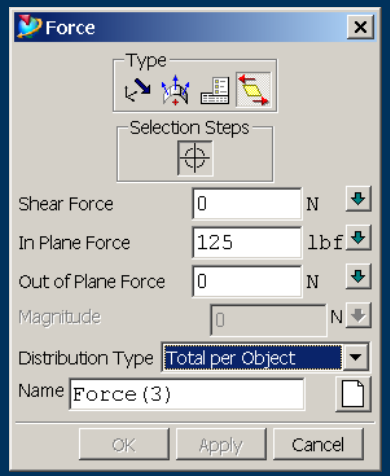
# Load Creation

- More ways to define forces
  - Force total load distributed over multiple geometric entities or as a total load per geometric entity
  - Force direction options
    - Defined by vector selection
    - Normal to geometry
    - Components of a coordinate system
    - Edge force direction in terms of face
      - in plane, out of plane, shear

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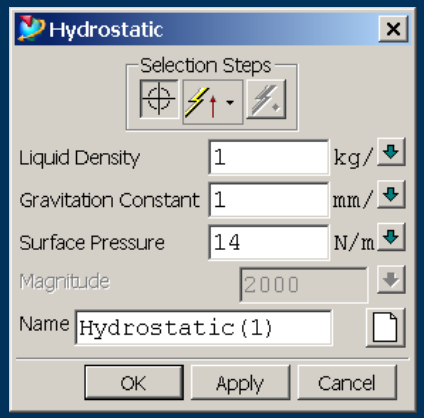
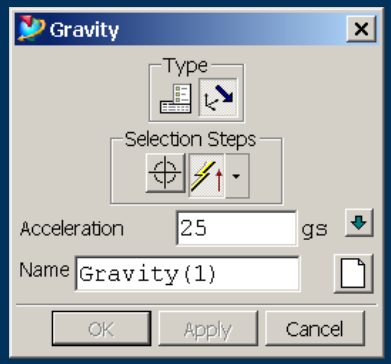
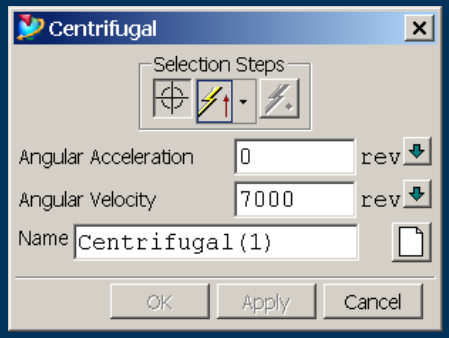
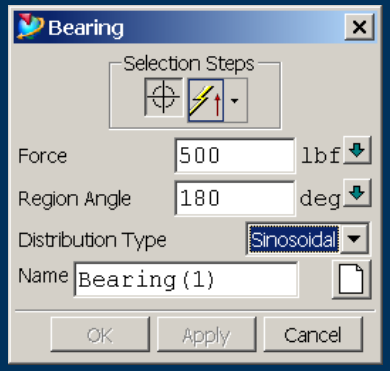
# Load Creation

- New ways to create loads
  - Hydrostatic pressure
- UI improvements
  - Gravity, centrifugal
    - Direction by vector selection
  - Centrifugal
    - Select geometry (ABAQUS)
  - Bearing
    - Compact version of NX 3 UI

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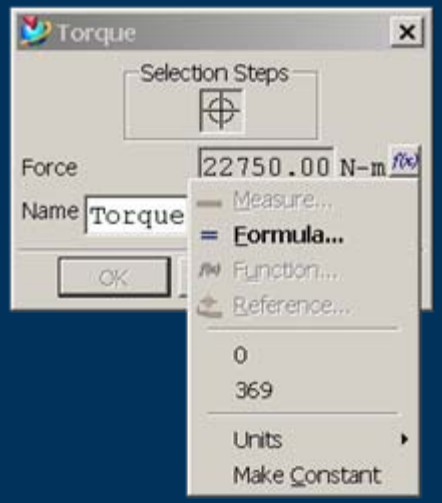
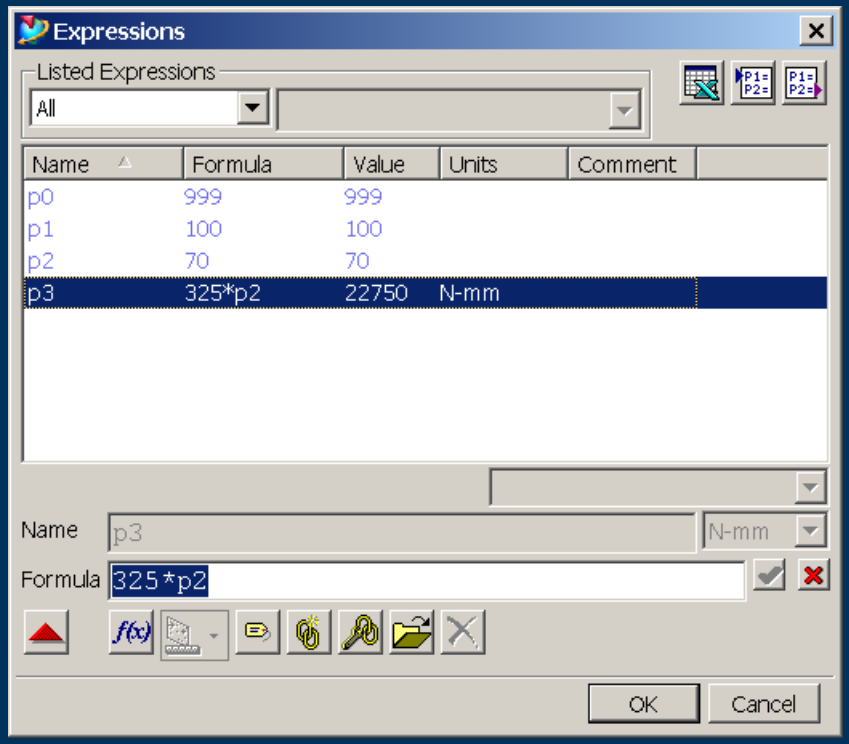
# Load Creation

- Define amplitudes in terms of NX expressions or functions

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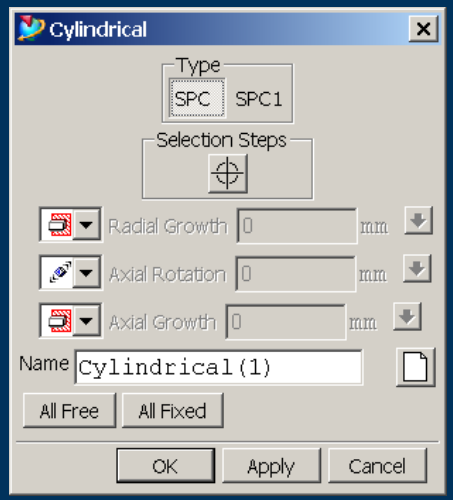
# Constraint Creation

- Several canned constraint types
  - Fixed, slider, cylindrical, planar, etc.
    - Vector selection to define appropriate direction
- Pull down for free, fixed, enforced



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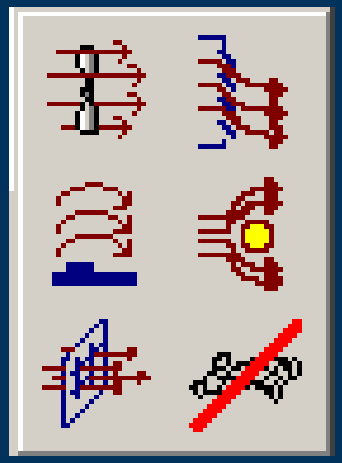
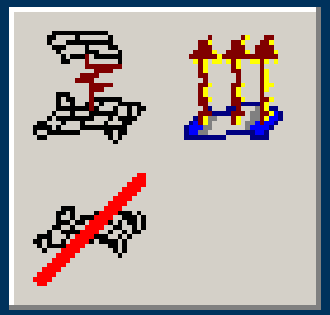
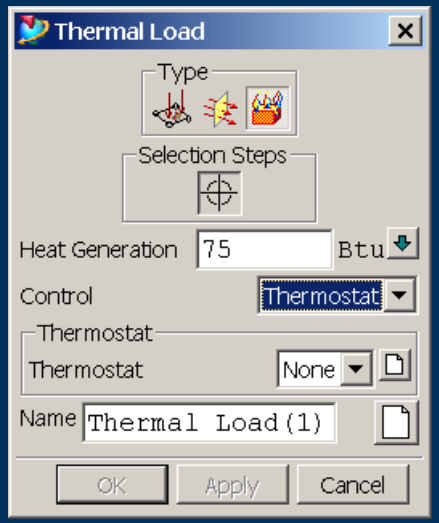
# Flow and Advanced Thermal

- Flow
  - Fan
  - Vent
  - Flow surface
  - Flow blockage
  - Screen
  - Deactivation set
- Thermal
  - Thermal coupling
  - Radiation
  - Deactivation set
- Thermal loads
  - Heat load
  - Heat flux
  - Heat generation





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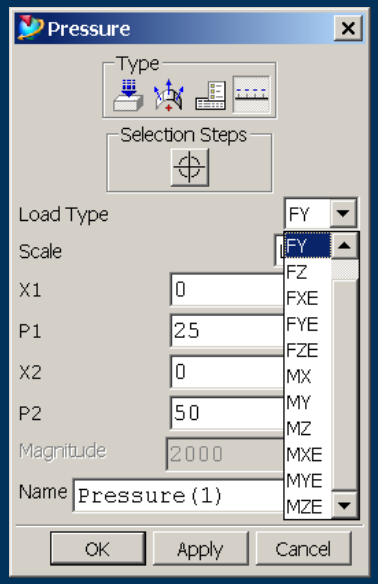
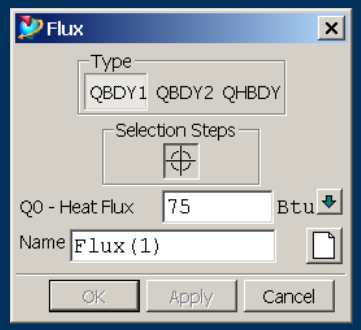
# More BCs…

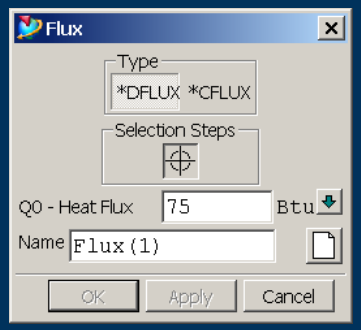
- New thermal load types
  - Radiation, heat generation

- Beam distributed loads

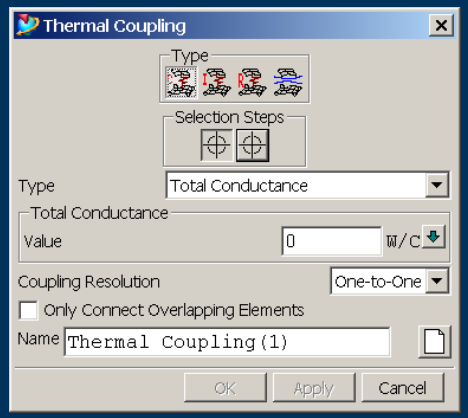


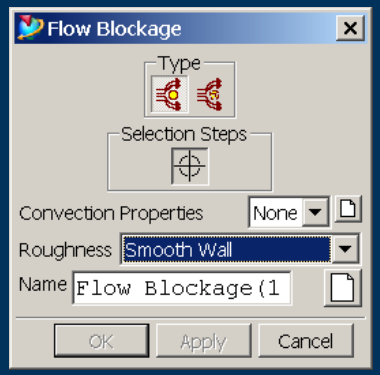

- Solver language terminology




- Solver specific objects

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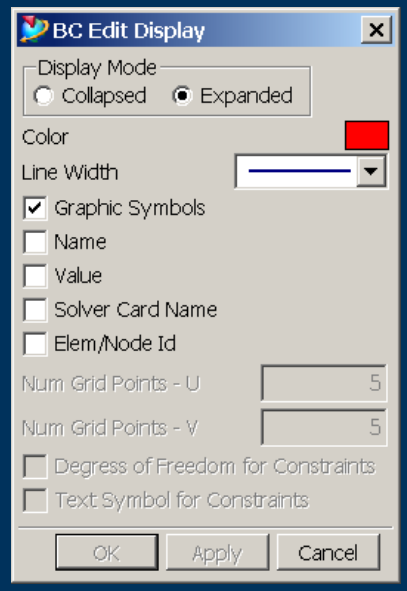
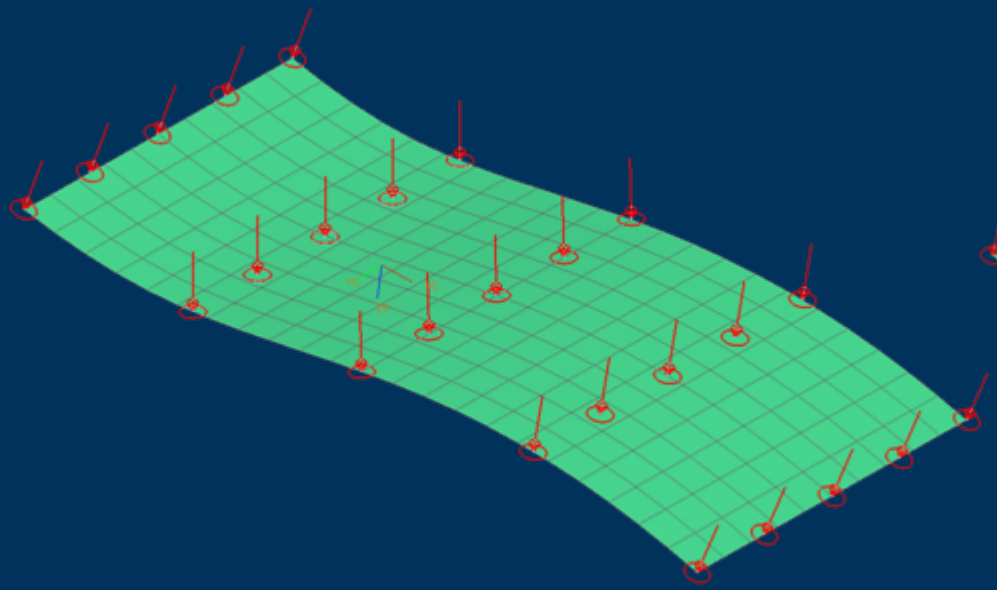
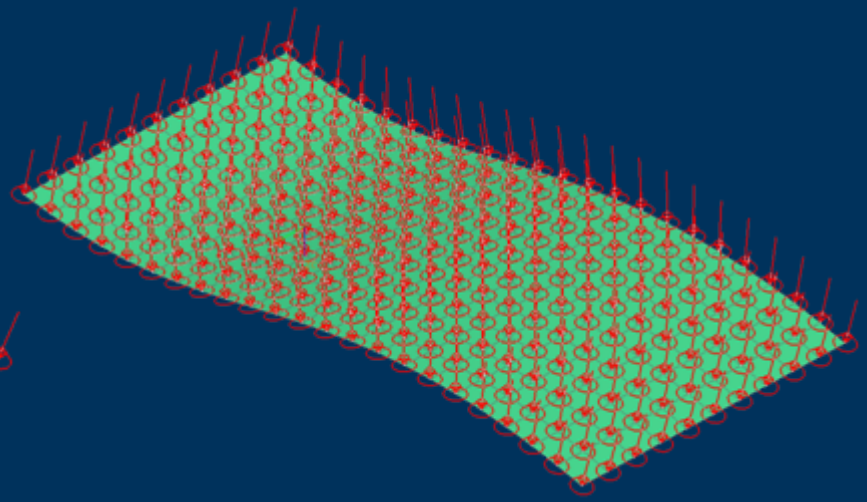
# BC Display

- Display geometry based BCs distributed over geometry or expanded to FE entities
- Display amplitude value, name, etc.
- Edit multiple selection display properties without affecting amplitude!





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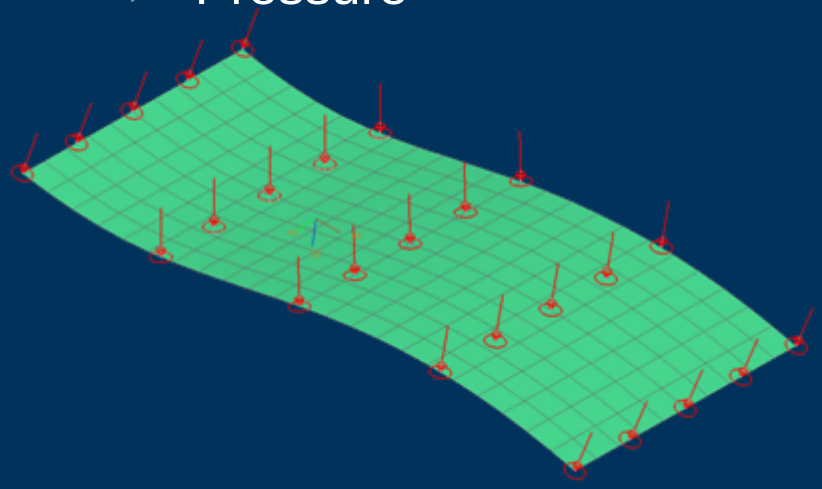
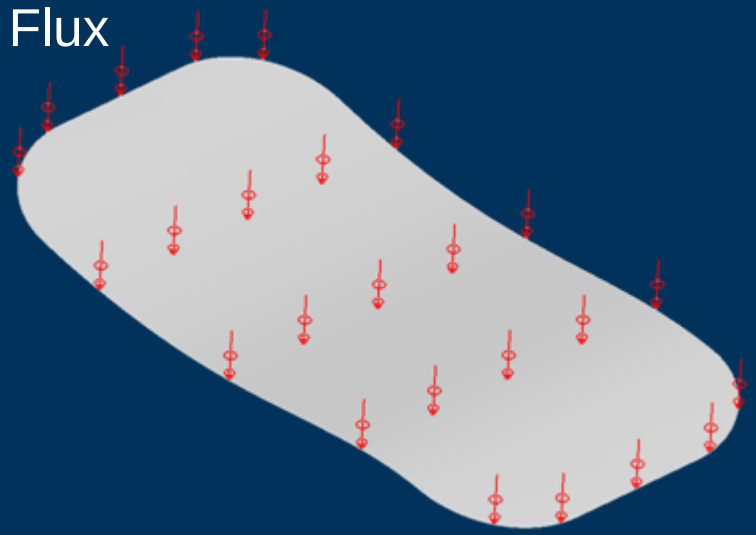
# BC Display

Meaningful arrow representations

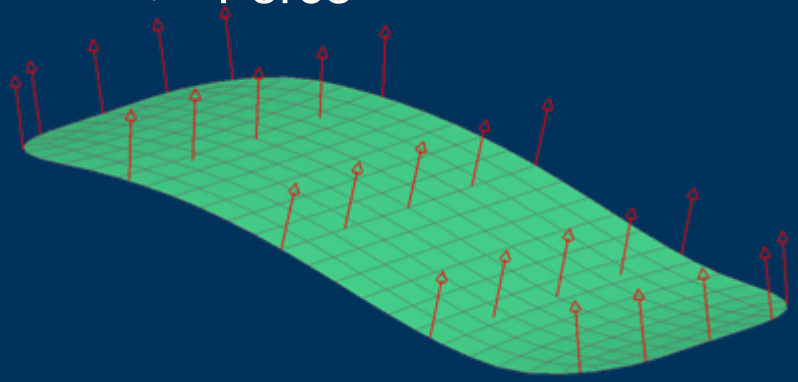
- Pressure



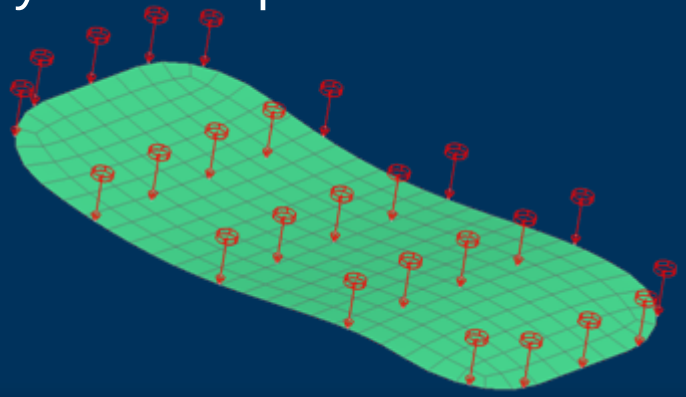
- Flux



- Force



- Hydrostatic pressure



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# NX 4 CAE Internal Solvers

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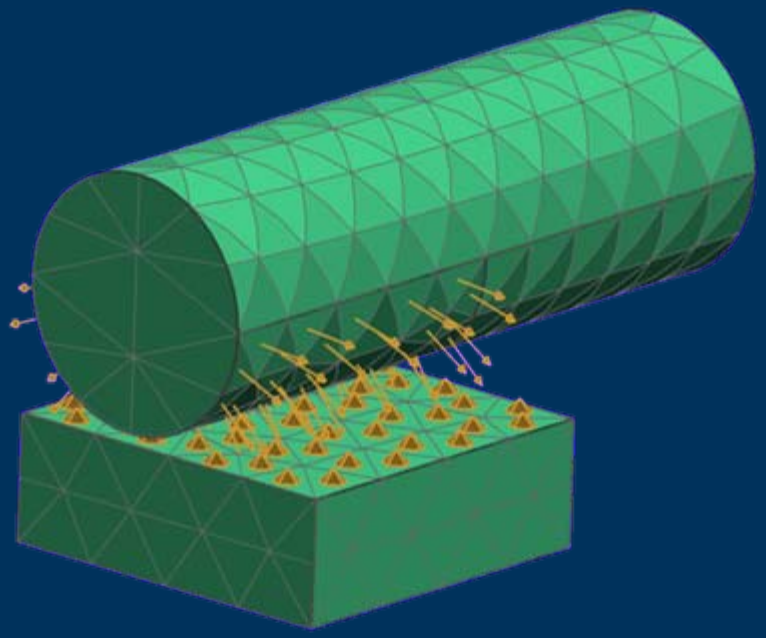
# Contact Solutions

- NX 4 contact
  - NX NASTRAN linear statics surface-surface contact pre/post
  - NX NASTRAN advanced nonlinear surface-surface contact
  - Abaqus surface-surface contact
  - Post processing support of NX NASTRAN contact results



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# Advanced Nonlinear Solution

- Initial support of NX NASTRAN advanced nonlinear
  - Transient loading
  - Large displacement/strain
  - Solution time step definition
  - Surface-surface contact
  - Transient results post processing

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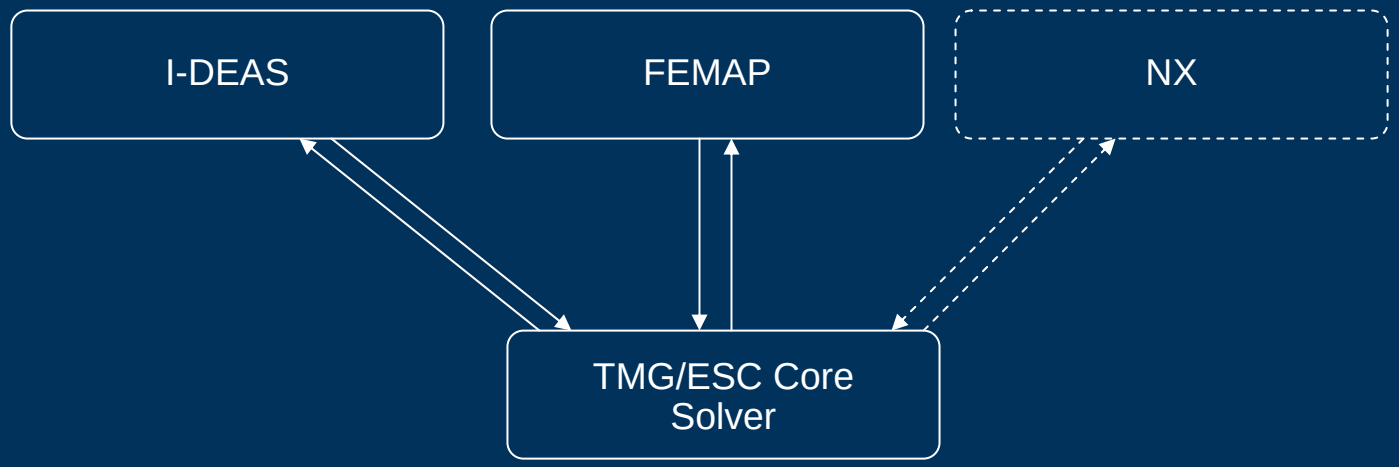
# Advanced Thermal and Flow Analyses

- Use the existing TMG and ESC solver code as the basis for a new set of fluid flow and thermal analysis tools to be developed as modules of the NX CAE suite

- Full commonality at a solver level with I-DEAS TMG/ESC and FEMAP Thermal/Flow

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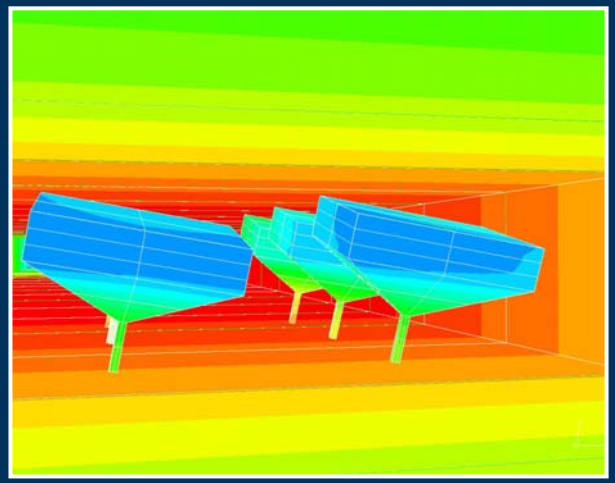
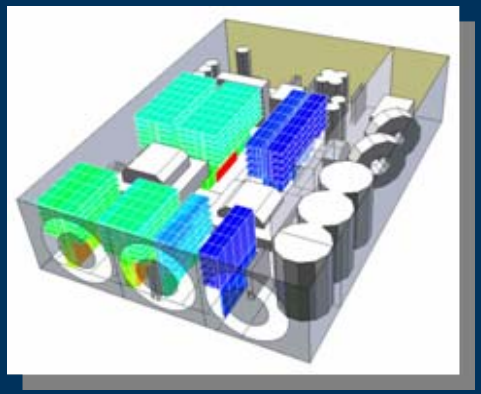
# NX Solver Products

- Thermal Stack:
  - NX Thermal
  - NX Thermal Advanced
- Flow Stack:
  - NX Flow
  - NX Flow Advanced
- Vertical Applications:
  - NX Electronic System Cooling
  - NX TMG Space Thermal





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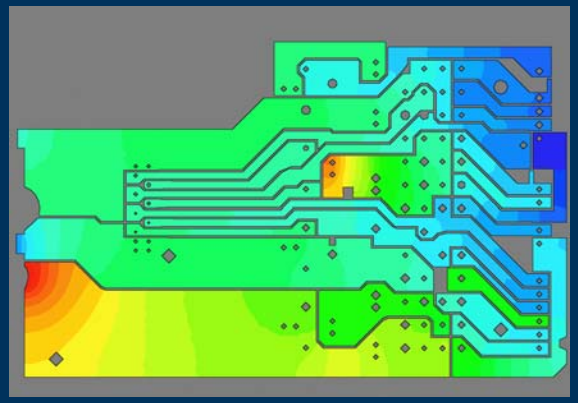
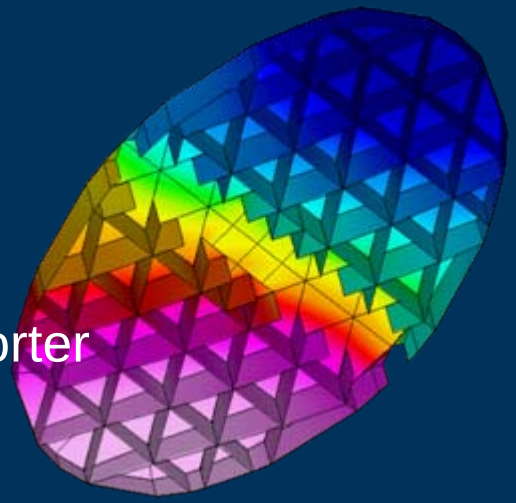
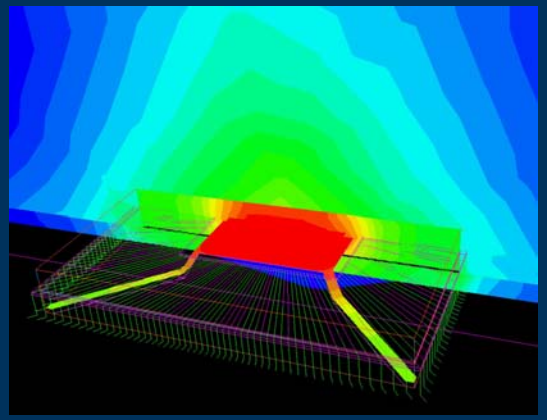
# NX Thermal

- Steady state and transient solutions
- Nonlinear material properties
- Thermal couplings
- Radiation
- Solution Restarts
- Axisymmetric modeling
- Temperature mapping
- Excel based results reporter







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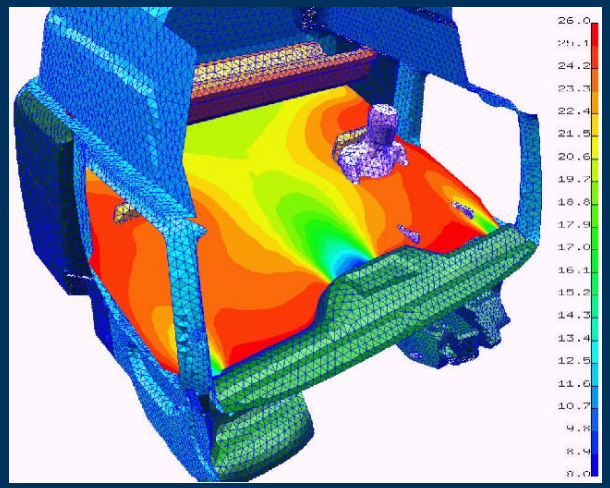
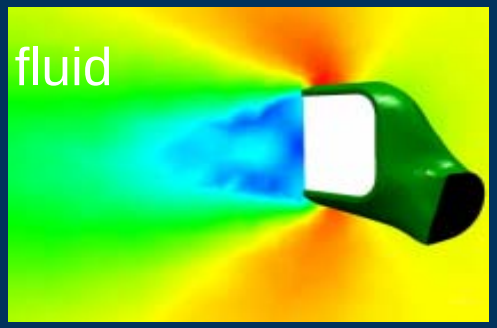
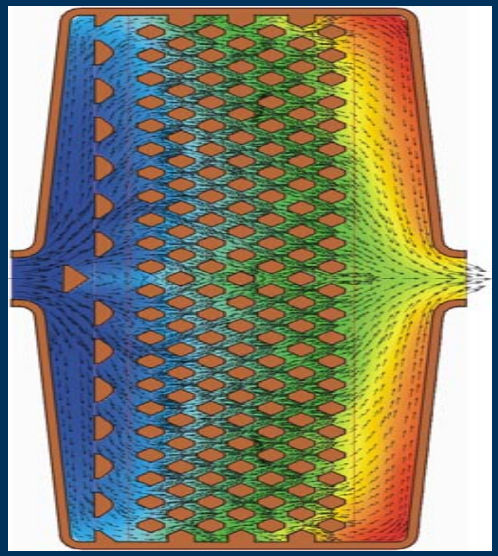
# NX Flow

- Steady state and transient solves
- Unstructured fluid meshes
  - Supports tets, bricks, wedges
- Multiple fluids
- Laminar and turbulent flow
- Heat loads and temperature restraints on the fluid
- Solid blockages, screens, baffles
- Support solutions of disjoint fluid meshes







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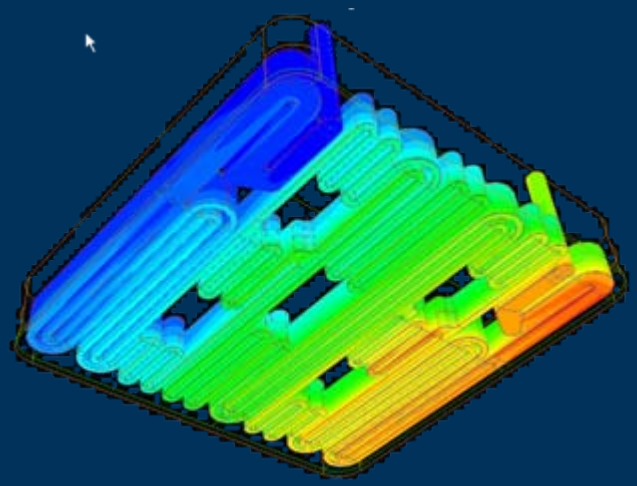
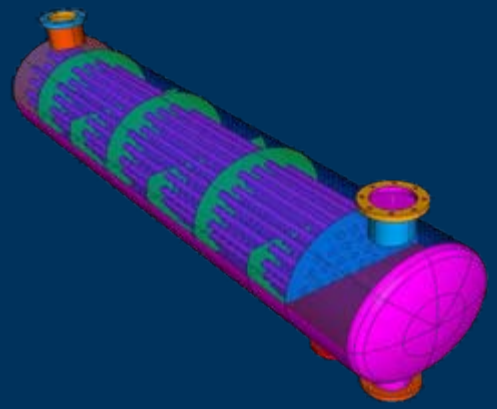
# Coupled Thermal Flow

- NX Thermal and NX Flow models can be fully coupled
  - Concurrent coupled solver
  - Forced and natural convection
  - Handles all types of conjugate heat transfer
  - Mesh can be fully disjoint at the fluid/solid boundaries





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# NX 4 CAE Post Processing

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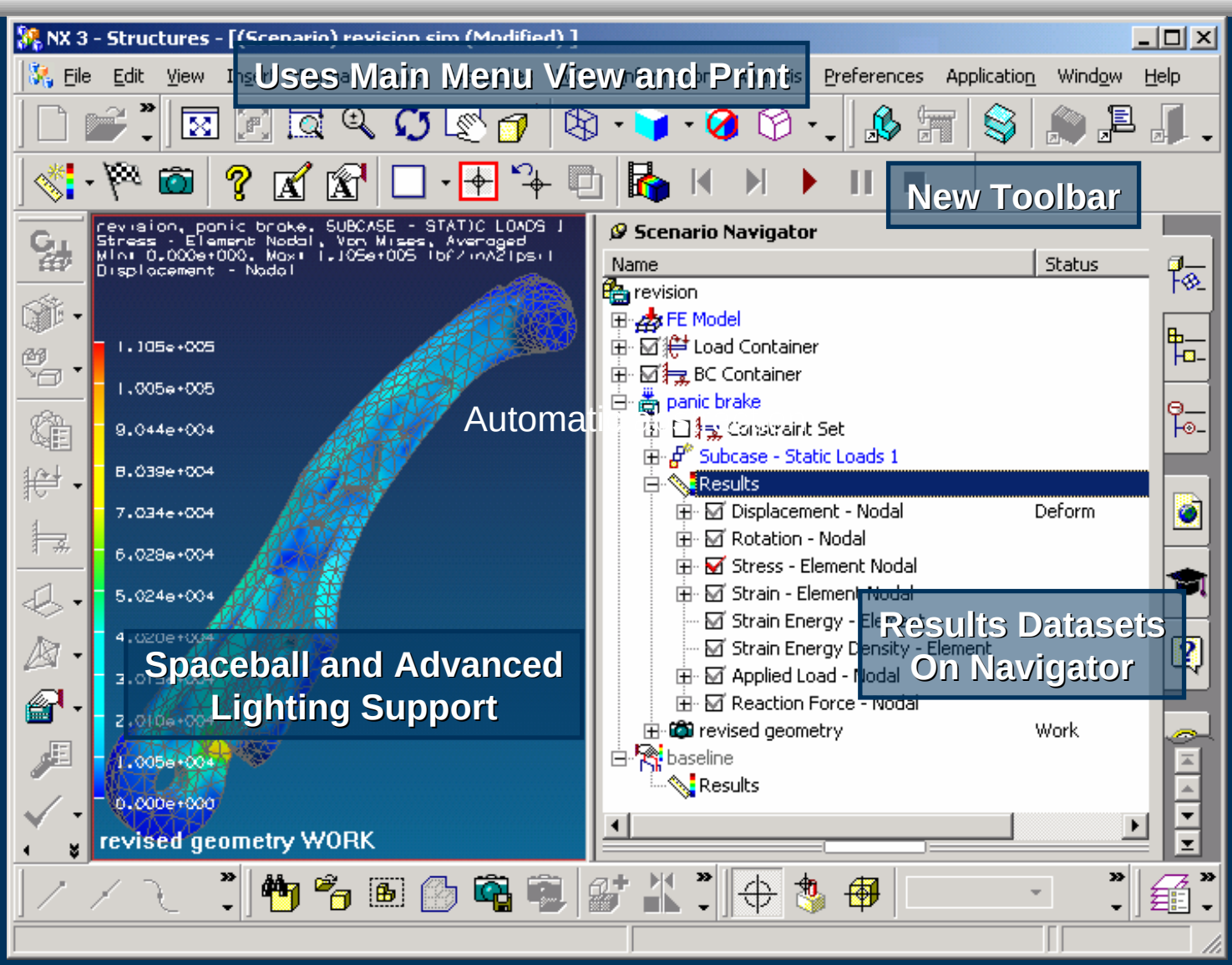
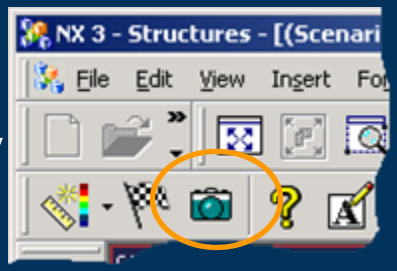
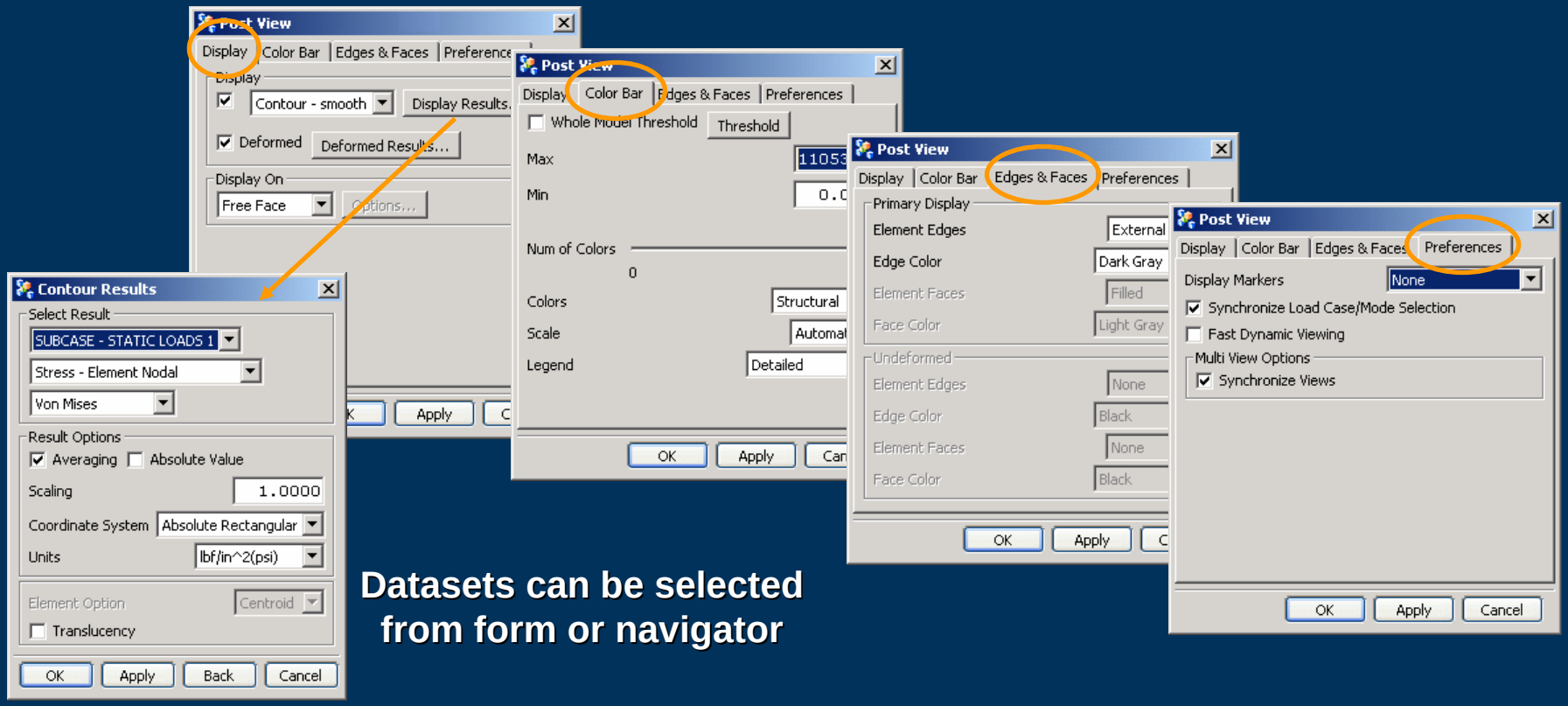
# Integrated Post Processing



# Integrated Post Processing

- Post View Icon opens up Results Selection and Display Options

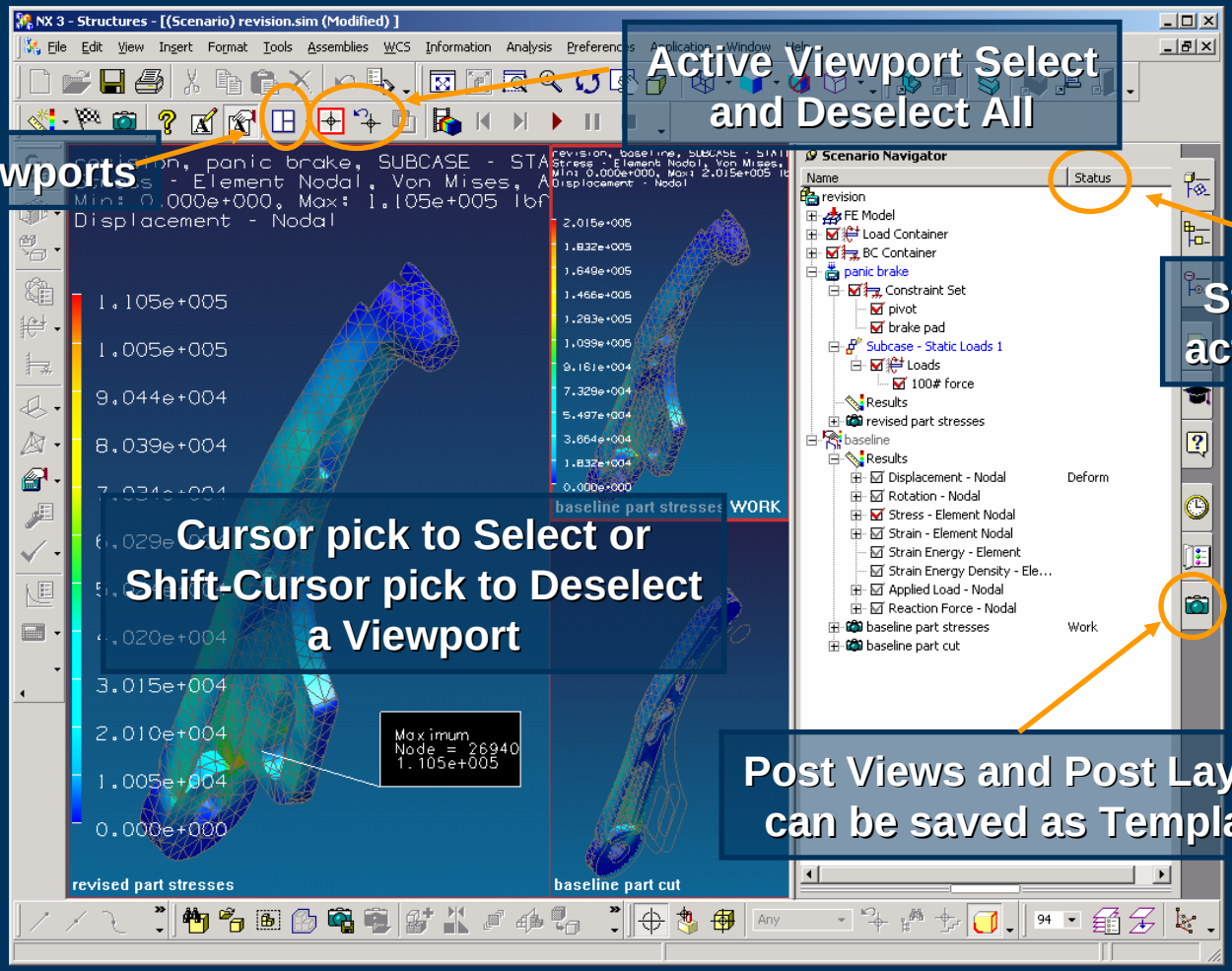



**Datasets can be selected from form or navigator**

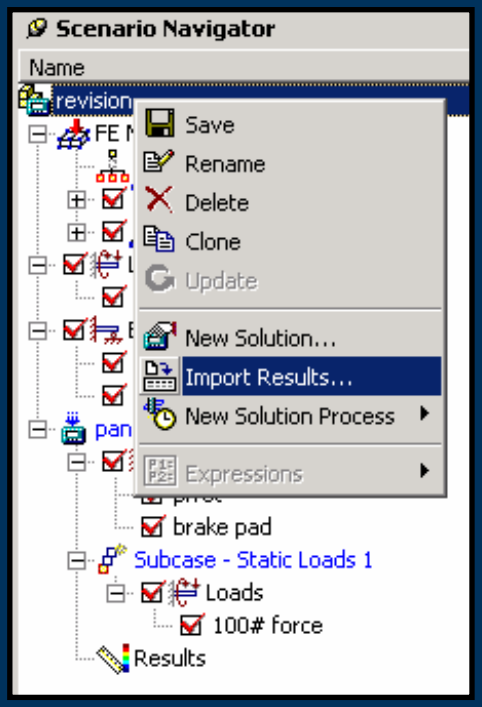
# Integrated Post Processing

- Multiple Viewport support



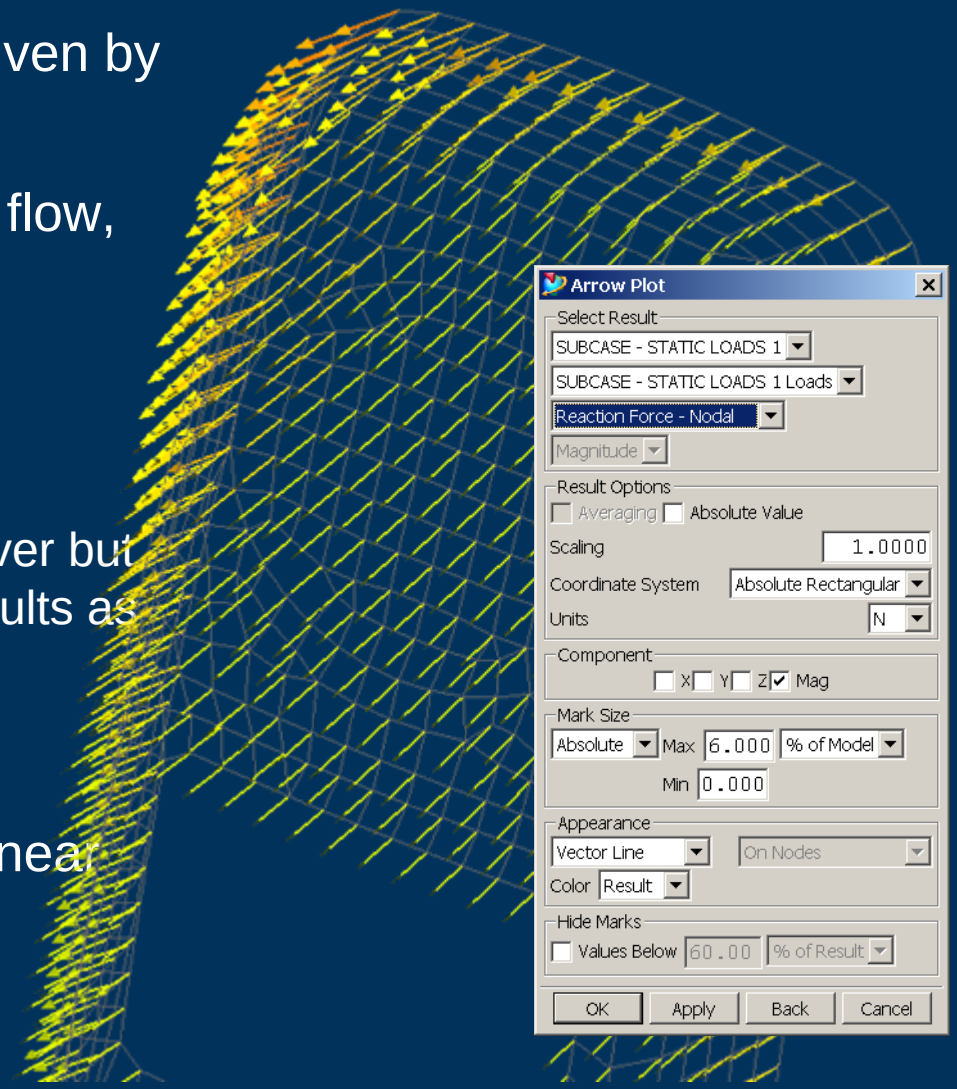
# Integrated Post Processing

- Import Results
  - Useful for comparing results
- Directly import…
  - I-deas .unv, .bun
  - Structures PE .vdm
  - Nastran .op2
  - Ansys .rst and .rth
  - Abaqus .fil
- No longer uses Auxiliary Scenario

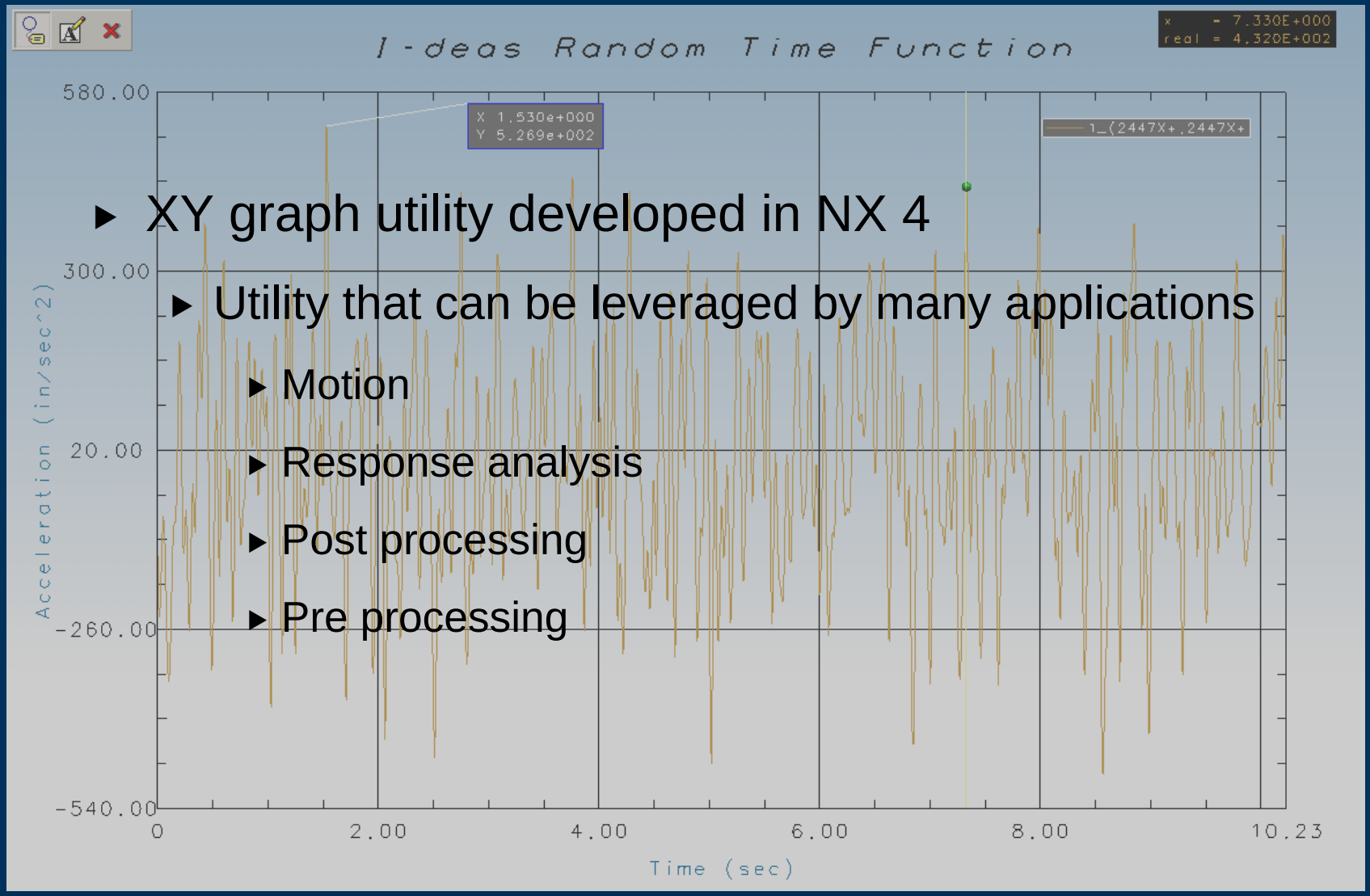


# Post Processing

- Post processing enhancements driven by new solutions supported by NX4
  - Transient results from thermal, flow, advanced nonlinear
    - Static display and animation
  - Arrow plots
    - Initiated by need from flow solver but benefits structural analysis results as well
  - NX NASTRAN contact results
  - NX NASTRAN Advanced nonlinear results



# XY Graphing




- XY graph utility developed in NX 4
- Utility that can be leveraged by many applications
  - Motion
  - Response analysis
  - Post processing
  - Pre processing

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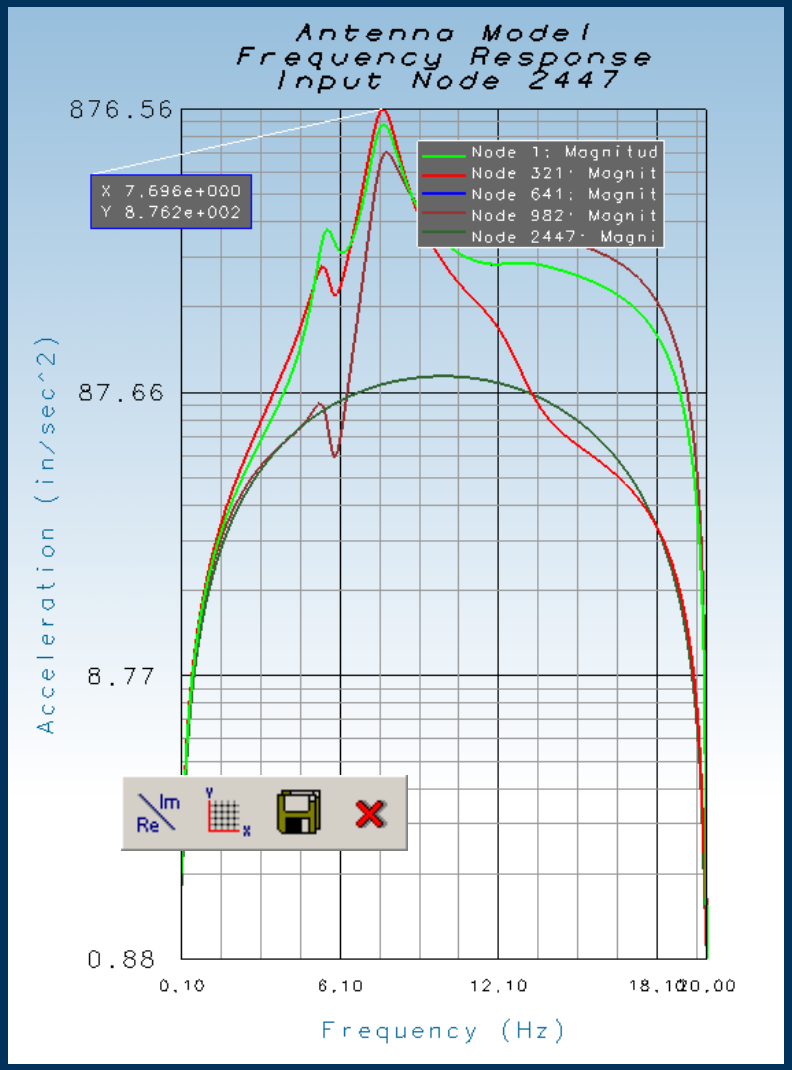
# XY Graphing




Graphing

- Edit via screen selection
- Real and complex
- Linear, log, dB
- Multiple-axes
- Overlay

Data Tracking

- Probing the data points on the curves

Windowing

- Zoom in/out

Multiple Views

- XY graphs w/ or w/o models

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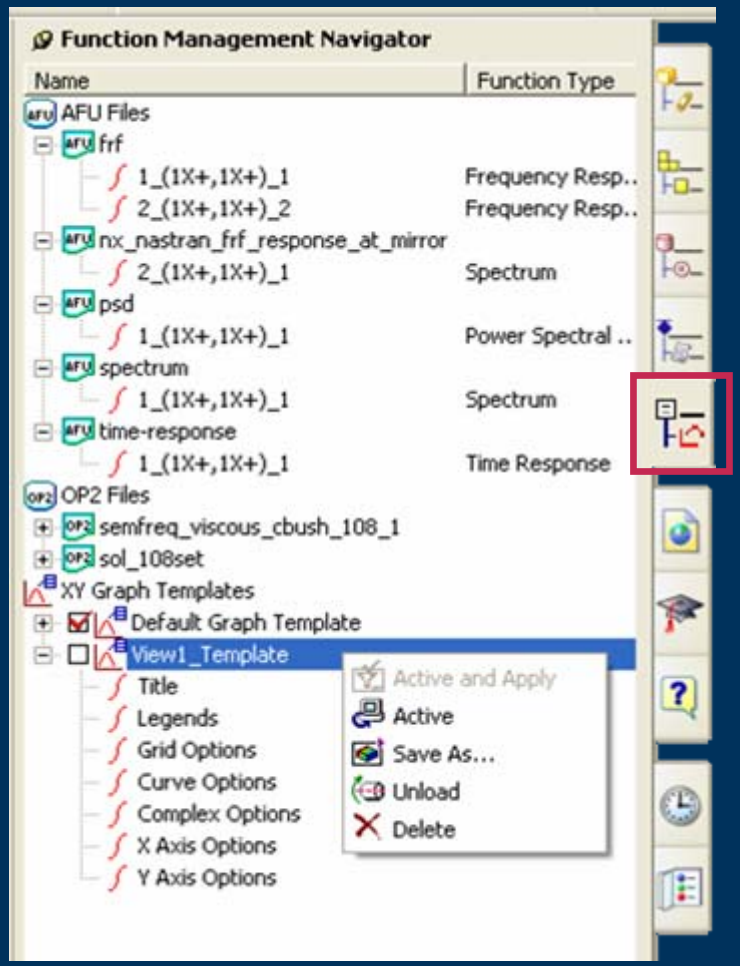
# XY Graph Templates




Title and Legend

- Font, size, locations, etc.

Grid controls

- Background, lines, size, etc.

X- and Y-axes

- Labels, fonts, scales, etc.

Curve lines

- Color, thickness, type, etc.

Data tagging

- Min/Max & user-selected

Store and reuse the display setting

- Templates in XML
- Templates managed by navigator

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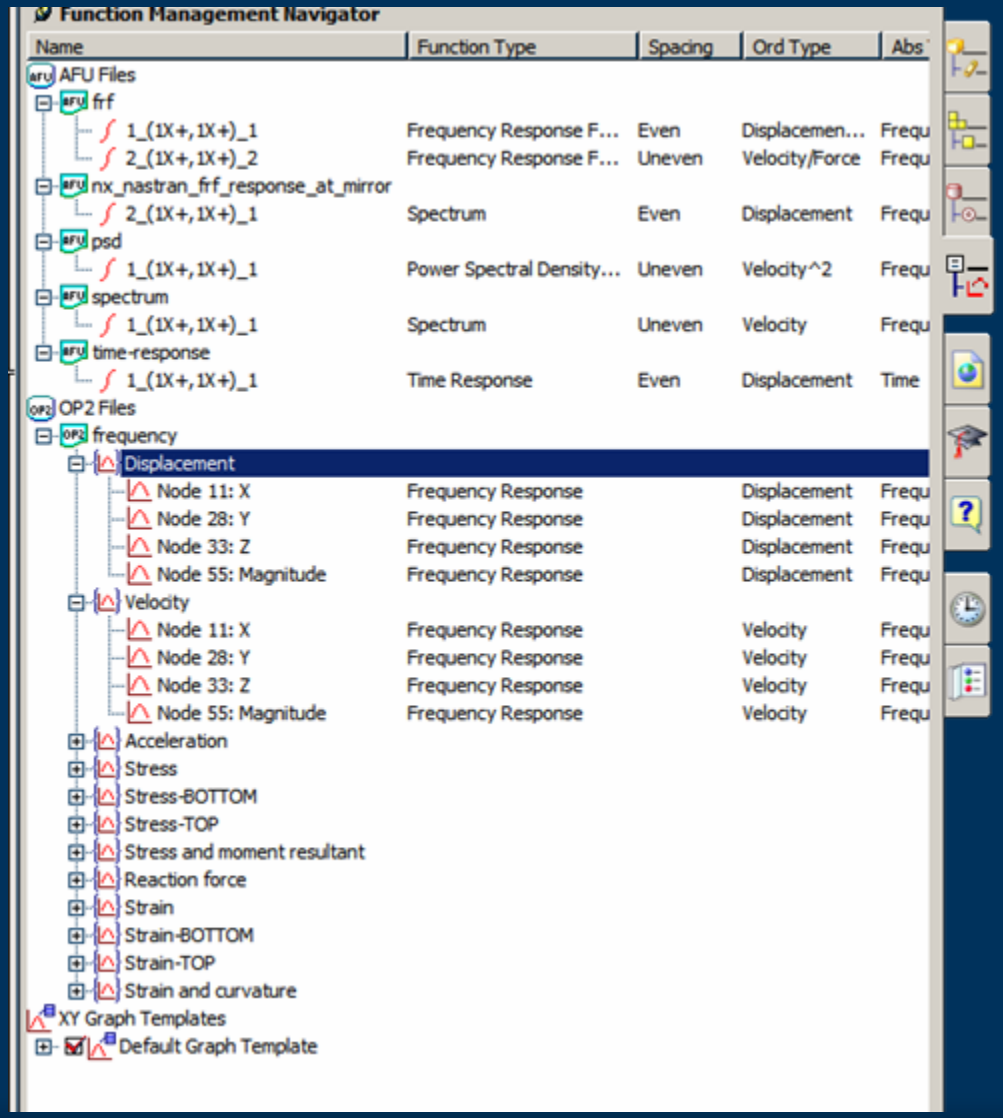
# OP2 and AFU Support

AFU function types

- general
- Time function
- Spectrum
- FRF
- PSD
- SRS

OP2 SORT2 results

- SOL101
- SOL103 Alter- PSD
- SOL103 Alter- SRS
- SOL 108 & 109
- SOL 111 & 112
- SOL 106 & 601

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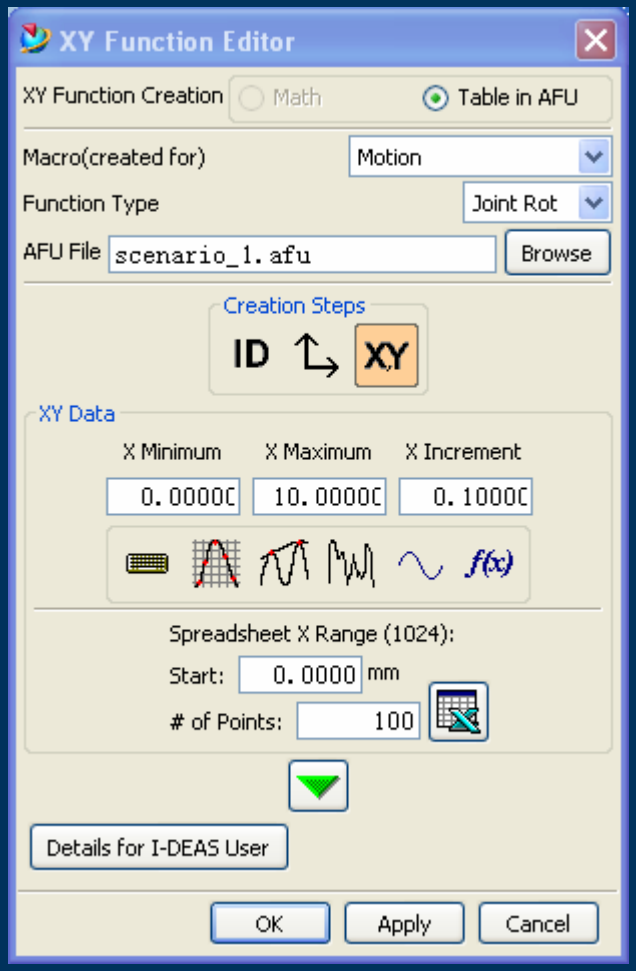
# XY Table Creation




XY tables created in AFU

- Compatible with I-deas
- Used for both Motion and FE

Creation

- Key-in
- Sine-wave sweep
- Random data
- From spreadsheet
- From OP2
- From Math functions
- From Grid
- From Data

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# NX 4 CAE Simulation Process Automation

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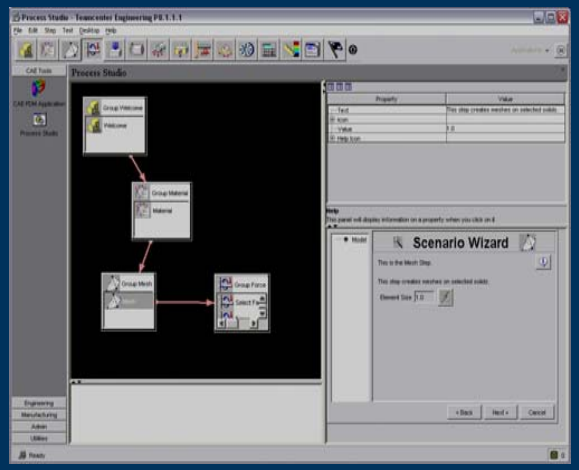
# Simulation Process Studio

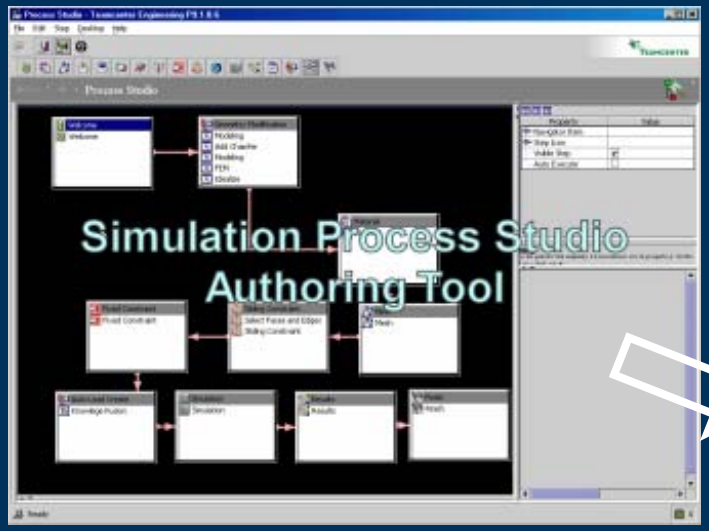
- Simulation Process Studio (SPS)
  - Custom CAE Wizard Builder
- Simulation Wizards for Designers & Design Engineers
  - “First pass” early checking of component design alternatives
  - Fully Integrated into the Unigraphics modeling environment
  - Advanced CAE technology, with a clear user interface and workflow
    - Requires no specialist simulation knowledge
  - All data is readily accessible and completely scalable
    - Standard html simulation reports automatically created
    - Creates models accessible by Advanced Simulation

# Simulation Process Studio

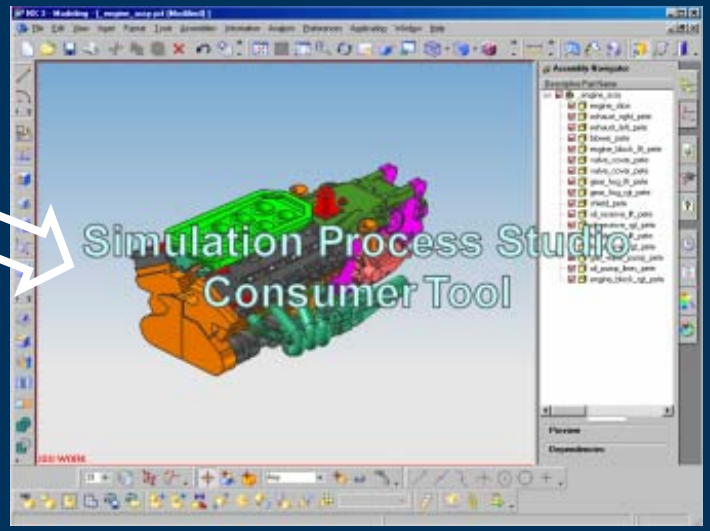
- Authoring Tool
  - CAD independent environment to define process steps
  - Based on (AIF) application integration framework from TeamCenter (Java)
  - Based on a plug in concept for other applications (CAM, CAD etc)
  - User Defined Steps using NX/Open & Knowledge Fusion
    - Provides an extremely flexible way for users to edit/add/amend their own details / steps / logic etc
- XML
  - The transfer mechanism from the author to the user
  - XML schema that describes the process and the objects within it
  - Open standard
- Consumer Tool
  - Reads XML
  - Drives object creation



# Simulation Process Studio

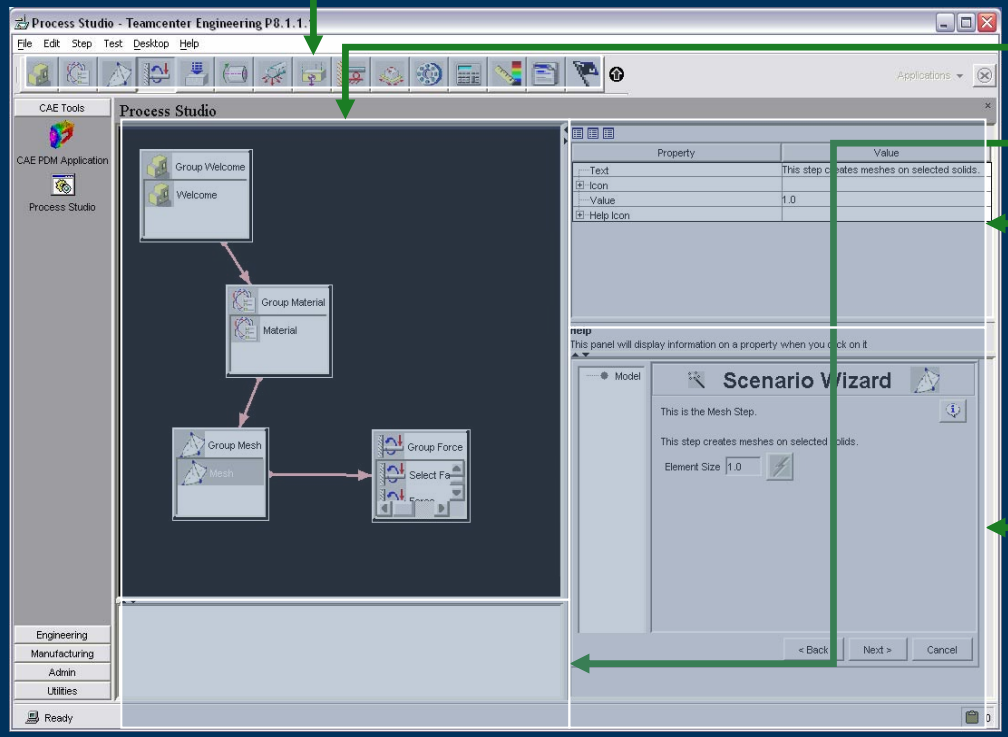



XML



# Simulation Process Studio

- Process Studio Authoring Tool
  - Creates XML template file




**Specific CAE Toolset**

**Process Definition Workspace**

**User Feedback**

**Property page**

**Wizard Feedback**

Graphical preview

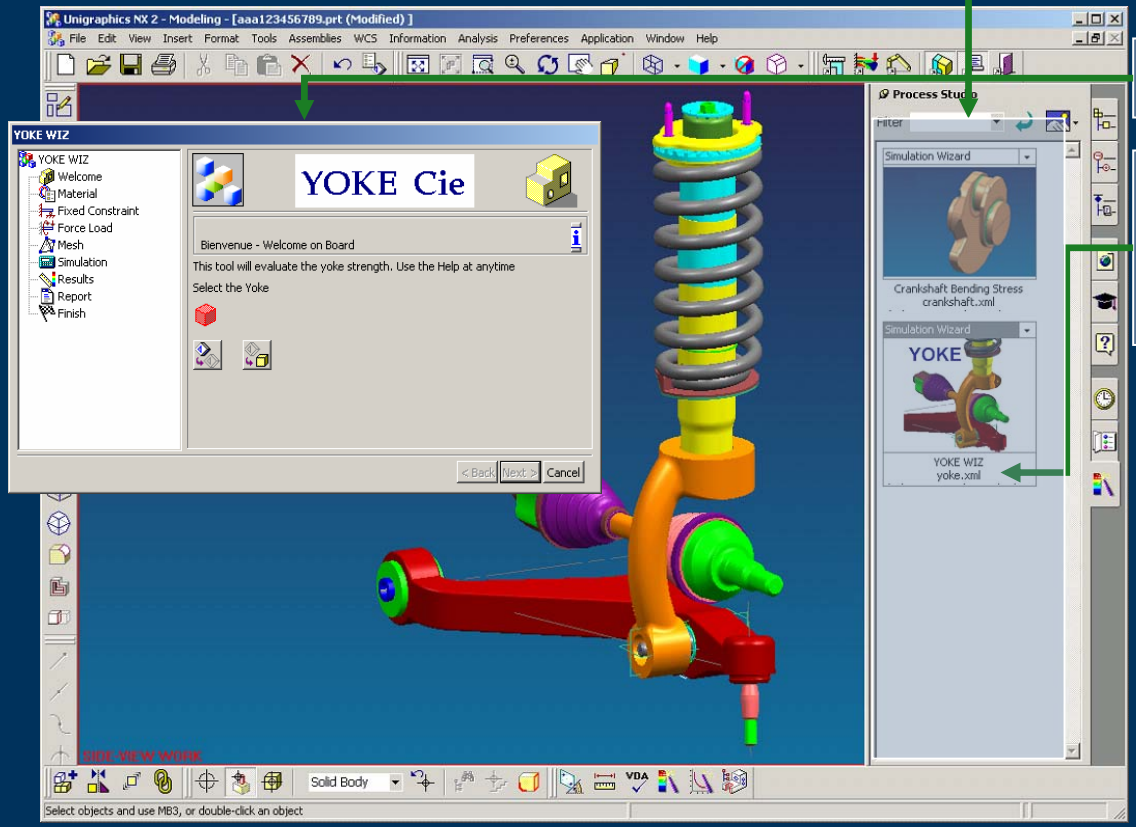
Shows specific step as it would appear in NX

Dynamic & Interactive

**Process saved as a template (XML file)**

# Simulation Process Studio

- Process Studio Consumer Tool
  - Driven by XML template file




**Unigraphics NX Resource Bar**

User drags the template on to the model

**Specific Wizard Begins**

**Wizard generatively creates CAE objects and analyses problem**

Steps generatively create NX Simulation, Scenario objects

Simulation data, solution and result interpretation are all controlled via the Wizard

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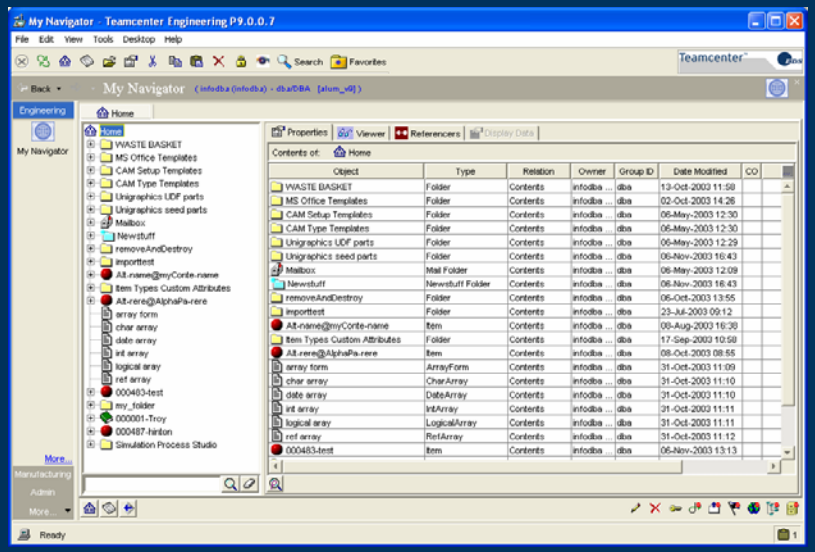
# Simulation Process Studio

- Process Studio is available stand-alone or embedded into TeamCenter Engineering
  - Processes saved as Items in TeamCenter Engineering
    - PS Revisions, Datasets, Named references
    - Access to other “linked” datasets i.e. Knowledge Fusion



# NX 4 CAE Motion Analysis

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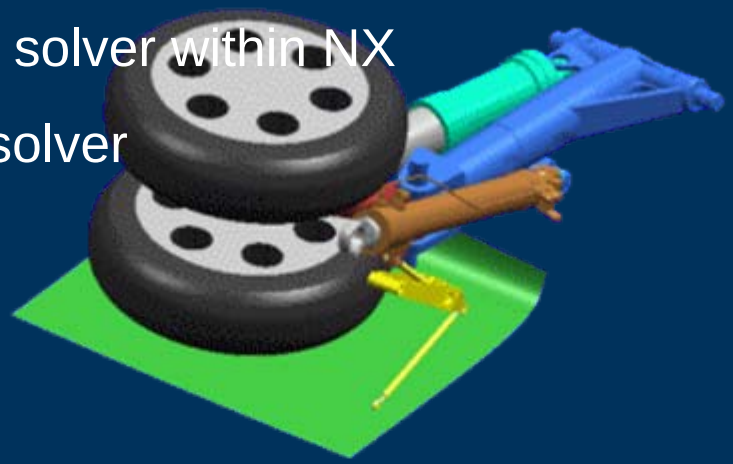
# Motion Simulation

- Why Motion Simulation?
  - Integrated mechanism solver within NX
  - Uses MSC.ADAMS® solver
  - Can be used for…
    - Motion studies
    - Packaging
    - Finite element load generation
  - Solution can be…
    - Kinematic – all degrees of freedom constrained
    - Dynamic – links can be underconstrained, Newton's Laws determine motion



# Beyond Assembly Mating Conditions

- Assembly Mating Conditions can be used to simulate motion, but it cannot…
  - Use functions to drive motion
  - Use forces and torques to drive motion
  - Evaluate forces and torques in a system
  - Model contact
  - Model springs, dampers
- Assembly Mating Conditions can be automatically mapped to joints

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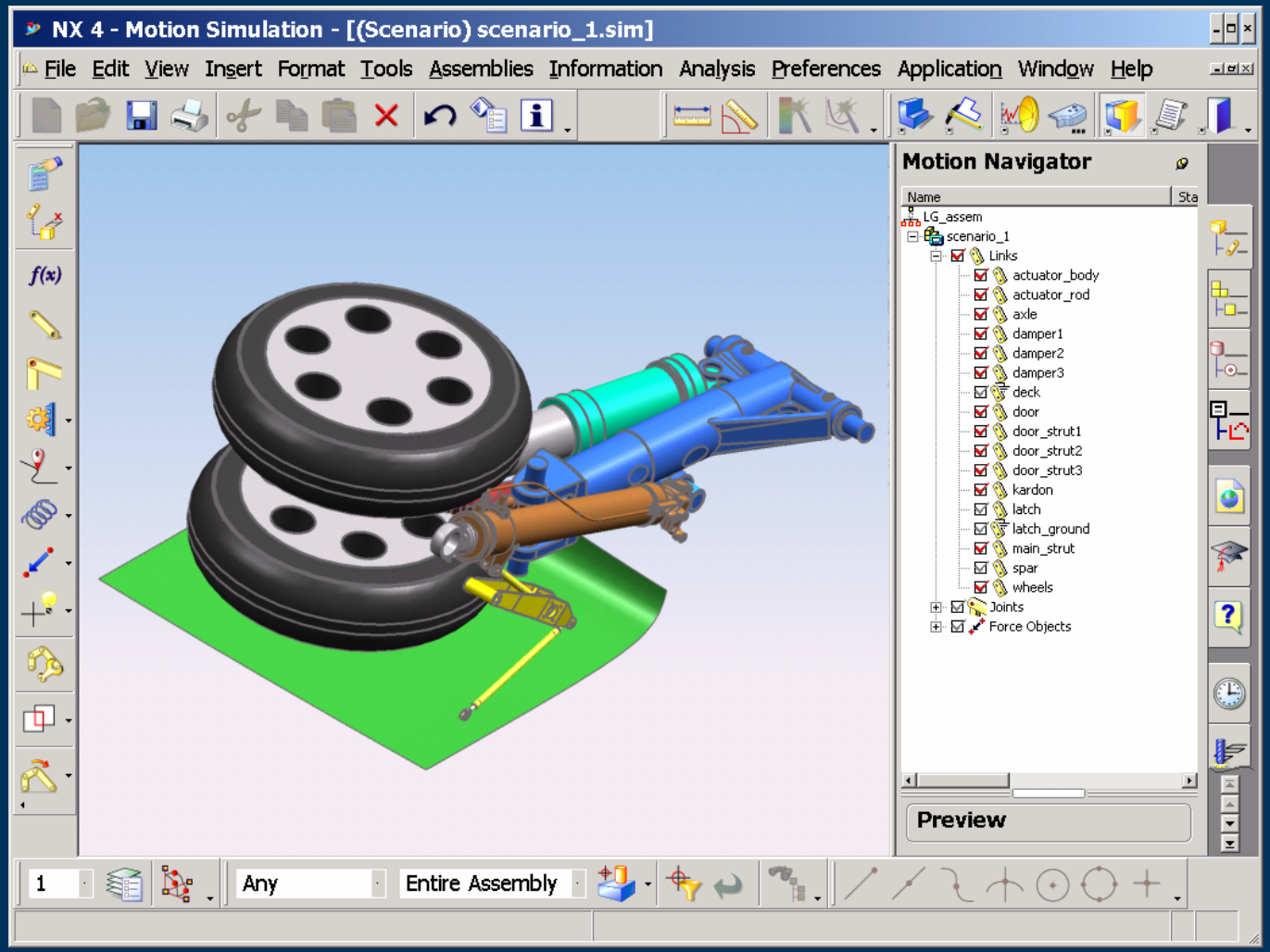
# Workflow

- Start with assembly or collection of geometry
- Create a Scenario to hold mechanism model
  - Multiple Scenarios can be created for design studies
  - Scenarios are linked to CAD assembly, but can be modified independently
- Create links from components, points, curves, sheet and solid bodies
- Create joints to connect the links
  - Joints are typical mechanical connections like hinges and sliders
- Solve using internal MSC.ADAMS® solver or export to an external data deck
- Post process within the NX viewing environement

# User Interface

Model Preparation And Solution Commands




Motion Navigator Tracks Entities In Model

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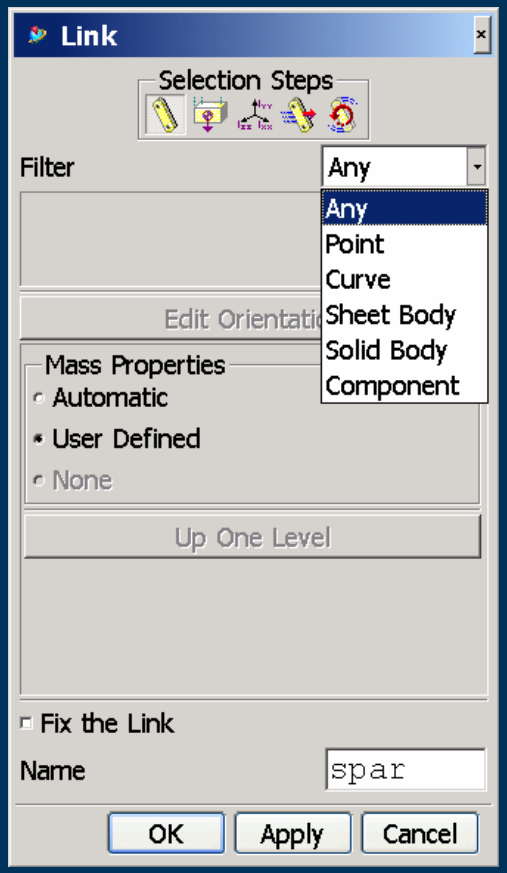
# Links

- Links translate to MSC.ADAMS® PARTS
- Can be created from assembly components or geometry
- Mechanism does not need to be assembly, links can be created from a single part
- Mass and inertial properties are automatically calculated from part geometry or can be User Defined

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# Joint Library

- Revolute
- Slider
- Cylindrical
- Screw
- Universal
- Spherical
- Planar
- Fixed

Joints represent mechanical connections between Links

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# Contact

- Point on Curve
- Curve on Curve
- Point on Surface
- 3D Contact
- 2D Contact

Contacts allow accurate modeling of interactions and collisions between links

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# Couplers

- Rack and Pinion
- Gear
- Cable

Couplers relate the motion between two joints

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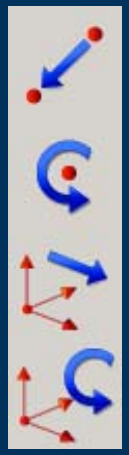
# Force Entities

- Spring
- Damper
- Bushing
- Scalar Force
- Scalar Torque
- Vector Force
- Vector Torque

Springs and dampers



Forces and torques represent external loads applied to a mechanism

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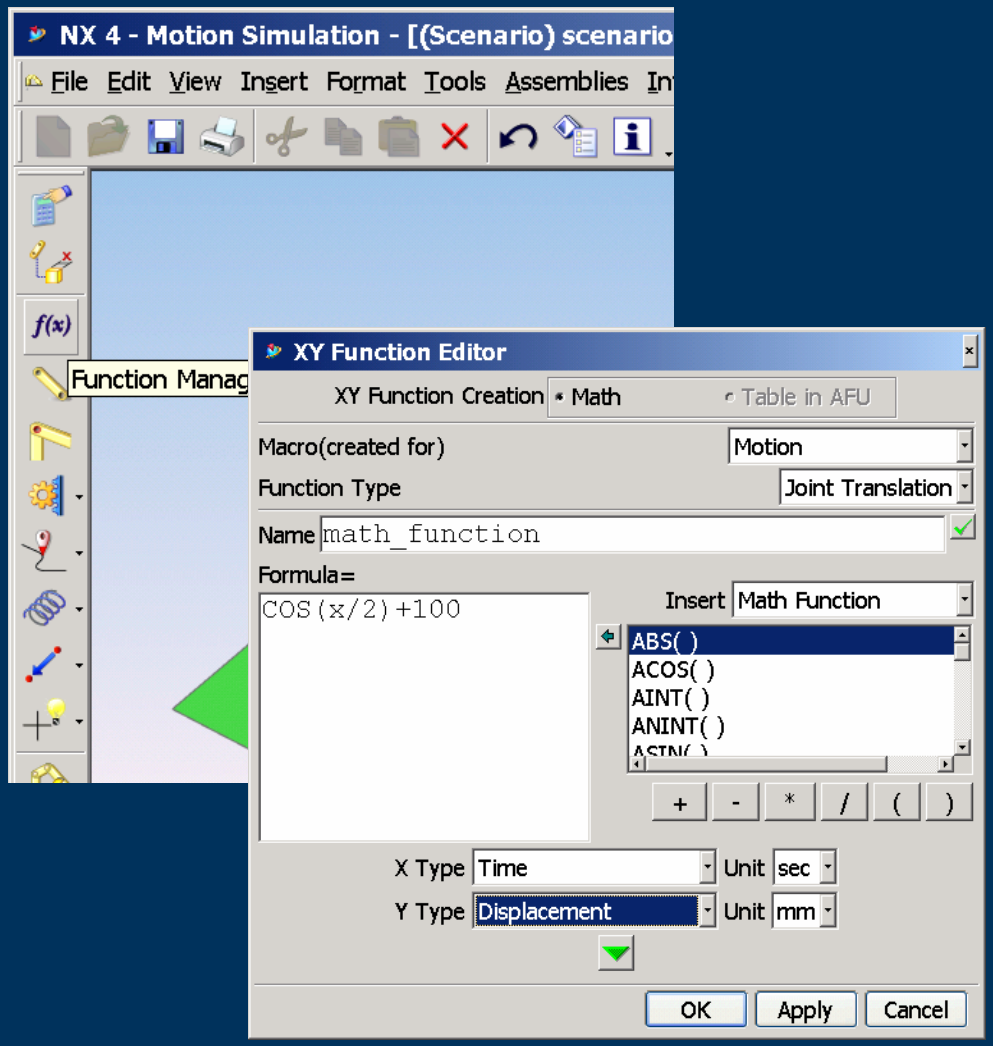
# Function Editor

- Driving motions and loads can be easily defined using functions (NX 4)
- Functions can be common math functions or MSC.ADAMS® functions
- Function XY plots can be preview directly on the form

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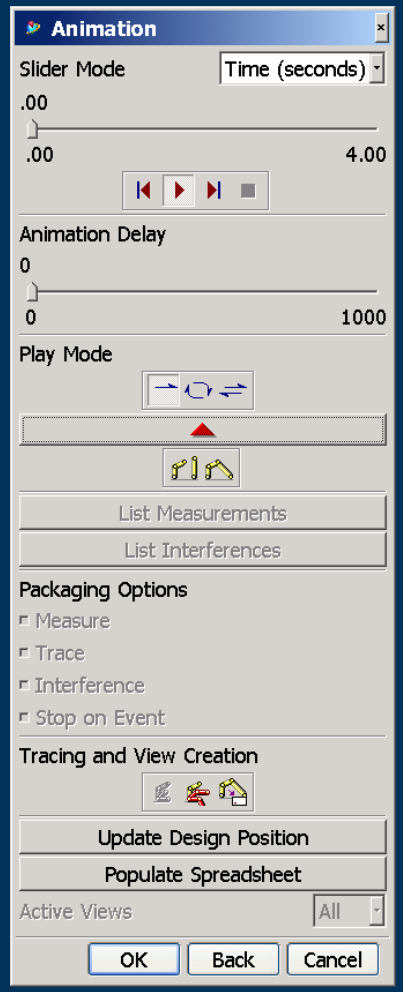
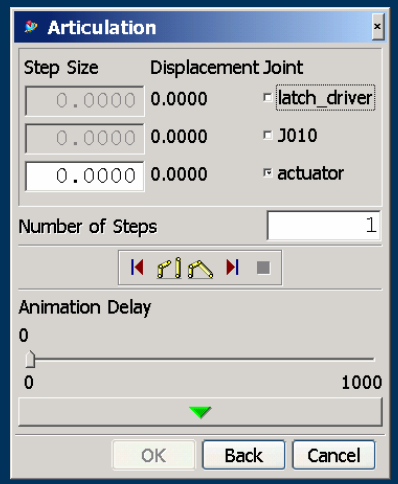
# Solution Options

- Several solution options are available
  - Animation
    - Time step solution of mechanism
  - Articulation
    - Discrete stepping of individual joints
  - Spreadsheet
    - Joints are driven by entries in a spreadsheet



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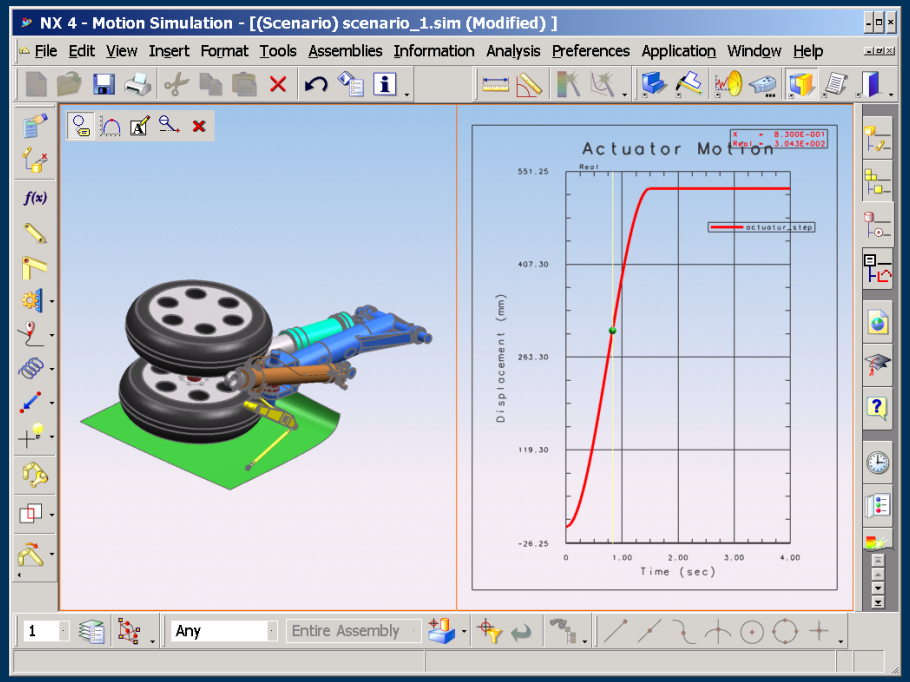
# Result Post Processing

- Results can be plotted through a spreadsheet or integrated XY plotting (NX 4)
- Mechanism can be animated and exported to MPEGs and JT .VFM format for 3D visualization
- Packaging Options give real time feedback on interferences during motion (NX 4)



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# THANK YOU!

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