

# Femap 11.4.2 What's New

#### **Femap Release Schedule**





Regular release schedule • v11.4.2: November 2017 • v11.4.1: October 2017 • v11.4: May 2017 • v11.3: May 2016 • v11.2: March 2015 • v11.1: November 2013 • V11: January 2013 • v10.3.1: January 2012 • v10.3: October 2011 • v10.2: October 2010 • v10.1.1: January 2010 • v10.1: August 2009 • v10: December 2008

#### **Femap Direction**



Maximize efficiency of FEA tasks

- Efficient creation of high fidelity FE models that accurately represent real-world engineering problems
- Intuitive interpretation of analysis results to improve the design and performance of engineered products

Build upon strong Femap capabilities

- Geometry idealization and processing for FE models
- Powerful meshing, model creation and interactive editing
- In-depth support for industry standard solvers
- Flexible customization tools to streamline analysis processes

## **Femap 11.4.2** Overview – Thermal and Flow Solver Enhancements





#### **Femap 11.4.2** Thermal and Flow Solver Enhancements



#### Updated UI for Improved Workflows Updated Solver with Parallel Processing



Thermal/Flow Model Info

Loads

▲ I Model

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#### Femap 11.4.2 Contemporary Graphical User Interface

*Thermal/Flow Model Info* pane, analogous to Femap *Model Info* pane

 Activate from the Panes toolbar or with the Tools > TMG Thermal/Flow Analysis command







#### Femap 11.4.2 Thermal/Flow Model Info Pane

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Create all loads, constraints, and other simulation entities using the right-click commands in the *Thermal/Flow Model Info* pane

Model – Set-Based Objects

- Loads
- Constraints
- Simulation Objects

Model – Other Objects

Modeling Objects

Analyses – analogous to Analysis Sets

4 ⊞ Model		
🚸 Loads		
🖌 🚄 Constraints		
🖌 🚄 1Muffler_Inlet_Tempe	rature	
4 😤 Constraint Definition	15	
🗹 🚝 1InletTemp		
Simulation Objects		
▲ # 1Muffler_Flow		
1D Flow Definitions		
4 📧 3D Flow Definition	Single Selection	Elemental
I te a MufflerInlet	Multi-Selection	Elemental
Ite 2. MufflerExha	Entire Model Selection	On Surface
It= 3Internal_Mu	Entire Model Selection	On Solid
■ = 4AII_Around_	Edit Where Applied	On Group
S.All_Alound_	Edit Simulation Object	on droup
V = 7 MufflerCase	Copy To Set	
🖻 🏪 Radiation Definitio	Move To Set	
を Thermal Coupling	List	
🔤 General Definition	Delete	
🖻 🛍 Modeling Objects	Renumber	
🛚 😼 Analyses 👘 👘		

#### Femap 11.4.2 Loads

New – Create New Load Set

 Multiple Load Sets can be defined

Single Selection – Use to apply Loads on Elements, Curves, Surfaces, Solids, or by Group

- Joule Heating
- Rotation apply Angular
   Velocity to selected individual entities
- Thermal Loads

Entire Model Selection – Use to apply loads to entire model • Rotation – Angular Velocity Edit Where Applied or Edit Load Copy and Move between Load Sets List, Delete, or Renumber individual Loads

Single Selection

Entire Model Selection

Edit Where Applied

Edit Load

List Delete

Copy To Set Move To Set

Renumber

.

Thermal/Flow Model Info

4 1...Untitled

Simulation Objects
Modeling Objects

Constraints

S Analyses

Load Definitions

Model
Model
Loads

itle			
<ul> <li>Joule Heating</li> <li>Current</li> <li>Voltage</li> <li>Rotation</li> </ul>	Region Override		
Model Subset Thermal Loads Heat Load Heat Flux	Magnitude Value (kg m^2 / s^3)	Dependence	
Heat Flux Heat Generation	Heat Load	0None	✓ f <sub>xy</sub>
	Heater Control Control Heater Heater Controller or Thermostat	0None	-
	Multi-Layer Shells		
	Apply to	Тор	*
	Distribution		
	Per Element		



### Femap 11.4.2 Constraints

New – Create New Constrain Set

 Multiple Constraint Sets can be defined

Single Selection – Use to apply

Constraints on Elements, Curves,

Surfaces, Solids, or by Group

- Convection To Environment
- Initial Conditions
- Simply Radiation to Environment
- Temperature

Edit Where Applied or Edit Constraint

Copy and Move between Constraint Sets

List, Delete, or Renumber individual Constraints







### Femap 11.4.2 Constraints

#### Convection to Environment

- General
- Free Convection to Environment
- Forced Convection to Environment

Initial Conditions – All

Initial Temperature

Initial Conditions – 3D Flow

 Initial Fluid Pressure, Fluid Velocity, Fluid Turbulence, Humidity, Tracer Fluid, Mixture, and Water Content Simple Radiation to Environment

#### Temperature

Convection to Environment	Parameters		
Free Convection to Environment	Correlation	Plate Aligned with Free Stream	•
Initial Conditions	Convect from	Тор	-
Initial Temperature	Characteristic Length (m)		
Initial Fluid Pressure - 3D Flow	Multiplier	1	
Initial Fluid Turbulence - 3D Flow			
- Initial Tracer Fluid - 3D Flow	Environment		
Initial Mixture - 3D Flow	Fluid Material	Air	•
Simple Radiation to Environment	Fluid Velocity (m / s)		
Simple Radiation to Environment	Temperature	Fluid Ambient	-
Temperature			01.00

## Femap 11.4.2 Simulation Objects

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New – Create New Simulation Object Set

 Multiple Simulation Object Sets can be defined

Single Selection – Use to apply Simulation Objects on Nodes, Elements, Curves, Surfaces, Solids, or by Group

 Entities vary depending on Simulation Object

Multi-Selection – Use to apply Simulation Objects which require multiple inputs

 Inputs vary depending on Simulation Object Entire Model Selection – Use to apply
Simulation settings to entire model
Settings vary depending on
Simulation Object

Edit Where Applied or Edit Simulation Object

Copy and Move between Simulation Object Sets

List, Delete, or Renumber individual Simulation Objects



## from a "Convecting Region" to Ducts 3D Flow Definition

**1D Flow Definitions** 

- Single Selection Flow Boundary Conditions, Flow Surfaces, Screens, Supersonic Inlets, Symmetry Planes
- Multi-Selection Disjoint Fluid Mesh Pairing, Flow Boundary Condition, Flow Surface, Periodic Boundary Condition
- Entire Model Selection Translating Frame of Reference

Single Selection – Duct to 3D Flow Interface

Conditions for One or Two-sided Convection

Multi-Selection – Duct Flow Boundary

## Femap 11.4.2 Simulation Objects for Flow

Flow Boundary Condition	Magnitude			-
E Screen	Mode		Velocity	
± Symmetry Plane	Value (m / s)	Dependence		
	Velocity		0None	► f <sub>oy</sub>
	Fan Control			
	Controller Ty	pe	None	•





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## **Femap 11.4.2** Simulation Objects for Radiation



Single Selection

Articulation

Spinning

Multi-Selection

- Orbital Heating
- Radiation
- Radiative Heating
- Solar Heating Space

**Entire Model** 

- Orbital Heating
- Radiation
- Solid Motion Spinning
- Solar Heating Space

Create Simulation Objects on Surfaces Title		23			
<ul> <li>Solid Motion Effects</li> <li>Articulation</li> <li>Spinning - Selected Elements</li> </ul>	Joint Selection Joint 0None				
		Title Orbital Heating Illuminate All Elements Radiation All Radiation Solid Motion Effects Spinning - All Elements Solar Heating Space Illuminate All Elements	Parameters          Include Radiative End         Calculation Method         View Factor Accuracy         Element Subdivision	nvironment Hemicube Rendering Medium (128 x 128) 3	•
Create Simulation Objects on Multiple S     Simulation Family     Orbital Heatin     Orbital Heatin     Radiation     Top Side Illuminated Region     Bottom Side Illuminated Region	elections		☑ Include Faces of So	lid Elements	Cancel

## Femap 11.4.2 Simulation Objects for Thermal Coupling



Single Selection

Interface Resistance

#### Multi-Selection

- Interface Resistance
- Joule Heating
- Thermal Coupling
- Thermal Coupling Advanced
- Thermal Coupling Convection
- Thermal Coupling Radiation

	Title				-
	Interface Resistance	Magnitude			2
	Surace Interface	Type		Total Conductance	
			Value (kg m^2 / s^3 C)	Dependence	
		Conductance		0None	for
ata Cimulat	ion Objects on Multiple Select			οκ	Cancel
ate Simulat ition Family tion Type	tion Objects on Multiple Selecti Thermal Coupling Interface Resistance Joule Heating	ons 🛛		OK (	Cancel

## Femap 11.4.2 Simulation Objects for General Definitions

Creat



Single Selection

Deactivation

Merge Elements

- Report
- Selective Results

Multi-Selection

- Peltier Cooler
- Report

Entire Model Selection Immiscible Fluid Report

	Create Simulation Objects of	n Surfaces	8
	Title Deactivation Set Deactivation Set Merge Set Merge Set Report Per Element Per Region Track During Solve Lift and Drag Heat Maps Selective Results 3D Flow	Axes Lift and Drag CSYS Lift Axis Drag Axis Characteristic Dimensions Characteristic Dimensions Characteristic Dimensions Planiform or Projected Area (m^2)	0Global Rectangular
Create Simulat Simulation Family Simulation Type Cold Plate Region Hot Plate Region	tion Objects on Multiple Selections	Length (m) Approach Velocity (m / s) Reference Density (kg / m^3)	1.207 OK Cancel

#### Femap 11.4.2 Modeling Object Definitions

Single Selection – Use to apply Modeling Object Definitions on Elements, Curves, Surfaces, Solids, or by Group

- Active Heater Controller
- Fan Speed Controller
- Target Temperature
- Target Temperature Between Time Steps

Multi-Selection

Generic Entity

Create Modeling Objects on Multi Modeling Object Generic Entity Element Set 1 None	ple Selections 🛛 🔀	Thermal/Flow Model Info  Model  Constraints  Simulation Objects Modeling Objects	
Element Set 2 None	OK Cancel	Modeling Object Definition Material/Property Update I Analyses	Def Single Selection No Selection Edit Where Applied Edit Modeling Object
Title Active Heater Controller Fan Speed Controller Target Temperature Target Temperature Change Thermostat	Sensor Temperature Sensor	Selected	List Delete Renumber
	Type Cut-in Temperature (C) Cut-off Temperature (C)	Proportional	



## Femap 11.4.2 Modeling Object Definitions

No Selection

- Active Heat Controller
- Advanced Parameters
- Convection Properties
- Duct Convection Correlation
- Duct Head Loss
- External Conditions
- Joint, Joint Orbital Tracker
- Monte Carlo Settings
- Non-geometric Entities
- Orbit
- Planar Head Loss
- Thermostat
- Tracer Fluid

itle	
<ul> <li>Active Heater Controller</li> <li>Advanced Parameters</li> <li>Convection Properties</li> <li>Duct Convection Correction</li> </ul>	Orientation Axis 🔀 🛞 🚺
<ul> <li>Duct Head Loss</li> <li>External Conditions</li> <li>Joint</li> <li>Joint - Orbital Tracker</li> <li>Monte Carlo Settings</li> <li>Non-Geometric Element</li> </ul>	Alignment Align Vector 🖉 🌸 🧕 Align with Sun
Orbit Planar Head Loss Thermostat Tracer Fluid	Orbit Selection Orbit 0All Active Orbits
	Parent Joint Select Joint 0None



## Femap 11.4.2 Material/Property Update Definitions



Single Selection – Use to		Create	e Modeling Objects			83
apply Material/Property		Title				
Update Definitions on Elements, Surfaces, or by Group • Bottom Side		Abl. Hor Imn Mul Nor Stac	ation-Charring mogeneous Gas Mixture niscible Fluid Mixture lti-Layer Shell n-Newtonian Fluid ck Layer	Ablation Ablation Material Transforms at Abla Transformed Material	0None ation Temperature 0None	•
No Selection <ul> <li>Ablation-Charring</li> <li>Homogeneous Gas Mixture</li> <li>Immiscible Fluid Mixture</li> </ul>	Thermal/Flow Model Info	bjects jects Object Definitions Property Update Definitions	83		ОК Са	ancel
<ul> <li>Multi-Laver Shell</li> </ul>	- S Analyses	Single Selection	Elemental			
Non-Newtonian Eluid		No Selection	On Surface			
Stack Laver		Edit Where Applied Edit Modeling Object	On Group			
		List				
		Delete Renumber				

#### Femap 11.4.2 Thermal/Flow Analysis Setup



Analysis Manager replaces multiple commands and dialog boxes:



Solver Control			
Solver Control Solver Mode Solver Mode Execute Themal Solver Restart Restart Control Solution Type Steady State Transient Start Time At time Find Time At time Farallel Processing Run Solution in Parallel Validate Machines OK Apply	Internal Solver 3D Flow Solver (auguled Solver Coupled Solver Advanced Options Initial Conditions Initial Conditions Ini	2 Create Table  1 Create Table  2 Create Table  5 Ludy Muffler_Flow  Thermal Solver Initial Conditions  4 Auto Determine  5 Auto Determine  5 Constrained in the second in the	
	elect Gravity Vector 3D Flow Options Leference temperature for bulk heat transfer coefficients Adjust density and pressure for altitude 10000 uct Ambient Material OK Apply Reset Cancel	Specify a Unition value     303.13     ?       Start from results in other directory     .X     ?       Start from results in file (TEMPF format)     No File Specified     ?       3D Flow Solver Initial Conditions     .Auto Determine     .Start from results in other directory     .A       Start from results in other directory     .A     ?       Specify Values	



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#### Femap 11.4.2 Thermal/Flow Solver Enhancements



Solvers synchronized with Simcenter 3D solvers

#### Flow

- Parallelized solver
- Extended two-equation turbulence models
- Large Eddy Simulation
- Fractional step scheme
- Enhanced second-order discretization schemes
- Enhanced freeze-flow and re-start options
- Static pressure and convective outflow boundary conditions

#### Thermal

- Parallelized solver
- Improved adaptive time stepping
- Enhanced thermal couplings
- Initial conditions from dissimilar meshes
- Thermostat and active heater controller reports
- Enhancement to transient end time options
- Hydraulic Networks

Advanced Thermal

Enhanced Orbit Visualizer

#### **Femap 11.4.2** Thermal/Flow Solver Enhancements



New capabilities

- Homogeneous gas mixtures
- Immiscible fluid mixtures (volume of fluid method)





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### Femap 11.4.2 Parallel Processing



Extended parallel processing from view factor calculation (available in previous releases) to entire solution sequence for thermal and flow runs

Distributed Memory Parallelization (DMP) of the thermal and flow solvers: parallel solution threads can separately access both CPU and RAM

Up to 8 processes on a compute node can be executed with Femap Advanced Thermal and Femap Flow licenses for no extra cost

omputer Lists	Settings		Modules to Run in Parallel
pc-zouyaz-s7 [master]	Property	Value	View Factors
	Name	pc-zouyaz-s7 [master]	
	Number of Processors to Use	6	
	Number of Processors on Computer	12	
	Status	Success	
alidation Output			
Available nx Thermal/Flow paralle	processing capabilities:		
- Thermal Solver Parallel - Thermal Solver Parallel DMP - Flow Solver Parallel - Flow Solver Parallel DMP	= Yes Yes = Yes = Yes		
Using MPI installation from D:\FEMAP\FP1141\tmg/mpich2/bii (default)	n/mpiexec		

#### Femap 11.4.2 Simulation Results

#### Expanded results output options

#### Enhanced CGNS export

Radiation	Orbital and Radiative Source Fluxes	1D Flow	Optional Output Format	
✓ Tecplot				
ransient Resu	lts	Single File		
Transient Results		Single File		



Cantural	Thomas	2D Elaw	De dinin	Outiful and Budiation Course of	
Control	Inermal	3D FIOW	Radiation	Orbital and Radiative Source Huxes	
Tempe	eratures				
Veloci	ties				
Veloci	ties Adjusted				
Vortici	ty				
Static	and Total Pre	essures			
Local a	and Bulk Con	vection Coeff	ficients		
🔽 Turbu	lence Model (	Quantities			
Non-N	lewtonian Mo	del Quantitie	s		
🔲 Fluid D	Densities				
🔲 Shear	Stresses				
Rough	nness				
🔲 Y+					
Surfac	e Pressures				
Mass I	=luxes				
Conve	ective Fluxes				
🔲 Humid	ity, Tracer Fl	uids, and Mix	tures		
	Predicted Me	an Vote)			
PPD (F	Predicted Per	cent Dissatis	fied)		
Mach	Numbers				
Acous	tic Power Der	nsity			
Pressu	ure and Shea	r Resultants			
Conde	ensation/Evap	ooration			

#### Femap 11.4.2 Boundary Condition Symbols



Symbols for Boundary Conditions now appear in the graphics window

• Symbols vary based on type of boundary condition



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#### Femap 11.4.2 Boundary Condition Symbols

Visibility of Boundary Conditions controlled via "visibility check box" next to each individual Boundary Condition in the Thermal/Flow Model Info tree ("Constraint – Temperature" and "Simulation Object – Inlet Flow" hidden)







#### Femap 11.4.2 Contour Arrow Plots



Update of Contour Arrow plots in Femap 11.3.x have made creation of Contour Arrow plots much more robust and easier to create

• Select a Total Vector as the Contour Output vector to display an Arrow Plot of

Flow Velocity



#### Femap 11.4.2 Q and A



