ALGOR

Heat Transfer

Capabilities for simulating thermal effects include steady-state and transient heat transfer analysis. These analysis capabilities are all available within FEMPRO, ALGOR's easy-to-use, single user interface for finite element modeling, results evaluation and presentation.

MODELING

A suite of modeling capabilities includes:

- InCAD technology for direct CAD/CAE data exchange with Alibre Design, Autodesk Inventor, Inovate, IronCAD, KeyCreator, Mechanical Desktop, Pro/ENGINEER, Rhinoceros, Solid Edge and SolidWorks
- full associativity for each design change for most CAD solid modelers
- CAD support for 2- and 3-D CAD universal files
- Superdraw 2- and 3-D sketching tools
- 2- and 3-D parametric structured meshing
- automatic, unstructured 2- and 3-D meshing
- automatic, intelligent, feature-based mesh refinement and point-and-click definition of areas where a finer mesh is desired
- a midplane mesh engine for reducing thin, solid features in a CAD model to plate/shell elements with automatic handling of parts, assemblies, multi-thickness regions and mixed element type models
- an automatic, hex-dominant hybrid solid meshing tool to produce higher quality elements on the first pass and more accurate results

ANALYSIS

Steady-state and transient heat transfer analysis capabilities include:

- consideration of conduction, convection, heat flux, heat generation, radiation and thermal contact
- a body-to-body radiation capability, including an automatic view factor calculator to control the extent to which the different bodies interact
- coupled heat transfer and fluid flow analysis to accurately simulate natural, forced or mixed convection
- viscous heating capabilities
- automatic transfer of electrostatic results to a heat transfer analysis for simulation of Joule heating
- determination of temperature distribution, heat flow and heat flux
- automatic transfer of temperature results to:
  - a static stress analysis or Mechanical Event Simulation
  - a steady fluid flow analysis
  - an electrostatic analysis

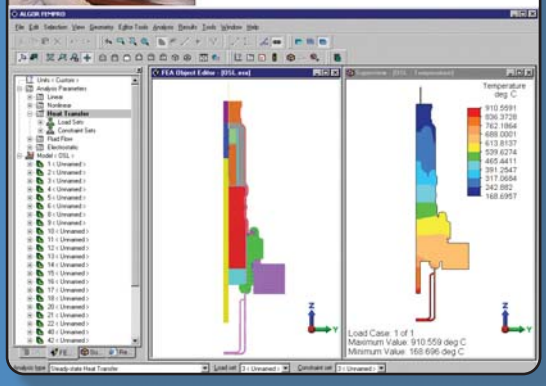
RESULTS EVALUATION AND PRESENTATION

Extensive results evaluation and presentation capabilities include transparent display options, multiple-window displays, fast dynamic viewing controls and customization options including user-defined color palettes and annotations. All analysis results can be:

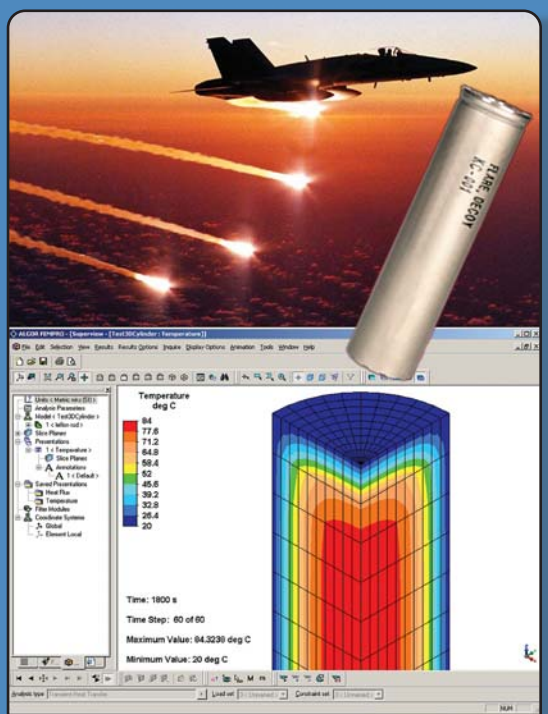
- displayed graphically as contours or plots
- output in the BMP, JPG, TIF, PNG, PCX and TGA formats
- animated with AVI creation and display tools
- presented in text, HTML or PDF reports

"My results agreed with laboratory results within 4%. I'm very satisfied with this correlation, especially since the variables of an experiment can never be controlled as well in the laboratory as they can be with an FEA model."

C. Scott Nelson
Delphi Corporation



Nelson used heat transfer analysis to optimize a wide-range oxygen sensor that will help automobiles to run more cleanly and efficiently.



"We chose ALGOR after exhaustively researching many finite element software packages."

Dr. Mark Driver
Director of Advanced Countermeasures Technology at Kilgore Flares

Kilgore Flares Company LLC manufactures decoy flares that are designed to draw heat-seeking missiles away from military aircraft. Kilgore engineers used ALGOR transient heat transfer analysis to simulate a flare component being quenched in water during manufacturing. The ALGOR results helped Kilgore to improve the reliability of their flares while trimming production costs through the reduction of rejected material.

HEAT TRANSFER FEATURES

Analysis Capabilities
- Steady-state heat transfer
- Transient heat transfer
- Thermal stress
- Thermal contact
- Viscous heating
- Natural convection (buoyancy)
- Forced convection
- Mixed convection
- Joule heating

Modeling
- See the FEMPRO (Part No. 3201.326) and CAD Support (Part No. 3201.331) product data sheets for the complete list of modeling features

Meshing
- See the CAD Support product data sheet (Part No. 3201.331) for the complete list of meshing features

Element Library
- Thermal 2-D element (planar, axisymmetric)
- Thermal rod element
- Thermal plate element
- Thermal brick element
- Thermal tetrahedral element

Material models
- Thermal isotropic
- Thermal orthotropic
- Temperature-dependent thermal isotropic
- Temperature-dependent thermal orthotropic

Loading and Constraints
- Temperatures (nodal, surface, initial and applied)
- Convection (steady and temperature-dependent)
- Radiation (isolated and body-to-body)
- Heat flux
- Internal heat generation (steady and temperature-dependent)

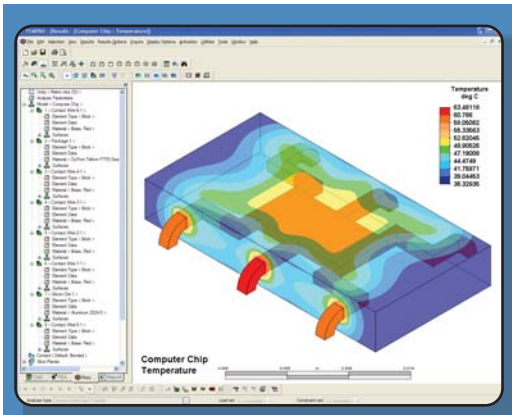
Solver Options
- Symmetric sparse
- Unsymmetric sparse
- Skyline
- Banded
- Restart capability
- Parallel processing for multiple processors

Results Evaluation
- Result displays of:
  - Static and time-dependent temperature distribution
  - Static and time-dependent heat flow
  - Static and time-dependent heat flux
  - User-supplied functions operating on calculated results, user-supplied constraints and material properties
- Automated tools for multiphysics simulation to:
  - Transfer temperature results to a static stress analysis, MES, linear dynamic or electrostatic analysis
  - Couple heat transfer and fluid flow analysis to accurately simulate natural, forced or mixed convection
- See the FEMPRO product data sheet (Part No. 3201.326) for additional results evaluation features

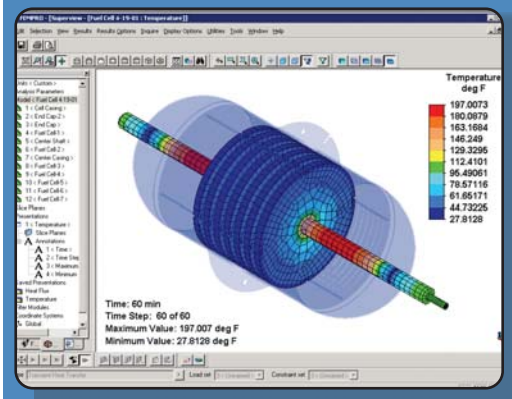
Results Presentation
- See the FEMPRO product data sheet (Part No. 3201.326) for the complete list of results presentation features

User Interface
- Automatic view factor calculator for determining the amount of radiation to be passed between bodies in a steady-state heat transfer analysis based on user-specified input
- Film/Convection Coefficient Calculator for open (external), closed (internal) and buoyant flows uses classical correlations to estimate the heat transfer coefficient between a solid and adjoining fluid
- See the FEMPRO product data sheet (Part No. 3201.326) for additional user interface features

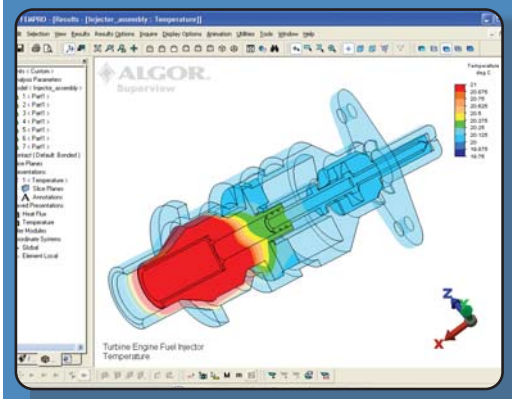
Note: For complete details on our heat transfer features, see the "Products" section of www.ALGOR.com. ALGOR's web site contains additional information about our wide range of simulation capabilities including static stress and Mechanical Event Simulation (MES) with linear and nonlinear material models, linear dynamics, fatigue, steady-state and transient heat transfer, steady and unsteady fluid flow, electrostatics, full multiphysics and piping.



A computer chip assembly was modeled in SolidWorks and then analyzed in ALGOR to determine the steady-state heat transfer results.



The Superview IV Results environment features transparent (translucent) display capabilities. The casing of a nickel hydrogen hybrid fuel cell is displayed transparently to reveal the transient heat transfer analysis results on the interior parts.



A steady-state heat transfer analysis was performed for a turbine engine fuel injector to determine the temperature distribution from convection loads applied to the inner shaft and the outside surface of the entire assembly. Model courtesy of The Simon Floyd Design Group.

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