Mechanical Event Simulation

Mechanical Event Simulation (MES) combines large-scale motion and stress analysis and supports linear and nonlinear material models. The combination of motion and stress analysis considering full inertial effects enables engineers to see motion and its results, such as impact, buckling and permanent deformation. These analysis capabilities are all available within ALGOR's complete and easy-to-use finite element modeling, results evaluation and presentation interface, FEMPRO.

MODELING

A suite of modeling capabilities includes:

- the Alibre Design Basic parametric, feature-based solid modeling system
- InCAD technology for direct CAD/CAE data exchange with Autodesk Inventor, CADKEY, Mechanical Desktop, Pro/ENGINEER, Solid Edge and SolidWorks; CAD support for Alibre Design and Rhinoceros; full associativity; and support for CAD universal files
- 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
- built-in precision FEA model-building capabilities with structured meshing tools for building designs from scratch and refining CAD designs
- automatic, intelligent, feature-based mesh refinement and point-and-click definition of areas where a finer mesh is desired
- automatic, unstructured FEA meshing for parts and assemblies with a built-in aspect ratio check, using bricks, tetrahedra or a hybrid of bricks on the model surface (where result values are highest) and tetrahedra inside

ANALYSIS

MES provides:

- rigid-body motion and flexible-body kinematics that account for the bending, twisting, stretching, squashing and inertial effects of a model while simultaneously calculating motion
- support for flexible joints and links in a mechanism
- linear and nonlinear material models for real-world behavior of parts
- an automatic time-stepping scheme that incorporates an implicit timestep method to produce an efficient and accurate solution
- results based on physical data, rather than calculated or assumed loads and constraints
- freedom from estimating dynamic or contact forces or inputting constraints that do not exist in the real world (i.e., free-falling objects)
- automatic calculation of contact points, orientations and stiffnesses
- Timeline technology for managing time-dependent input
- dynamic visualization of the part's behavior during or after the event

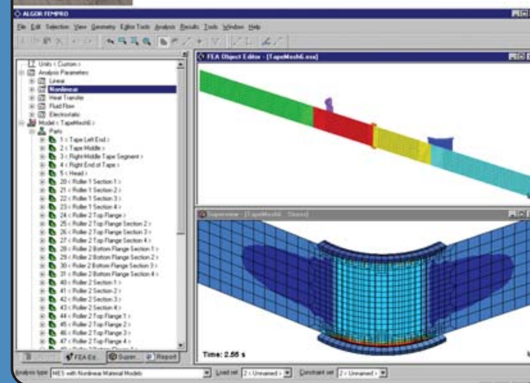
RESULTS EVALUATION AND PRESENTATION

A built-in graphics environment provides extensive results evaluation and presentation capabilities and features 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 or HTML reports

"Calculating the stress levels with MES enabled me to make adjustments and optimize the design [of a back-up tape drive]."

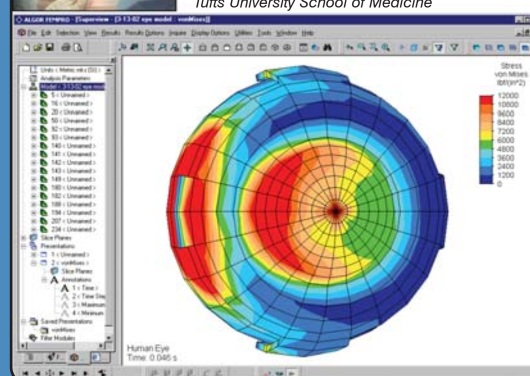
Paul Poorman
Hewlett-Packard



Paul Poorman of Hewlett-Packard chose MES to predict stress levels in the magnetic tape within a back-up tape drive. This data was used to develop a solution for reducing stresses in the tape.

"I chose FEA-based MES because it could predict stresses for a complete bio-mechanical model based on acceleration and deceleration as well as forces."

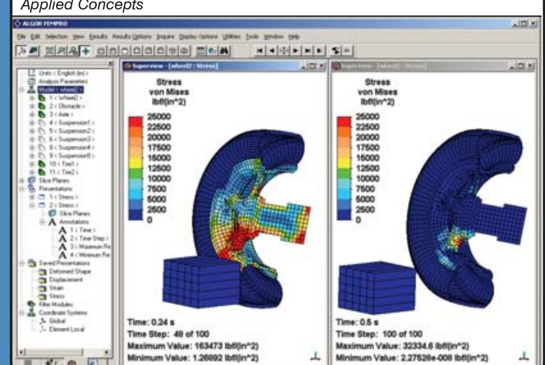
Robert Park
Ophthalmic Consultants of Boston and
Tufts University School of Medicine



Dr. Robert Park is using MES to study eye movement and resulting stresses in order to research retinal detachments. Possible outcomes of Park's research include the explanation, prevention and improved treatment of retinal detachments.

"ALGOR has an easy-to-use interface, provides a wide range of analysis capabilities including a powerful implicit nonlinear solver and is affordable."

Terry Bender
Applied Concepts



This Mechanical Event Simulation of an automotive tire and wheel assembly shows the stresses over time, including residual stresses, when the tire impacts an object such as a curb.

MECHANICAL EVENT SIMULATION FEATURES

Analysis Capabilities
- Rigid- and flexible-body motion with linear and nonlinear material models
- Multiple-body contact and interaction
- Hertzian contact
- Elastic deformation
- Permanent deformation
- Local buckling
- Pre-stress
- Residual stress analysis
- Thermal stress
- Creep analysis
- Failure analysis
- Sub-modeling
- Inertial effects
- High- and low-frequency effects
- Hydrodynamic effects
- Voltage-induced effects
- Load stiffening
- Damping
- Geometric nonlinearity

Modeling
- KinePak mechanism wizard to define links and then dynamically examine the motion of various types of basic mechanisms including four-bar, toggle, slider/crank, class 1, 2 and 3 levers and triangles
- See the FEMPRO (Part No. 3201.326) and CAD Support (Part No. 3201.331) product data sheets for additional modeling features

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

Element Library
- 2- and 3-D kinematic element
- 2- and 3-D hydrodynamic element
- General contact element
- Contact element
- Coupling element
- Dashpot element
- Translational and rotational actuator element
- Slider element
- Pipe element
- Spring element
- 2-D element
- 3-D truss element
- 3-D beam element
- 3-D membrane element
- 3-D shell element
- 3-D brick element
- 3-D tetrahedral element

Material Models
- Elastic
- Plastic
- Variable tangent
- Curve description
- Curve description with cutoff tension
- Drucker-Prager
- von Mises with isotropic hardening
- von Mises with kinematic hardening
- von Mises curve with isotropic hardening
- von Mises curve with kinematic hardening
- Temperature-dependent orthotropic
- Thermoelastic
- Thermoplastic
- Viscoelastic
- Viscoplastic
- Mooney-Rivlin
- Multiple-coefficient (5-constant) Mooney-Rivlin
- Multiple-coefficient (9-constant) Mooney-Rivlin
- Ogden
- Piezoelectric
- General piezoelectric

Loading and Constraints
- Initial velocities and rotations
- Impact planes
- Point-to-surface contact
- Surface-to-surface contact
- Dynamic friction
- Time-dependent load curves
- Multiple load curves
- Nodal, follower, surface and edge forces
- Moments
- Nodal and surface temperatures
- Nodal and surface voltages
- Nodal prescribed displacements and rotations
- Pressures and tractions
- Follower pressures
- Hydrostatic pressures
- Gravitational and centrifugal forces
- Nodal, surface and edge global and off-axis constraints
- End releases
- Nodal lumped masses

Solver Options
- Symmetric sparse
- Skyline
- Restart capability
- Automatic time-stepping
- Parallel processing for multiple processors

Results Evaluation
- Result contours of:
  - Displacement
  - Stress
  - Strain
  - Plastic strain
  - Reaction force
  - Vector plots of principal stress directions
- Capability to dynamically monitor the distance between parts or surfaces involved in surface-to-surface contact
- Fast Fourier Transform (FFT) display
- 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
- Timeline editor/viewer for viewing and editing the multiplier data associated with a time-dependent loading event
- See the FEMPRO product data sheet (Part No. 3201.326) for the complete list of user interface features

Note: For complete details on our Mechanical Event Simulation 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, steady-state and transient heat transfer, steady and unsteady fluid flow, electrostatics, full multiphysics and piping.

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