FEMtools™ Dynamics

Advanced Finite Element Solutions for Simulating Dynamic Response and Structural Modifications

Components

FEMtools Dynamics contains tools for

- Complex modes analysis.
- Superelement analysis.
- Frequency response functions (FRF).
- Harmonic response analysis.
- Structural dynamics modification.

Complex Modes Analysis

- Use integrated FEMtools sparse solvers or pilot external FEA solvers.
- Lanczos complex and Hessenberg modal solvers.
- Support for various types of damping (modal, proportional viscous and structural damping, viscous damper elements, material damping).

Superelement Analysis

A superelement is defined by grouping a number of elements and solve for this substructure separately. Superelements offer great time-savings in application that require significant re-analysis like time-domain and frequency domain responses analysis, design optimization, probabilistic analysis, robust design and multi-body simulations. Superelements are also used to overcome situations where a full solution is not even possible because of limited computer resources (internal memory, disk space).

- Integrated Craig-Bampton matrix reduction.
- Easy definition of superelements using sets of elements or sets of nodes.
- Support for assemblies without residual model.
- Automatic generation of master DOFs and processing of DOF relations.
- Support of slave DOFs in DOF relations as master DOFs of a superelement.

Frequency Response Functions (FRF)

To obtain FRFs, the response function is divided by the excitation force. Because these functions do not contain force information, they only depend on mass, stiffness and damping properties of the structure, just like the modal properties. Therefore they are also suitable as response for correlation analysis, sensitivity analysis and model updating.

Key Features

- Compute FRFs that are directly comparable to experimentally obtained FRFs.
- Use integrated FEMtools sparse solvers or pilot external FEA solvers.
- Modal and direct solvers.
- Residual vectors (inertia relief, viscous damping and applied loads).
- Modal FRF synthesis using from FEA or test modes.
- Support for various types of damping (modal, proportional viscous and structural damping viscous damper elements, material damping).
- Support for local coordinate systems.

Harmonic Response Analysis

In harmonic response analysis, the excitation is defined in the frequency domain. All of the applied forces are known at each forcing frequency.

Key Features

- Operational shapes analysis using modal and direct solvers.
- Displacement, velocity or acceleration response functions at selected DOFs.
- Enforced motion excitation.

Structural Dynamics Modification

Structural Dynamics Modification is a design-oriented tool to rapidly simulate effects of structural changes on the modal parameters and results obtained by modal techniques like FRFs or operational shapes.

Structural changes can be modeled as simple springs, masses, dampers, or any type of finite element (bar, beam, shell, volume). Because only a model geometry and modal parameters are used, the original data can be finite element data, test data and hybrid models.

Benefits

Structural modifications are transformed to equivalent changes of mass, stiffness and damping expressed in modal coordinates. The resulting set of equations can be solved at minimal computational expense and can therefore be done in real-time.

Key Features

- Modification using finite elements that are added to a test model or a finite element model. An unlimited number of modification elements and types can be combined.

- Point-and-click interactive definition of modification elements.
- Solution of modified mode shapes and resonance frequencies using modal parameters coming from modal test or finite element analysis.
- Slider control for all physical properties of the modification elements with real-time re-analysis and display of mode shapes, mode shape pairs, FRFs and operational shapes.
- Correlation analysis between unmodified and modified models.
- Variational analysis of all physical properties of the modification elements using the fast modal solver.

Applications

- Simulate structural modifications.
- Modal sensitivity and variational analysis.
- Design of tuned absorbers.
- Inverse analysis using target response.
- Substructuring.
- Investigate effect of different modeling assumptions on the level of correlation with test data.
- Fast modal solver for model updating.
- Sampling of design space.
- Estimate best starting values for model updating and design optimization.

Modification Elements

- Rigid or elastic linear spring (2-node or grounded.
- Viscous and structural dampers.
- Lumped mass addition or removal at any degrees-of-freedom.
- Truss (2-node element with axial stiffness only).
- General 3D beam element (2-node element with axial, torsional and bending stiffness).
- Tetrahedron, prism and brick volume elements.
- Physical properties depend on the element type and include spring stiffness, viscous and structural damping, material properties (Young's modulus, mass density, Poisson's ratio), plate thickness, beam cross section, beam section torsion and bending moments of inertia.

User Interface

- All definition, editing and analysis accessible via intuitive menus and dialog boxes or using free format commands for batch processing and process automation.
- Point-and-click interactive definition of modification elements.
- Dedicated graphics viewers for model inspection and results evaluation.
- Animated, side-by-side and overlay plots or unmodified and modified models, mode shapes, FRFs and operational modes.
- A slider control to dynamically change parameter values and immediately see the effect of the change in tables and graphics.
- All functionality is programmed in FEMtools Script language and can be easily customized or extended to fit user-needs.

Prerequisites

- FEMtools Framework with basic FEA Solvers (included).

Options

- Upgrade to FEMtools Correlation.
- Upgrade to FEMtools Model Updating.
- Upgrade to FEMtools Optimization.
- NASTRAN interface and driver.
- ANSYS interface and driver.
- ABAQUS interface and driver.
- UNIVERSAL FILE interface and driver.

Services

- Regular software maintenance.
- Installation, training and customization.
- Support by e-mail, fax and phone.
- Internet support site.
- Custom software development.
- Project research.
- Engineering services.

Supported Platforms

- Window XP, XP Pro, Vista/7/2003/2008 32-/64-bit
- Unix (HP-UX, IBM AIX, SUN Solaris)
- Linux (32-bit and 64-bit)

Flexible node-locked or floating licensing of annual or paid-up licenses.

For more information, contact us at

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