FEMtools™ Model Updating

An Integrated Solution for Structural Dynamic Simulation, Model Validation and Model Updating

Overview

FEMtools Model Updating contains modules for

- **Sensitivity Analysis** – Analyses how changes of parameters influence the structural responses. This information can be used for different applications including model updating.
- **Model Updating** – Iteratively changes updating parameters to make the structure better match the target responses.
- **Harmonic Force Identification** – Identifies harmonic loads from operational shapes.
- **Probabilistic Analysis** – Applies uncertainty to parameters to obtain probability distribution on output responses.
- **Design of Experiments** – Efficient sampling of the design space.

Applications

- What-If analysis.
- Variational and sensitivity analysis.
- Finite element model validation and refinement.
- Probabilistic model updating.
- Design improvement and robust design.
- Finite element model reduction.
- Structural damage detection.
- Material identification.
- Identification of structural parameters (e.g. joint stiffness, damping,…).

Benefits

- **All-In-One** - A single dedicated program with all capabilities required for productive test-analysis correlation and FE model updating.
- **Open Environment -** Using FEMtools Script, end-users, partners or subcontractors can customize existing tools, develop new proprietary tools or integrate in-house tools. Data translators to use test data and FEA data coming from other programs are available. External solvers can easily be integrated. Updated FE models are exported in ready-to-run data decks.
- **Practical** - FEMtools has been designed to update structural FE models as used in industrial applications. There are no limitations in model size. FEMtools fits into existing CAE environments.
- **Availability -** Native versions of FEMtools are on all hardware platforms available that are popular for CAE or testing applications.
- **Easy-to-Use** - FEMtools offers an intuitive graphical user interface and a powerful, free-formatted command language. Online documentation and context-sensitive help support the user.
- **Proven Technology** – FEMtools is the result of continuous research and development by a dedicated team of engineers and programmers.

Supporting Tools

- Direct data interfaces and drivers for external solvers.
- Database management.
- Integrated element library and solvers.
- Pretest analysis.
- Test-analysis correlation.

For more information, see the datasheets for FEMtools Framework, FEMtools Dynamics and FEMtools Correlation.

Sensitivity Analysis

Sensitivity analysis provides gradient information on the relation between parameters and responses.

- Selection of all element material properties, geometrical properties, boundary conditions, lumped masses, and damping factors as parameters.
- Selection of mass, static displacements, strain, resonance frequencies, modal displacements, MAC, FRFs, FRF correlation functions and ODS as responses.
- Sensitivity for local and global parameters.
- Internal sensitivity analysis to computer absolute or normalized sensitivities, finite difference and differential sensitivities .
- Pre- and postprocessing of external sensitivity analysis (e.g. Nastran SOL 200).
- Sensitivity and gain matrix analysis.

Model Updating

Model updating is used to minimize the 'distance' between FEA and reference test data.

- Automated iterative updating method.
- Possibility to combine different parameter types and response residues in a single run.
- Weighting of updating parameters and targets.

- Constraints on updating parameters.
- Linking of updating parameters.
- Simultaneous updating of multiple models (MMU).
- Superelement-based model updating.
- Probabilistic correlation and model updating.
- Internally or externally computed sensitivities.
- Automated scaling of sensitivity matrix .
- Automated support of internal and external solvers for static and dynamic re-analysis.
- Tracking of updating parameters and responses during updating.
- Undo functions and database restoration.
- Regrouping of local model updating results.
- Export of updated FE models.

Design of Experiments

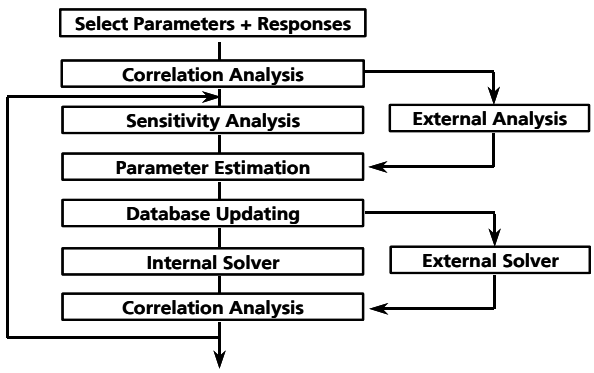
- Sample parameters using factorial, central composite, Latin hypercube or D-optimal designs.
- Find optimal starting values for parameters in case of poor initial correlation.

Harmonic Force Identification

- Force identification from dynamic response measurements.
- Definition of masks for location of forces.
- Identification of harmonic nodal and element pressure loads.
- Export of identified forces.

Probabilistic Analysis

- Apply a statistical probability distribution and randomly sample thousands of physical properties using only a few commands.
- Re-analysis using FEMtools or external solvers.
- For dynamic responses, a fast approximate modal solver can be used to significantly reduce the time required to run hundreds of simulations.
- Use all parameter and response choices available for Sensitivity Analysis and Model Updating.
- Postprocess simulations to obtain histogram, mean and standard deviation of output responses.



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.
- Complete electronic documentation.
- Dedicated graphics viewers for model inspection and results evaluation.
- Point-and-click interactive selection.
- Direct access to FEA and test data.
- Unlimited customization FEMtools Script language.

Prerequisites

- FEMtools Framework with basic FEA Solvers (included).
- FEMtools Dynamics (included).
- FEMtools Correlation (included).

Options

- Upgrade to FEMtools Full Version.
- NASTRAN interface and driver.
- ANSYS interface and driver.
- ABAQUS interface and driver.
- UNIVERSAL FILE interface and driver.
- Rigid Body Properties Extractor (Add-on).

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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