FEMtools™ Model Updating

An Integrated Solution for Structural Dynamics Simulation, Finite Element Model Verification, Validation and 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 (Included)

- 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 Pretest and 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, stress, resonance frequencies, modal displacements, MAC, POC, 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
- Internally or externally computed 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
- 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

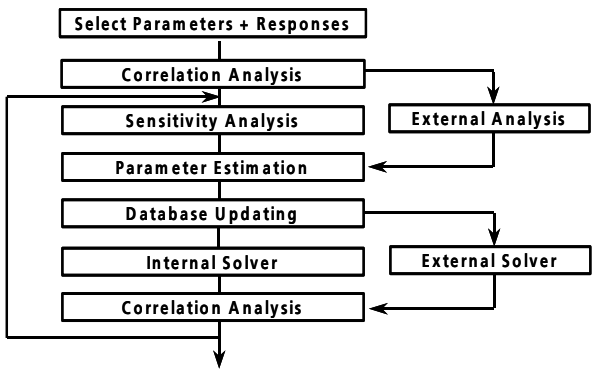
- Sample parameters using factorial, central composite, Latin hypercube or D-optimal designs
- Find optimal starting values for parameters in case of poor initial correlation

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

Prerequisites

- FEMtools Framework with FEA Solvers (included)
- FEMtools Dynamics (included)
- FEMtools Pretest and Correlation (included)

Options

- Upgrade to FEMtools Model Updating and Optimization
- FE interfaces and drivers (Ansys, Abaqus, LS-DYNA, MSC.Nastran, Simcenter Nastran, OptiStruct, SAP2000, Universal File)
- Data Acquisition (Add-on)
- Modal Parameter Extractor (Add-on)
- Rigid Body Properties Extractor (Add-on)

Services

- Installation, training and customization
- Support by e-mail, phone and support site
- Custom software development
- Project research

Supported Platforms

- Windows 10, 11 (64-bit)
- Linux 64-bit

For more information, contact us at

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