Overview

The FEMtools Modal Parameter Extractor module is a tool for extracting modal parameters (natural frequencies, mode shapes, modal damping) of a structure from a set of measured Frequency Response Functions (FRFs) or cross power spectra that are computed from response time series (Operational Modal Analysis).

Modal parameters can be used for applications in structural dynamics or to validate and update a finite element model. The extractor can be used interactively or as a component of an automated process for structural health monitoring and evaluation.

When using time series, DSP commands are available to process data and compute cross power spectra.

Applications

The FEMtools MPE uses Frequency Response Functions (FRF) for classic input-output modal analysis (EMA) or time series of responses for output-only modal analysis (Operational Modal Analysis; OMA).

FRFs and time series are experimentally obtained using dedicated hardware and software. For National Instrument frontends, FEMtools DAQ add-on can be used.

Response signals are divided by an excitation signal to obtain FRFs.

Under operating conditions, the excitation signal is unknown and FRFs cannot be obtained. In this case, FEMtools MPE computes cross correlation spectral functions that are in turn used to extract modal parameters.
FEMtools MPE can be used as a standalone tool for modal extractions, or combined with a data acquisition system.

As an add-on to any standard FEMtools configuration, modal extraction can be used in other FEMtools modules for the following purposes:

- Structural dynamics - Dynamic analysis relies on modal superposition of mode shapes for response analysis in time or frequency domain.
- Structural dynamics modification - Predict the effect of changes to stiffness, mass and damping.
- Modal coupling - Simulate the dynamic response of assembled structures, using coupled modal models obtained from test or FE analysis.
- Pretest planning - The modal extraction process can be evaluated using simulated test data as part of a virtual testing process.
- Test Analysis modal correlation - Comparing reference test modes with predicted modes provides a mean to validate simulation models.
- FE model updating - Finite element models are updated by improving the correlation between reference test modes and predicted modes.
- FRF re-synthesis - Test FRFs can be smoothed by re-synthesis from extracted modal parameters which is recommended if these FRF will be used for FRF-based updating of FE models.
- Rigid body properties extractor - To obtain a better mass line for rigid body properties extraction, the first resonance peaks can be removed from the FRFs. This is done by modal extraction and re-synthesis.
- Material Identification - Identification of material properties using mixed numerical-experimental vibration analysis. Modal extraction provides a way to identify the mode shapes of a test sample.
- Structural health monitoring - Modal extraction is a component of a system for automated monitoring of modal parameters in structures.

Benefits

- Powerful - Using efficient algorithms and optimized DSP, modal extraction is fast and can support a very high number of channels.
- Easy to Use - Only minimal user-interaction is required and all functions are combined in a single interactive applet.
- Efficient - Very clear stabilization charts are produced making them suitable for automatic identification of stable poles.
- Reliable - Reliable and stable methods are used for global and local extraction of modal parameters. Out-of-band modes are taken into account to compensate residual effects and improve extraction accuracy.
- Flexible - Modal extraction can be operated manually or used as part of an automated process.

Prerequisites and Licensing

FEMtools MPE requires a separate license that is used together with a license for any FEMtools standard configuration.

Test FRFs for modal analysis and time series for OMA can be obtained with FEMtools DAQ add-on or imported from 3rd party hardware and software.

Services

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

Supported Platforms

- Windows 7, 8, 10, 11 (64-bit)
- Linux 64-bit

For more information, contact

Ambachtenlaan 14/5
B-3001 Leuven
Belgium
+32 (0)16 40 23 00
info@femtools.com - www.femtools.com