

FEMtools™ Data Acquisition

Time Signal and Transfer Function Acquisition through National Instruments Frontends

The FEMtools Data Acquisition (DAQ) is a FEMtools add-on tool for acquiring vibration signals from a structure through data acquisition hardware. The required hardware includes response transducers like accelerometers and an optional excitation device (impact hammer or shaker) that is equipped with a piezoelectric-based force transducer.

This module can be combined with other FEMtools add-ons such as FEMtools MPE for modal parameter extraction or FEMtools RBPE for rigid body properties extraction, which can ultimately be used for applications in structural dynamics or to validate and update a finite element model.

Overview

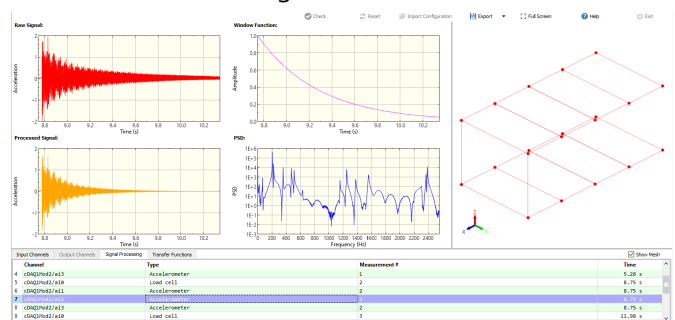
The FEMtools Data Acquisition module is a tool for acquiring multi-channel vibration signals from a structure with the use of data acquisition hardware in an easy and intuitive way.

The module is available to all FEMtools configurations as an add-on, only requiring FEMtools Framework. The following features are introduced:

- Direct interfacing with data acquisition frontends from National Instruments for Dynamic Signal Acquisition (DSA) using NI-DAQmx drivers. The NI CompactDAQ, CompactRIO, PCI and PXI product lines are supported through the NIDAQmx device drivers
- Test model display to assist in connecting data channels to measurement degrees of freedom
- Reference channel selection
- Support for roving hammer or roving sensor impact test with optional automatic measurement point increment
- Trigger-based data acquisition for hammer excitation with audio and visual feedback
- Shaker signal generation (chirp, burst random, pure random, pseudo-random)
- Free run data acquisition (for operational modal analysis)
- Real-time monitoring of time series (amplitude or FFT) for selected channels
- Signal windowing options
- Linear and exponential averaging
- H1, H2 and Hv FRF estimators

- Auto and Cross-Power Spectra (XPS), FRF and Coherence function monitoring
- Time histories manipulation (detrending, decimation and filtering)
- Preview and selection of transfer functions before saving them in the FEMtools internal database
- Direct access of FRF and XPS functions to other FEMtools modules for modal parameter extraction, mass properties extraction and correlation with FE analysis

Exporting of measured time series, FRF and XPS functions is done using the universal file format.

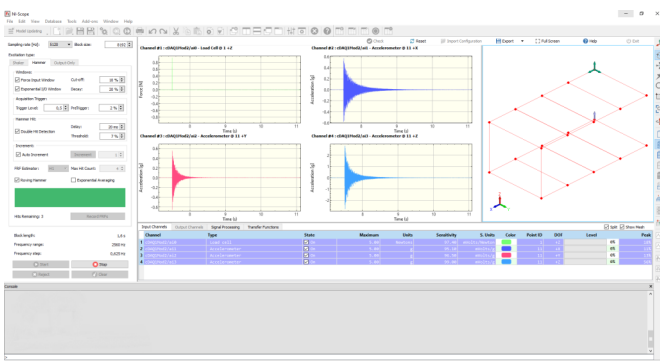


Signal Processing tab during impact hammer test.

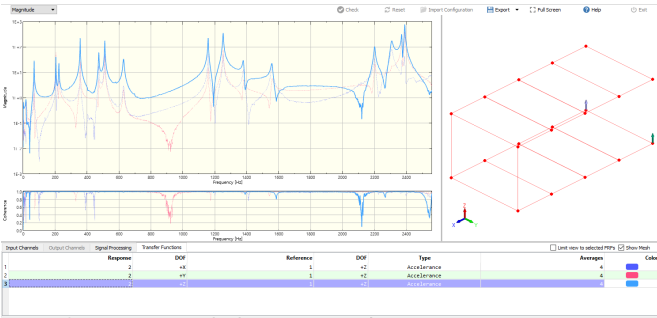
Applications

FEMtools DAQ can be used as a tool for obtaining transfer functions that are then exported to other software, or used together with other FEMtools modules. The following applications are available:

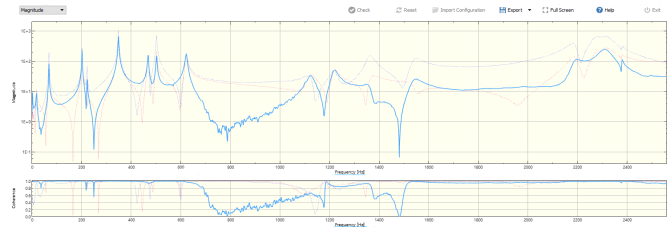
- **Modal Parameter Extractor (MPE)** - Modal parameters can be extracted from FRFs (input-output) or XPS (output-only). The resulting modal parameters can be used for applications like:
 - **Dynamic response analysis** - Dynamic analysis relies on modal superposition of mode shapes for response analysis in time or frequency domain.
 - **Structural Dynamics Modification (SDM) and Modal-Based Assembly (MBA)** - Simulate the dynamic response of assembled structures, using coupled modal models obtained from test.
 - **FRF re-synthesis** - Test FRFs can be denoised by re-synthesis from extracted modal parameters,



FEMtools DAQ panel.



Transfer Functions tab during impact hammer test.



FRF Magnitude and Coherence functions in FEMtools DAQ. The Coherence function can be used to evaluate quality of multiple extractions over the frequency range of interest.

which is recommended if these FRFs are to be used for FRF-based updating of FE models.

- **Modal-based correlation and updating** - Comparing reference test modes with simulated modes provides a means to validate simulation models. Finite element models can then be updated by improving the correlation between reference test modes and predicted ones.
- **Rigid Body Properties Extractor (RBPE)** - Rigid body mass properties can be extracted from FRFs if the measurements respect a number of conditions. The resulting properties can be used for lumped mass model creation or as a target for FE model updating.
- **FRF-Based Assembly (FBA)** - Test FRFs obtained from a component can be assembled with FRFs obtained from other components, either by test or simulation.
- **FRF-Based correlation and updating** - Finite element modes can be updated to improve the correlation between reference test FRFs and simulated FRFs.

FEMtools DAQ can also be part of a complete vertical solution that integrates data acquisition, modal extraction and FE model updating for application such as:

- **Material Identification** - Identification of material properties using mixed numerical-experimental vibration analysis.
- **Structural Health Monitoring (SHM)** - Automated monitoring of modal parameters of structures for damaged assessment and residual lifetime estimation.

Benefits

- **Easy to Use** - A single control window is used for all settings and very little user-interaction is required once test setup is ready.
- **Flexible** - Shaker tests, impact hammer tests or output-only tests can be run, according to the user needs and available hardware.
- **Integrated** - Combined with other FEMtools modules and add-ons, multiple applications can be explored from start to finish with one software only.

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 test data
- Unlimited customization with FEMtools Script language

Prerequisites and Licensing

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

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

 **Dynamic Design Solutions**

CAE Software and Services

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