m+p Analyzer

Structural acquisition & analysis

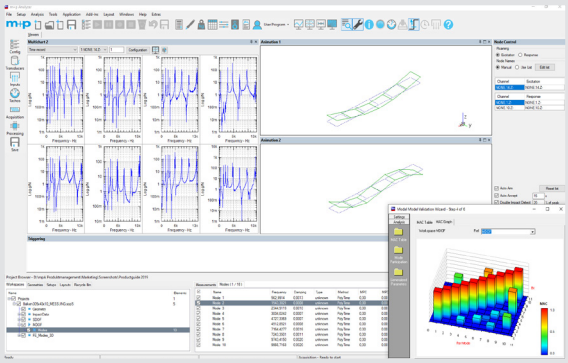
The Structural Dynamics package, part of the m+p Analyzer for noise and vibration testing, offers comprehensive tools for for measuring, analyzing and documenting the vibrational behavior of machines and structures. It supports classical and operational modal analysis, impact and MIMO acquisition, ODS, SDOF, MDOF analysis, and includes a modal model validation module.

Users can easily create structure geometry, calculate modal parameters, and animate mode shapes. Experimental modal data —frequency, damping, and mode shape—are obtained via curve fitting of FRF (Frequency Response Function) measurements, which can be measured, calculated, or imported.

Key features

Structural acquisition and analysis

- Data collection, analysis and reporting in one package
- Impact (modal hammer) data acquisition
- Creation of component based geometries
- ODS (Operational Deflection Shape) analysis
- SDOF (Single Degree of Freedom) analysis
- MDOF (Multiple Degree of Freedom) analysis
- OMA (Operational Modal Analysis)
- Modal model validation
- Polyreference Time Domain algorithm
- Polyreference Time Domain Plus algorithm
- Polyreference Least-Squares Complex Frequency Domain algorithm
- Connection to FEMtools for SDM analysis (optional)
- Correlation and model updating between experimental data and Finite Element Analysis (FEA), with optional SDM analysis using FEM tools
- Intelligent wizards for easy and safe user guidance
- Copy & paste to applications like MS Word and PPT
- Free installation of the m+p Analyzer Viewer software to actively view/analyze data on any MS Windows PC
- Advanced frequency domain curve fitter and optimized pLSCE



Comprehensive structural data analysis tools

Structural add-ons

- MIMO (Multiple Input/Multiple Output) analysis including multi-source outputs
- Stepped sine online analysis
- Sine reduction analysis

Applications

- Analysis of structural dynamics in the automotive, aerospace, defense, consumer and other industries
- Experimental modal analysis
- Operational modal analysis
- Fixture analysis for environmental vibration test (for MILSTD 810F)
- Vibrational troubleshooting

Overview

The Windows-based Structural software uses intelligent wizards which, step by step, guide you through the process of performing a modal acquisition and analysis. Graphs and mode shapes can be directly copied and pasted into compliant applications such as Microsoft Word or PowerPoint. The m+p Analyzer Viewer software can be installed on any PC at no extra cost.

A data interface is available between the m+p Analyzer and the FEMtools software of DDS Corporation. FEMtools also interfaces to all popular FE analysis software packages. It has modules for pre-test analysis, SDM (structural dynamics modifications) analysis, correlation analysis and FE model validation and updating. More information is available at www.femtools.com.

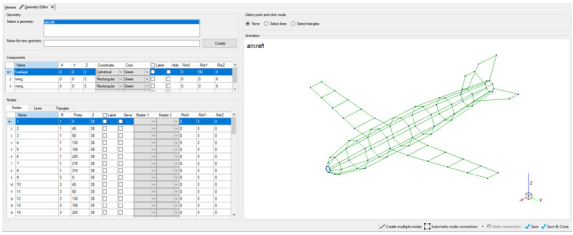
Impact data acquisition

Impact testing includes useful tools like the selection of a roving hammer or transducer, selection of data points/nodes, double impact detection and rejection, definition of force and exponential window and a user-definable display configuration as a visual measurement feedback. The combination of automatic DOF/node scheduling, automatic rejection of invalid measurements and automatic saving of data after a user-defined interval virtually eliminates all keyboard interaction. This is helpful for impact testing on large structures or at locations that are difficult to access.

Unlimited and freely definable list of user-specific header information (metadata) for annotation, data retrieval, sorting and reporting
Simple parameter entry for the channels in tables including engineering units, transducer calibration data and inputs
Channel type: excitation, response, inactive; DC or AC coupled; input range, offset, pregain
Channel input: V, ICP
Enter transducer calibration data or import from Excel
Roving hammer or roving transducer mode
Easy selection of measurement points (nodes) and directions
Level trigger with selectable pretrigger
Acquisition setup: sample rate or useful bandwidth, blocksize, arming
Data processing/data storage: time record, spectrum, PSD, cross-PSD, cross-half-PSD, FRF, coherence; linear averaging
Windows: uniform, force-exponential; force width and exponential end in %
Automatic detection and rejection of double impact measurements
Automatic, hands-off stepping through measurement points (nodes) and storage of averaged results during acquisition
User-definable displays for impact pulse, PSD, FRF/Coherence etc.
Save and recall measurement and display setups

Geometry creation

Component based geometries for ODS/modal analysis can be created in a simple step-by-step approach. The steps are to define the components, describe them with nodes and draw lines and surfaces. Geometries can also be imported as UNV/UFF files and from most CAD packages via STL format.



Geometry creation

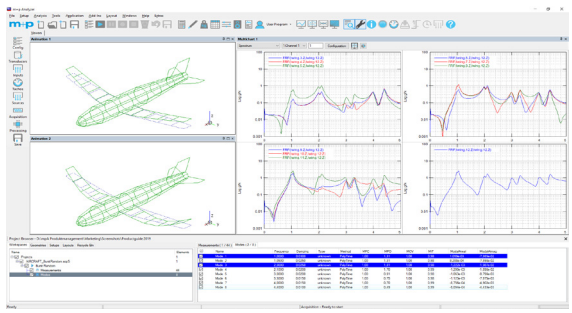
- Rectangular, cylindrical or spherical coordinate systems
- Components can be displayed in different colors
- Rotate components around the X, Y and Z axis
- Arbitrary node names
- A node can be a slave to one or two other master nodes
- Enter sensor/node direction as a rotation around the X, Y and Z axis
- Draw lines and surfaces with the mouse, or by entering node data in a table
- Rotate, resize and move the geometry while drawing
- Geometry tables can easily be imported from and exported to Excel for enhanced processing capability

Operating deflection shape (ODS) analysis

The Operating Deflection Shape (ODS) analysis is used to visualize how a structure vibrates under steady-state operating conditions. Unlike modal analysis, knowledge of the input forces is not required. The source of the data for the analysis can be time, spectra, crosspower or FRF measurements. A geometry and corresponding measurement data are the only prerequisites for an ODS analysis. Any measurement can easily be referenced to a node by a simple header entry. Measurement data and geometry are then displayed together allowing immediate animation of an ODS at any discrete frequency, or over a frequency sweep. While the structure is animated, there is access to tools for selecting the data being displayed, storing a mode, moving through the data or searching for the ”next“ peak in the data.

- ODS in frequency and time domain
- Automatic check for missing data
- Online display of ODS for cursor selected frequency
- Manual cursor placement or automatic sweep, adjustable sweep speed
- Automatic cursor peak finding for ODS storage

Modal analysis[1)]



Advanced MDOF modal analysis

Both SDOF (Single Degree of Freedom) and MDOF (Multiple Degree of Freedom) analysis use FRFs to calculate the modal parameters (natural frequencies, damping and mode shapes) of the structure. The SDOF analysis steps are identical to those of the ODS analysis. However, the SDOF analysis uses least squares fit, peak picking and quadrature cut methods to estimate the modal parameters.

The MDOF analysis handles the most sophisticated modal analysis tasks like detecting repeated or closely spaced modes. It takes the user through a simple series of steps to complete the analysis and also makes intelligent estimates of all analysis options so even an inexperienced operator can produce a reliable result whereas the experienced user can easily fine tune his result for the most difficult analysis situations and can therefore decide whether to use the automatic pole selection in the stability diagram, to use it partially, or to select the poles completely by hand.

[1)] included in AN-MM add-on

The SDOF and MDOF wizards include the option of processing operational modal data. This is for cases where a structure is self-excited or where input forces are not known. Applications include automotive testing using road loading, bridges using traffic passing, shakers using random or swept sine inputs etc. In this case, a set of cross power measurements replace the FRFs and are processed using accepted assumptions about the forcing function input. In contrast to classical experimental modal analysis which relies on FRFs calculated from measured excitation forces and response signals, OMA (Operational Modal Analysis) only requires the structure's responses which are measured assuming an equally distributed excitation.

Industry-proven time and frequency curve fitting algorithms with wizard-guided operation offer ease of use and simplify result interpretation for non-experts. The time domain method is optimized for lightly damped structures and can also be enhanced by the optional PTD+ algorithm to filter spurious modes. The frequency domain algorithm is optimized for high system orders (above 50) in more heavily damped structures. All methods include clear stabilization diagrams and synthesized FRFs for optimum analysis.

FRFs: acceleration/force, velocity/force, displacement/force
SDOF: least squares fit, peak picking and quadrature cut
MDOF: polyreference time domain method for extracting poles and modal participation factors; multi-reference least squares frequency domain method to estimate the modal vectors; multivariate and power spectrum summation mode indicators
Select data, references and directions for the analysis process
Automatic checking for missing data
Select frequency range, data being displayed and mode indicator function
Determine the modal order and the over-determination factor
Stability diagram: set the tolerance of the stability parameters and select poles by hand or automatically
Synthesis and shape animation: view and save selected mode shapes
Wizard guides through the analysis process and greatly facilitates it by limiting the choices to be made
Modal model validation (MAC, MPD, MPC, MOV, MIF)
OMA (Operational Modal Analysis)
Polyreference Time Domain algorithm (PTD/PolyTime)
Polyreference Time Domain Plus algorithm (PTD+/Polytime+)
Polyreference Least-Squares Complex Frequency Domain algorithm (p-LSCF/Polyfreq)

Multiple input/multiple output (MIMO) analysis[2)]

The Multiple Input/Multiple Output (MIMO) module allows full calculation of mulitple input multiple output FRF datasets. It enables to measure the crossfunctions of all responses versus all excitations and checks the correlation of multiple inputs by displaying the eigenvalues of the input crosspower. The results are the Principal Input Spectra indicating the number of uncorrelated physical inputs. Acquiring data with multiple inputs requires that the inputs are uncorrelated with one another.

Unlimited and freely definable list of user-specific header information (metadata) for annotation, data retrieval, sorting and reporting	
Simple parameter entry for the channels in tables including engineering units, transducer calibration data and inputs	
Channel type:	excitation, response, inactive; DC or AC coupled; input range, offset, pregain, acoustical weighting; FIR weighting filters hand, arm, body, user defined
Channel input:	V, ICP, Charge
Enter transducer calibration data or import from Excel	
Source modes:	random, burst random, periodic random, sine, stepped sine, burst sine, chirp, sine sweep, multiple level controlled fixed/swept sine and random
Source parameters:	level, bandwidth, burst %, sine frequency, sine phase, ramp time

[2)] included in AN-MM add-on

Acquisition setup:	sample rate or useful bandwidth, blocksize, arming
Trigger modes:	free run, source, channel, pos./neg. slope, zone entry/exit; level, pretrigger up to 100%
Data processing:	principal input spectra, time record, spectrum, autopower, crosspower, PSD, cross-PSD, FRF, coherence, autocorrelation, crosscorrelation, histogram, probability distribution, probability density, impulse response
Averaging:	none, linear, exponential
	uniform, hanning, hamming, flattop, exponential; exponential end in %
Auto-ranging:	instant graphical feedback, automatic/manual ranging, range up only
Overload handling:	ignore, retry or break
Save and recall measurement and display setups	
Calibration:	calibrate transducers

Swept and stepped sine analysis[3)]

Both swept sine and stepped sine analysis modules are available. Compared to random excitation modes these single frequency excitation modes offer improved signal to noise ratio, the ability to analyse non-linear effects and user control over structural settling times for improved mode identification.

Entry of start frequency, end frequency, frequency step or sweep rates
User selection of step delay, averaging and tracking filter bandwidth
Data processing/data storage: FFT spectra, auto-power spectra, crosspower spectra, FRF, coherence
Modal analysis using the SDOF and MDOF functions
Automatic cursor peak finding for ODS storage

Viewers/post-processing

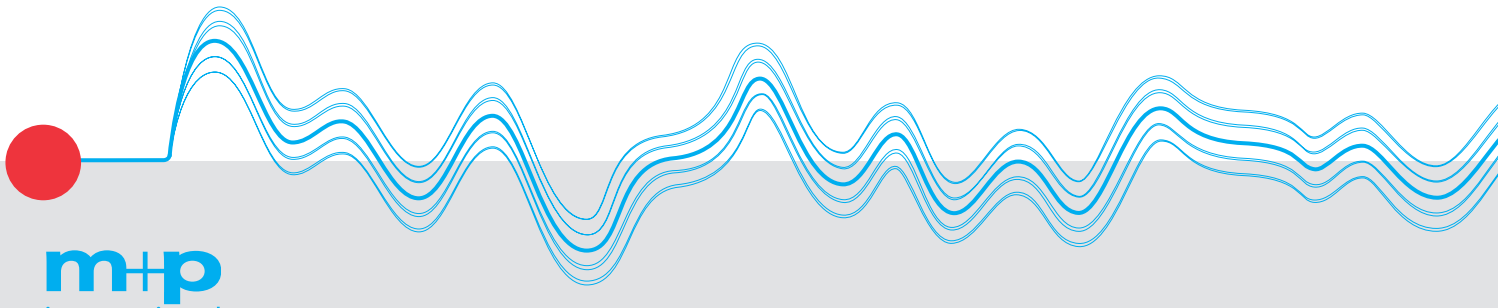
The basic license already includes extensive data import/export and viewer functions for 2D and 3D viewers, such as scaling, zoom and cursor functions, to name just a few. Detailed descriptions of the functions can be found in the “m+p Analyzer eReporter” data sheet. With regard to structural analysis, the m+p Analyzer offers the following additional features.

Animation viewer
Unlimited number of displays, up to 4 views (x, y, z-axis, selectable) per display
Rotate, resize, move the geometry
Solid or wireframe view
Undeformed or animated view
Animation speed and amplitude selectable, or manual stepping
Node measurement direction view
Geometry component color selection
Post-processing
Advanced data import/export (for example ansys text file)
All processing can be done from imported time domain signals
Drag/drop data combining from different workspaces
Advanced calculator for non-standard calculations

[3)] included in AN-SSO and AN-SINR add-ons

Operating system

Microsoft Windows 10/11 Pro 64 bit



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