Modal Parameter Extraction LabVIEW VIs

Modal Parameter Extraction, a subset of Modal Analysis, consists of a set of algorithms used to identify the modal parameters of a structure (natural frequency, damping ratio, mode shapes). These algorithms are either used for experimental research or for operational on-line monitoring. These algorithms include Peak Picking, Least Square Complex Exponential Fit, Frequency Domain Polynomial Fit, Stochastic Subspace Identification, and FRF Synthesis. Each of these algorithms perform the same function of identifying the modal parameters, however, each are optimized for a specific test scenario.

Click here to download the Modal Parameter Extraction LabVIEW VIs.

*Note that to apply these functions, you need to install LabVIEW 8.6 or later, with the LabVIEW Advanced Signal Processing Toolkit (ASPT), and LabVIEW System Identification Toolkit (Sys ID).

Experimental Modal Analysis

Experimental Modal Analysis is the field of measuring and analyzing the dynamic response of a structure when excited by a stimulus. Experimental Modal Analysis is useful in verifying FEA results as well as determining the modal parameters of a structure. This type of analysis is used primarily in research and scale model testing. The following algorithms are available as LabVIEW VIs and available for download below.

Peak Picking

Peak Picking is a method used to extract a mode from a pre-computed signal's Frequency Response Function (FRF). It is a frequency domain Single-Degree-of-Freedom (SDOF) modal analysis method and suitable to estimate uncoupled and lightly damped modes. The computation is fast but the result is sensitive to the frequency shift.

Least Square Complex Exponential Fit

Least Square Complex Exponential Fit (LSCE) is used to simultaneously extract multiple modes from pre-computed signal's FRF. It is a time domain Multiple-Degree-of-Freedom (MDOF) modal analysis method and suitable for estimating modes in a wide frequency band. It is ideal for lightly damped modes.

Frequency Domain Polynomial Fit

Frequency Domain Polynomial Fit (FDPI) is used to simultaneously extract multiple modes from pre-computed signal's FRF. It is a frequency domain MDOF modal analysis method suitable to estimate heavily damped modes, particularly for heavily damped modes in a narrow frequency band.

Operational Modal Analysis

Operational Modal Analysis is the field of measuring and analyzing the dynamic response of a structure when in operation. Operational Modal Analysis is focused on the real-time on-line monitoring of a structure. Because the stimulus is unknown (ambient conditions such as wind, cars, seismic activity, etc.), a different set of algorithms are used. The following algorithm is available as a LabVIEW VI and available for download below.

Stochastic Subspace Identification

Stochastic Subspace Identification (SSI) is used to simultaneously extract multiple modes from time data samples. It is a time domain MDOF Operational Modal Analysis (OMA) method. Stochastic Subspace Identification does not require knowledge of the stimulus and only analyzes the time domain vibration data of a structure in operation. It is used primarily for on-line monitoring of structures such as bridges.

Modal Analysis Verification

Modal Analysis Verification is a process of verifying the Modal Parameter Extraction results by re-creating the FRF data. This method allows for a quick comparison to the original FRF data for validation.

FRF Synthesis

FRF Synthesis is used to create synthetic FRF for testing and evaluation. With computed modal parameters, you can compare synthesized FRF and original FRF to verify the resulting estimation.

Click here to download the Modal Parameter Extraction LabVIEW VIs.

Click here to download the Evaluation Version of LabVIEW.