

Software

IMAT + Signal™ | IMAT Signal Processing Toolkit

Overview

IMAT is a toolbox for use with MATLAB®, offered by ATA Engineering, Inc. (ATA). Designed for test and analysis engineers, it provides a framework for easily importing finite element (FE) simulation data and measured test data into the MATLAB environment to leverage the versatile programming, visualization, and mathematical strengths of MATLAB. With the IMAT toolbox, test and simulation data such as mode shapes, time histories, spectra, and other functions can be viewed and manipulated in MATLAB while preserving all of the native data attributes.

IMAT+Signal extends IMAT's functionality into signal processing, which involves processing data from the time domain into the frequency domain. IMAT+Signal provides graphical interfaces that greatly simplify the task of processing this data. spFRF (signal processing for frequency response functions) is a GUI application for computing power spectral density (PSD) and cross spectral density (CSD) functions from time histories and creating frequency response functions (FRFs) from spectral functions. spVIEW facilitates viewing and comparing different measurement datasets in the time and frequency domains. In addition, Rotating Test Kit (RTK) is a GUI that allows the analysis of rotational events using Vold-Kalman filtering. IMAT contains the most advanced implementation of order-based Vold-Kalman filtering available in a commercial software product. The IMAT+Signal GUI controls are provided as command-line functions such that any task can be easily scripted within MATLAB.

Stationary Signal Processing with spFRF

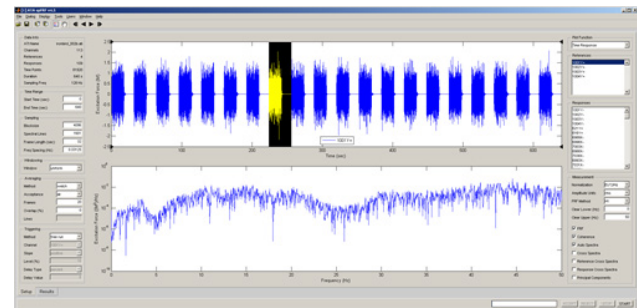
spFRF™ stands for "Signal Processing for Frequency Response Functions." The primary purpose of this application is to process time response data into spectral functions such as frequency response, coherence, auto-spectra, and cross-spectra. spFRF can read time response functions from ADF files, Universal files, or from the MATLAB workspace, and can write time response and spectral functions to the same. spFRF can process continuous measurements, as well as triggered measurements with the ability to preview, and accept or reject, each frame. Although the name implies that spFRF produces frequency response functions, it can also generate the auto-spectra of response-only datasets and can be used for principal component analysis.

Key features of spFRF:

- Process time histories into FRF and spectra
- Access features from the GUI or directly through a command-line interface
- Write your own extensions with plugin capability

Plotting Measurements with spVIEW

spVIEW™ is a companion to spFRF for plotting the spectra function results from multiple datasets of measurements. spVIEW can also plot time response, mode indicator, and sound pressure level functions in separate tabbed modules.



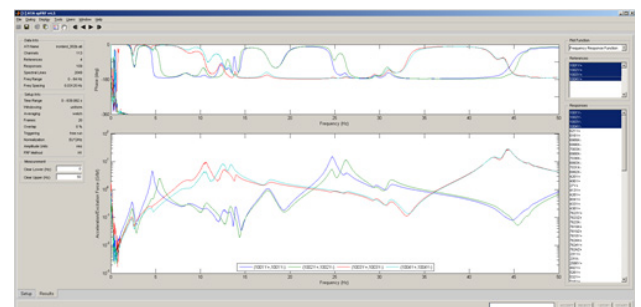
- Visualize and control processing of time-domain signals to the frequency domain with spFRF.

[1] spFRF : Channels

Chan Ref	Resp Coord	ID Line 1	Data Type
1	<input checked="" type="checkbox"/> 1001Y+	DP LC left wing	Excitation Force
2	<input checked="" type="checkbox"/> 1002Y+	DP LC right wing	Excitation Force
3	<input checked="" type="checkbox"/> 1003Y+	DP LC left stab	Excitation Force
4	<input checked="" type="checkbox"/> 1004Y+	DP LC right stab	Excitation Force
5	<input type="checkbox"/> 1001Y-	DP accel left wing	Acceleration
6	<input type="checkbox"/> 1002Y-	DP accel right wing	Acceleration
7	<input type="checkbox"/> 1003Y-	DP accel left stab	Acceleration
8	<input type="checkbox"/> 1004Y-	DP accel right stab	Acceleration
9	<input type="checkbox"/> 621Y+	left wing aft 2	Acceleration
10	<input type="checkbox"/> 616Y+	left wing aft 3	Acceleration
11	<input type="checkbox"/> 6989X-	right tail aft 1	Acceleration
12	<input type="checkbox"/> 6989X-	right tail aft 3	Acceleration
13	<input type="checkbox"/> 7003X-	right tail aft 2	Acceleration
14	<input type="checkbox"/> 6989X-	right tail aft 4	Acceleration
15	<input type="checkbox"/> 7038X-	right tail fwd 3	Acceleration
16	<input type="checkbox"/> 6993X-	right tail fwd 2	Acceleration
17	<input type="checkbox"/> 7031X-	right tail fwd 4	Acceleration
18	<input type="checkbox"/> 6992X-	right tail fwd 1	Acceleration
19	<input type="checkbox"/> 420Y+	right stab fwd 3	Acceleration
20	<input type="checkbox"/> 406Y+	right stab fwd 1	Acceleration
21	<input type="checkbox"/> 27Y+	right stab fwd 4	Acceleration

FILTER: All Resp Coord: Filter Invert CTrace
 Disable Resp Plot OK Cancel Apply

- Configure channels in spFRF using its powerful selection capabilities.



- spFRF displays your processed frequency-domain results so you can easily assess data quality.

And while the modules are mostly independent, some functions can be sent between the modules. For example, FRFs in the Spectra module can be used to compute mode indicator functions that are then sent to the MIFs module. spVIEW can read time response and spectral functions from ADF files, Universal files, or from the MATLAB workspace, and can write sieved and truncated datasets of functions to the same. spVIEW's primary purpose may be plotting measurements, but it also has some signal processing and computational capabilities, such as filtering, resampling, decimation, and octave band reduction.

Key features of spVIEW:

- Interactive viewing of many types of measurements
- Send datasets to and from spFRF and OPoly
- Access features from the GUI or directly through a command-line interface
- Write your own extensions with plugin capability

Order Tracking with RTK

The Rotational Toolkit (RTK) in IMAT+Signal is designed for jet engine and rotating equipment engineers. The RTK application is used for applying the Vold-Kalman filtering technique to order tracking of rotational events. The Vold-Kalman filtering capability included in IMAT is the most advanced capability available in any commercial software product. It can track multiple tachometer signals simultaneously in large datasets. RTK is a very easy-to-use GUI with three simple steps: load the data, run the analysis, and plot the results.

The application uses time history data files from simulations or real-time data collection to process and visualize the spectral properties of events. This tool facilitates the processes of obtaining response characteristics and finding insights into the mechanics of rotating events. Users are able to view results as a contour plot of the data, a 3D waterfall plot, or an "X-Y" plot that allows the user to select single or multiple items from all available results. This third plot option will also allow the user to filter items from the results produced.

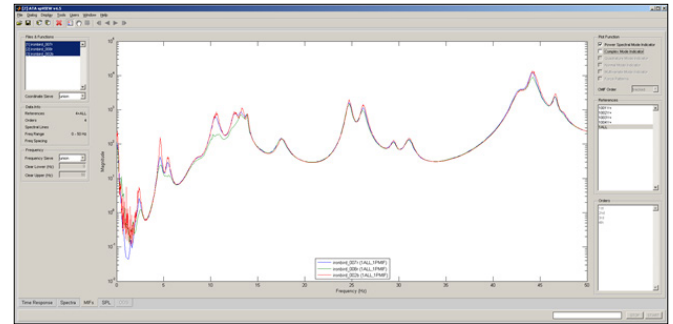
Key features of RTK:

- Perform order tracking on results in a user-friendly GUI
- Visualize order-related vibrations from non-order-related vibrations using contour plots
- Use advanced function plotting utilities designed specifically for rotating equipment
- Import comma-separated variable (CSV) files that contain time, speed, and forcing functions

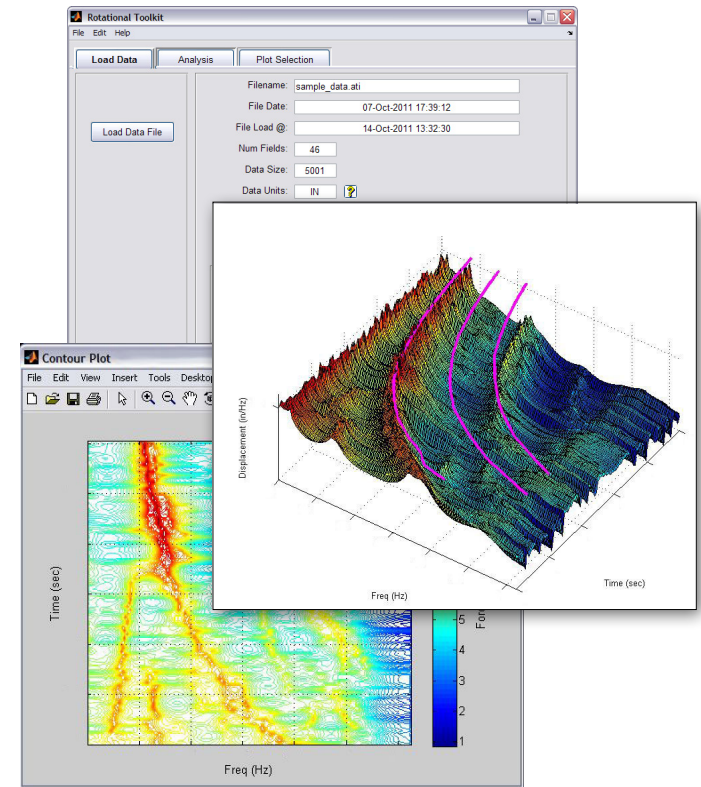
Command-Line Utilities

IMAT+Signal also provides a number of command-line utilities for performing various signal processing tasks:

- Computing PSD, CSD, FRF, and coherence from time-domain signals
- Time-domain IIR and FIR filtering
- Robust and powerful Vold-Kalman order-tracked filtering, including support for multiple tachometers
- Creating and plotting spectrograms without using the MATLAB Signal Processing toolbox
- Computing shock response spectra (SRS) from time-domain signals
- Generating time-domain signals from SRS or PSDs



- Easily compare mode-indicator functions from multiple test runs.



- Access powerful order-tracking plotting capabilities with RTK.

Hardware Platforms

The IMAT toolbox was written primarily in the MATLAB language. Versions are available for 64-bit Windows, 64-bit Linux, and 64-bit Mac platforms. MATLAB R2020a (or higher) is a prerequisite for IMAT v8.0. The RTK user interface of IMAT+Signal also requires the MATLAB Signal Processing toolbox.

About ATA

ATA Engineering has more than 45 years of experience in structural dynamics analysis and testing, and is a world leader in test-analysis correlation and model updating. For more information please visit www.ata-e.com.