



VIBES Toolbox for MATLAB

2019 Product Brochure

VIBES Toolbox for MATLAB

Unique capabilities packed in a powerful toolbox

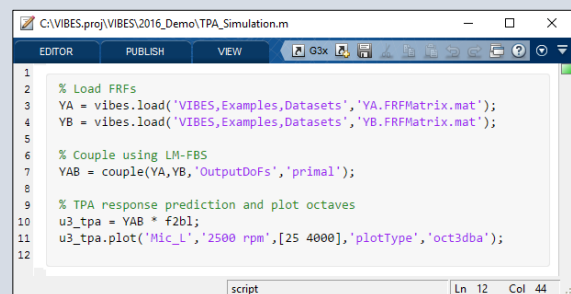
Dynamic Substructuring // Transfer Path Analysis // Virtual Point Transformation // Numerical Modelling

The VIBES toolbox for MATLAB offers unique capabilities for Dynamic Substructuring and Transfer Path Analysis. The latest scientific advancements in structural dynamics have been implemented in an easy-to-use toolbox for MATLAB. With the toolbox, you can:

- Create FEM-compatible 'super-elements' from FRF measurements using the Virtual Point Transformation.
- Combine experimental component models, numerical models and operational data, realizing a truly hybrid approach to sound & vibration simulation.
- Import, manage and share your results using the industry-standard ASAM-ODS format.

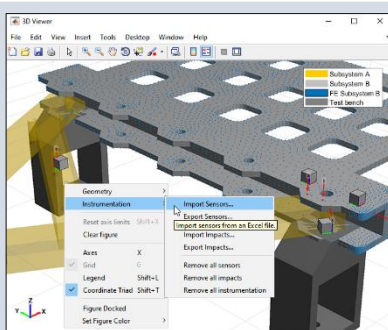
Intuitive arithmetic and automated bookkeeping

The object-oriented workflow unlocks a wide range of Dynamic Substructuring and TPA methods, all accessible and adaptable from the command-line. Save time by automating repetitive processes in simple scripts and generate plots conveniently using intuitive commands for data selection.



```

1 % Load FRFs
2 YA = vibes.load('VIBES,Examples,Datasets','YA.FRFMatrix.mat');
3 YB = vibes.load('VIBES,Examples,Datasets','YB.FRFMatrix.mat');
4
5
6 % Couple using LM-FBS
7 YAB = couple(YA,YB,'OutputDoFs','primal');
8
9 % TPA response prediction and plot octaves
10 u3_tpa = YAB * f2b1;
11 u3_tpa.plot('Mic_L','2500 rpm',[25 4000],'plotType','oct3dba');
12
    
```

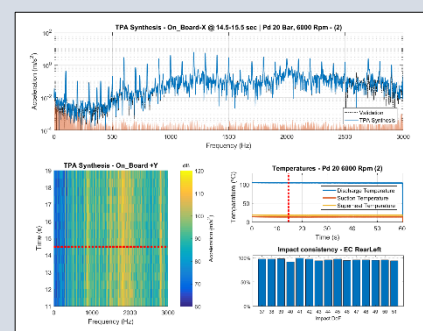


Powerful 3D environment

The toolbox comprises a powerful 3D environment, allowing to visualise mode shapes, work with CAD geometry and import complete measurement setups created in DIRAC. Navigate using intuitive camera controls and export mode shapes to popular video formats.

Advanced 2D plotting

Reduce time using built-in plot functions for time and spectral data, n^{th} -octaves, dB(A) and more. Quickly change plots by editing them directly through context menus within the plotting window. The toolbox includes all plotting functionality needed for advanced TPA analysis!



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VIBES Toolbox for MATLAB

Available as base license with two optional modules

Based on your needs, use just the comprehensive base license or add the optional Numerics and ATRX modules.
Find below more details for the base license and each module.

Base Module

Features

- ✓ **Signal processing:** time- and frequency-domain operations, easy plotting, playback and filtering
- ✓ **Object-based arithmetics:** matrix operations, matrix inversions, regularization techniques
- ✓ **Transfer Path Analysis:** the TPA framework, e.g. blocked force calculation and OSPA
- ✓ **Dynamic Substructuring:** primal and dual coupling and decoupling, flexible coupling
- ✓ **Virtual Point Transformation:** VP and other transformations including consistency calculations
- ✓ **Advanced 2D plotting:** comprehensive time and spectral plots, e.g. sum levels and octave plots
- ✓ **Interactive 3D environment:** CAD geometry, virtual experiment and mode shape animations

Base objects

- `vibes.Node` Class representing a node in 3D space.
- `vibes.VirtualPoint` Class representing a virtual point in 3D space.
- `vibes.DoF` Class representing a nodal Degree of Freedom.
- `vibes.ModalDoF` Class representing a modal Degree of Freedom.
- `vibes.Channel` Class for channels with physical unit and quantity.
- `vibes.Unit` Class for physical units.
- `vibes.Quantity` Class for physical quantities.
- `vibes.Block` Class to label blocks of time data.
- `vibes.Orientation` Class representing an orientation matrix.
- `vibes.Link` Class representing a coupling condition.

Dataset objects

- `vibes.TimeSeries` Class for time series data.
- `vibes.TimeBlocks` Class for time block data.
- `vibes.FreqBlocks` Class for frequency blocks.
- `vibes.FRFMatrix` Class for frequency response function (FRF) data.
- `vibes.IRFMatrix` Class for impulse response function (IRF) data.

Transformations

- `vibes.TransformationMatrix` Base class for coordinate transformation matrices.
- `vibes.LocalizationMatrix` Class representing a Localization (L) matrix.
- `vibes.BooleanMatrix` Class representing a signed Boolean (B) matrix.
- `vibes.IDMMatrix` Class representing Interface Displacement Mode (IDM) matrix.

Graphing

- `vibes.graph.Spectrum` Class for plotting of 2D spectra with context-menu controls.
- `vibes.ui.Figure` Class for 2D figures with interactive zoom/pan and playback.

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VIBES Toolbox for MATLAB

3D visuals

- `vibes.ui.Figure3d` Class for 3D visualization with interactive camera controls.
- `vibes.ui.Sensor` Class representing a sensor.
- `vibes.ui.Impact` Class representing an impact.
- `vibes.ui.Mesh` Class for 3D meshes and mode shape animation.

Math

- Fourier and inverse Fourier transformations
- Spectral windowing, frequency weighting and n^{th} -octave functions
- MAC, FRAC and other similarity functions
- ... many more open-access mathematics functions

Import/export utilities

- `vibes.util.pak.*` Import of PAK2mat MAT-files.
- `vibes.util.dirac.*` Import of DIRAC MAT-files.
- `vibes.util.stl.*` Import of STL-files.

Numerics Module

Features

- ✓ **Modal analysis:** Eigen-solver, mode shape analysis and animations, FRF and IRF synthesis
- ✓ **Modal reduction:** normal modes, Guyan-Irons, Hurty/Craig-Bampton, Hintz-Herting
- ✓ **FE node generation:** creation of RBE2 and RBE3 elements
- ✓ **Newmark time integration:** time stepping for transient analysis
- ✓ **FEM import/export:** interact with FEM packages (ANSYS, NASTRAN) and Universal File Format (UFF)
- ✓ **State space:** conversion to ss objects (uses the MATLAB Control System Toolbox)

Numerical model objects

- `vibes.MCKModel` Class for physical domain (MCK) numerical models.
- `vibes.HCBModel` Class for Hurty/Craig-Bampton (HCB) reduced models.
- `vibes.CMSModel` Class for Component Mode Synthesis (CMS) models.
- `vibes.ModalModel` Class for modal domain numerical models.

Import/export utilities

- `vibes.util.ansys.*` HB-format for MCK models and modal models.
- `vibes.util.nastran.*` PCH-files for MCK models (also HCB), HDF5 for modal models.
- `vibes.util.uff.*` Read & write *.unv files to VIBES datasets.

ATFX Module

Features

- ✓ **Read from ATFX:** Import of NVH data from ATFX-files, e.g. time series, FRFs
- ✓ **Write to ATFX:** Export of VIBES datasets to ATFX-files

Import/export utilities

- `vibes.util.ao.*` Reading and writing of ATFX-files.

VIBES Toolbox for MATLAB

What's new in version 3.0

Version 3.0 sees major improvements in functionality and usability.

The highlights are presented on this page

- **Documentation / Usability**
 - HCB tutorial using building case
 - OTPA tutorial
 - Auto-completion on most functions
 - Re-categorization of examples and tutorials
- **Numerical Modelling**
 - Model Reduction (CMS): Hurty/Craig-Bampton
 - RBE2 element generation in MCKModel
 - Hintz-Herting free-interface CMS
 - Newmark time integration of MCKModel > vibes.TimeSeries
- **Dynamic substructuring**
 - Compliant coupling in LM-FBS with interface terms
- **2D diagrams**
 - Dynamic 2D graphics for frequency domain spectra, FRFs and time domain data
 - 2D viewer with zoom/pan and playback controls
- **Transformations**
 - vibes.TransformationMatrix
 - vibes.LocalizationMatrix
 - vibes.BooleanMatrix
 - vibes.ReductionMatrix
- **IRFMatrix class**
 - Fast convolution
 - FIR stabilisation (centralisation)
 - Windowing
 - Conversions to FRFMatrix and TimeBlocks
 - Operations (such as $mckA * f1$)
- **Import/export**
 - ASAM-ODS ATFX import/export
 - UFF import/export
 - MSc NASTRAN (PCH) import
- **Other**
 - DoF-matching: more efficient implementation, slight change of use
 - New license for ASAM-ODS (ATFX module)

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