



About Mltools™

As engineering materials are becoming increasingly more complex, more sophisticated material models are needed to describe the material behavior. These material models use properties that are more difficult to measure. The conventional material characterization techniques based on analytical formulas are no longer able to provide these properties.

Mltools™ is a versatile software package for determining elastic material properties from the resonant frequencies of a set of test specimens. The power of Mltools™ lies in the use of finite element models to extract the elastic properties from the test data.

The unique combination of experimental data and FE-modeling in Mltools™ offers a powerful tool to determine the elastic properties of advanced engineering materials. Mltools™ provides this novel technology in a flexible and comprehensive way accessible to the non-specialist.

Method

The mixed numerical-experimental techniques (MNETs) implemented in Mltools™ determine the elastic properties of a material in an iterative way, by fine-tuning the material parameters of a set of finite element models (FEM) so as to reproduce the experimentally determined resonant frequencies of the test specimens. Mltools™ provides a general solver for resonant-based MNETs, which allows the use of any combination of specimen geometries and measured resonant frequencies.

The MNET approach provides identification routines that can identify the elastic properties of more complex engineering materials, such as orthotropic or layered materials, using samples with nearly any shape. Additionally, FEM-based sensitivity analysis can provide additional insight on how to optimize the test configuration (i.e. sample geometry and selected resonant frequencies) and, hereby, improve the reliability of the identified material properties.

Key Features

- A general MNET implementation of the resonant-based identification of bulk elastic properties of isotropic materials and in-plane elastic properties of orthotropic materials.
- Automatic mesh generation functions for homogeneous or layered test specimens with a beam, plate, or cylindrical geometry.
- A fully customizable and easy-to-use graphical user interface that makes the capabilities of the MNET techniques accessible to the non-specialist.
- A powerful graphical module that animates the vibration modes of the test specimens, illustrates the variation of the apparent properties, plots the results of a sensitivity analysis, etc.
- Integrated scripting language that allows the automation of nearly any resonant-based material identification routine.

Benefits

- Mltools™ processes the data of all the specimens simultaneously. By averaging the measurement noise of all the tested specimens, Mltools™ can provide more reliable global estimates of the elastic properties.
- The ability to detect the anisotropy of materials. For example, the methods implemented in Mltools™ are sensitive enough to detect the anisotropy of rolled metal sheets.
- The ability to identify the elastic properties of the constituent materials of laminated or coated materials.
- The ability to use any combination of specimen geometries and measured resonant frequencies to determine elastic properties.
- Automated data processing using the integrated scripting language.



Applications

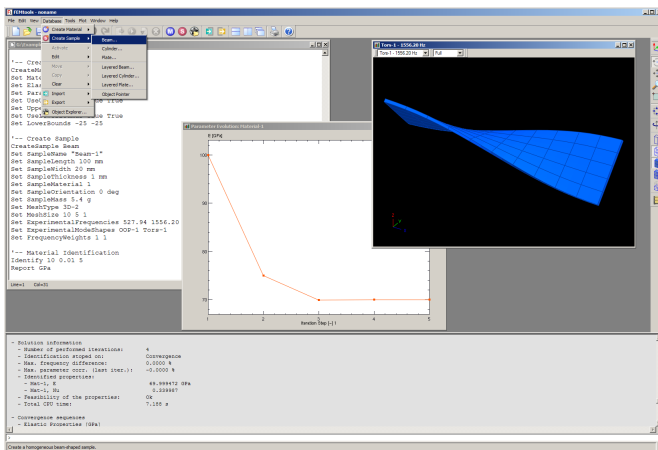
Examples of materials that can be characterized with MITools™:

- Engineering ceramics.
- Rolled metal sheets.
- Fiber-reinforced materials.
- Coatings.
- Sandwich materials.

User Interface

MITools™ has an easy-to-use graphical user interface with:

- Customizable menus, toolbars, and shortcuts.
- Complete online documentation.
- Multiple simultaneous graphics.
- Integrated script editor.
- A console window for command entry and feedback.



The MITools™ graphical user interface.

Scripting

MITools™ comprises the rapid scripting language FEMtools™ Script.

- All material identification and data processing operations can be executed by script.
- 70+ material identification functions.
- 180+ mathematical programming functions.

Graphics

MITools™ provides powerful graphics viewers:

- XY-curves, matrix, and mesh visualisation.
- Dynamic viewing (rotation, pan, and zoom).
- Animated mode shape plots.
- Export of graphics in various file formats: bmp, png, jpg, etc.
- Export of animated shapes as AVI files.

Services

A variety of services can be offered:

- Installation, support, and training.
- Engineering services, such as advanced processing of measurement data or pre-test planning to minimize the uncertainty on the identified parameters by optimizing the test configuration, i.e. sample dimensions, sample orientations, vibration modes, etc.
- Development of modules for the identification of elastic properties using customized test specimen geometries.
- Project research, such as feasibility studies of solving a particular problem using an MNET approach.
- Customization of the user interface, e.g. create a dedicated interface for routine tests that could be performed by a technician.

Supported Platforms

MITools™ runs on FEMtools™ Framework, which is available for Window (XP & Vista), Linux, and Unix (HP, AIX, Solaris)

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