Getting Started

Mefisto 2.8

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1 Introduction

The acronym “Mefisto” stands for “Mechanical Field Simulation Tools“. It is not a ready to use analysis software, but it is a toolbox, containing a set of GNU Octave[1] functions for the numerical analysis of mechanical field problems. Currently, it includes functions to solve linear problems in solid mechanics, aerodynamics and aeroelasticity.

The basic data units of Mefisto are so called components. In the simplest case an analysis model consists of only one component. Models containing more than one component occur in a coupled analysis where different components are used to model different mechanical fields.

Components are described by GNU Octave structures that contain all data necessary for the analysis as well as all results. These components are generated based on a model description provided by the user.

Mefisto has only limited pre- and postprocessing capabilities. However, there is an interface to Gmsh[2], a free software for pre- and postprocessing.

Mefisto is free software published under the GNU General Public License, see http://www.gnu.org/licenses/gpl-3.0.en.html and the license file in the software directory for details.

1 http://www.gnu.org/software/octave
2 http://www.geuz.org/gmsh

2 Installation

To install Mefisto, unpack the file `mefisto_2_8.zip`. Subsequently, start GNU Octave and execute script `install.m` which you find in the installation directory. The script will add the the command

```
addpath("path_to_mefisto/2.8/src");
```

to file `.octaverc` where ***path_to_mefisto*** is replaced by the actual name of your installation path. If the file does not yet exist, it will be created.

Alternatively, you may manually add this command to file `.octaverc`. If you create the file, make sure it is located in your home directory. If you use Windows, it is best to create or modify this file using the GNU Octave editor.

Mefisto has some limited plotting capabilities. The best results are obtained with the following graphics settings:

```
set(0, "defaultfigurepaperunits", "centimeters");
set(0, "defaultfigurepapertype", "a4");
```

Due to limitations of GNU Octave, plotting of larger models may be very time consuming. Also, plots of 3-dimensional models are not very nice.

If your installation has been successful, typing

```
help mefisto
```

in GNU Octave lists all Mefisto functions available. More information on a specific function is obtained by typing

```
help function
```

where ***function*** has to be replaced by the name of the function you are interested in.

The installation directory contains the following subdirectories:

`exa`	contains examples
`gmsh`	contains some useful scripts for Gmsh
`license`	contains the GNU General Public License
`pdf`	contains the documentation
`src`	contains the source code

Mefisto 2.8 has been tested with the following versions of GNU Octave:

- 10.3.0 on Linux systems

- 10.3.0 on Windows systems

It may also run with older or newer versions, but this cannot be guaranteed because sometimes GNU Octave functions change from one version to the next. Mefisto will definitely not run with Matlab.

3 Functionality

The current version of Mefisto supports solid mechanics, aerodynamics and aeroelasticity.

3.1 Solid Mechanics

You can use Mefisto to solve problems of linear elasticity. It supports the Finite Element Method with the following functionality:

Elements:	2-dim.: rod, beam, membrane, point mass, rigid body mass 3-dim.: rod, beam, membrane, solid, shell, point mass, rigid body mass
Analysis:	Linear static analysis Normal modes analysis Frequency response analysis Transient response analysis

Volume 1 of the User Manual (`user_solid.pdf`) contains a detailed description of the data structures and functions related to solid mechanics. Examples can be found in subdirectory `solid` of directory `exa` of your Mefisto installation. The examples are described in Volume 1 of the Examples Manual (`examples_solid.pdf`).

3.2 Aerodynamics

Currently, the only method implemented is the Vortex Lattice Method to solve problems of incompressible linear aerodynamics. Both a steady and a time-harmonic version of the Vortex Lattice Method are supported.

The following features are supported:

Analysis:	Steady aerodynamics Trim analysis

Volume 2 of the User Manual (`user_aero.pdf`) contains a detailed description of the data structures and functions related to aerodynamics. Examples can be found in subdirectory `aero` of directory `exa` of your Mefisto installation. The examples are described in Volume 2 of the Examples Manual (`examples_aero.pdf`).

3.3 Aeroelasticity

Aeroelasticity combines the features available for solid mechanics and aerodynamics to run a coupled analysis. Thus, you need be familiar with both solid mechanics and aerodynamics. The solid and the aerodynamic model are connected using splines.

The following features are supported:

Splines:	Torsion-bending splines
Analysis:	Steady aeroelasticity Trim analysis Flutter analysis: k-method and pk-method Frequency response analysis: manoeuvres and gusts

Volume 3 of the User Manual (`user_aeroelastic.pdf`) contains a detailed description of the data structures and functions related to aeroelasticity. Examples can be found in subdirectory `aeroelastic` of directory `exa` of your Mefisto installation. The examples are described in Volume 3 of the Examples Manual (`examples_aeroelastic.pdf`).