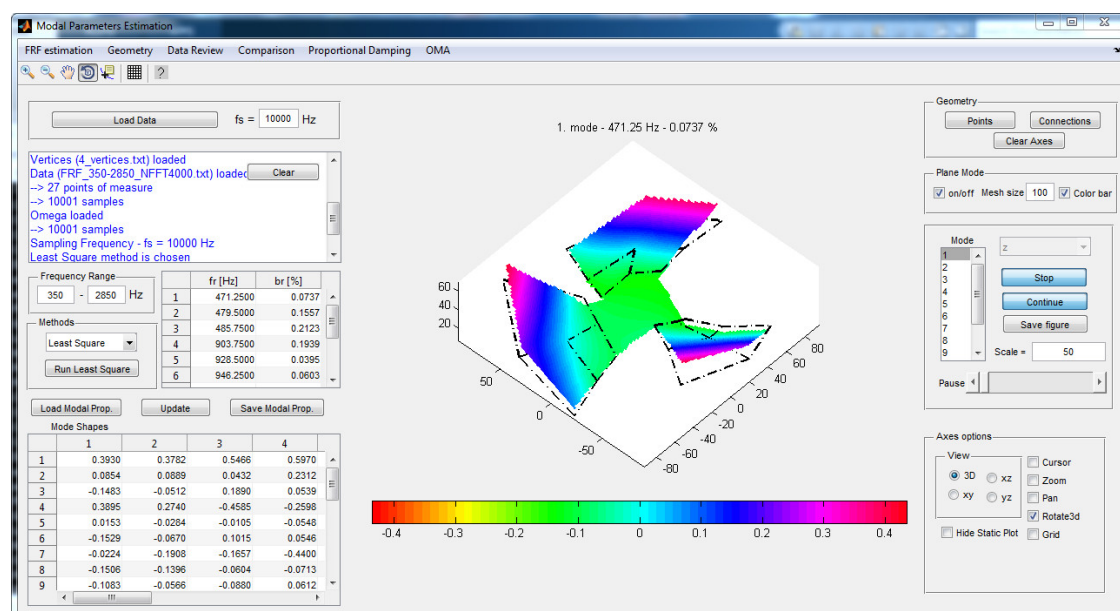


Autor: Bc. Václav Ondra (ondra.va@gmail.com)

Creation of modal parameter estimation application for experimental modal analysis

Inženýrská analýza a simulace

Školitel: Ing. Petr Lošák Ph.D., VUT



Formulace řešeného problému

In this time, when the technology has become a great part of everyday life, when we cannot imagine our lives without cars, airplanes or electricity we, as engineers, have to deal with many problems connected with all benefits that technology gives us. One of the most discussed problems is a vibration of the mechanical structures. There is no way how to avoid vibration in some applications, but we have to try to avoid a resonance state or minimize its consequences. In order to control vibrations we can update the design of the construction, use special damping elements, deal with excitation effects...but in every case we have to understand how to describe, predict and measure vibrations. As it is convenient at the present, it is possible to use finite element method for all necessary analysis, but this approach has one terrible lack – the material properties of the structure have to be known exactly. This, unfortunately, is never true (usually damping properties aren't known at all) therefore the validation and the verification of the computation model are in order. This is the place where an experimental modal analysis comes into account.

Cíl práce

Modal parameter estimation is one of the most important parts of the experimental modal analysis because the modal properties of the investigated structure (natural frequencies, damping factors and mode shapes) are obtained in the process. The issue is how to extract these parameters from a measured data which are usually represented by the frequency response function in the case of the experimental modal analysis. There can be found a few commercial software products for the experimental modal analysis, however, an academic environment, in which majority of analysis is made for purpose of science, needs to have a software which works with the known accuracy, with known assumption, can be modified or expand easily and in which more the one modal parameter estimation method can be used for identification of structure's modal model.

The objective of my diploma thesis was to create software with the requirements listed above. The software which inputs would be created by frequency response function and the output would be the natural frequencies, the damping factors and the mode shapes.

Závěr

The complex application for the experimental modal analysis (and in a limited way for an operation modal analysis) is the output and the main result of the diploma thesis. The modal properties (natural frequencies, damping factors, mode shapes) can be estimated by four different methods – Peak Picking, Circle Fit, Least Square method and Eigensystem Realization Algorithm. Beside the modal parameter estimation process itself several more techniques such as frequency response function estimation, comparison of the response models and modal properties etc. are implemented into the application. Source code of the all modules of the application is open and it doesn't prevent a future modification so one can add a modal parameter estimation technique of one's choice without problem. The application was already used for the experimental modal analysis on simulated test cases and also on real structures.

Fotografická dokumentace

