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Title: Making modal analysis easy and more reliable – Reference points identification and model size estimation

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Abstract:

Although experimental modal analysis (EMA) is a common tool in structural dynamics, it is still mostly performed by experts. To make it available to every user, many challenges must be addressed throughout the process of planning the EMA, conducting the measurements, extracting the modal parameters, and interpreting the results.

This paper will demonstrate two different approaches to support occasional as well as expert users during the workflow of experimental modal analysis.

One challenge during modal analysis is to choose the reference points in such a way that many, if not all, mode shapes can be found in the relevant frequency range. If the user choses not enough reference points or places them incorrectly, not all modes can be extracted in the following process steps. On the other hand, the user would like to avoid selecting too many reference points, as they slow the assessment and add complexity.

This work will show an approach to minimize the risk of inadequate experimental modal analysis results because of insufficient planning using the potential of a numerical model. This is made possible based on numerical modal analysis and an algorithm that automatically finds the best reference points while specifying the geometric area that is available. One key feature of the suggested approach is that the numerical model does not have to be fully validated.

Another challenge addressed in this work is the process step of parameter extraction in which the modal parameters (eigenfrequency, damping and mode shape) are estimated to fit the measured data. The Least Squares Complex Frequency Method (LSCF-Method) is a robust and efficient method widely used to perform this task. However, it requires the user to interact and define input-parameters to gain reliable results. Within the scope of this work a neural network was developed, trained, and tested, which assists the user to parametrize the LSCF-Method.

The success of both approaches is shown using examples.

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