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Title:

Coping with uncertainties in experimental modal analysis

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Abstract:

Experimental modal analysis is a well-established and widely used technique for characterizing the dynamic properties of mechanical structures. Despite its maturity, the analysis workflow still involves numerous experience-based decisions, for example during the planning of the modal analysis, during data acquisition, during parameter extraction, and post processing. These subjective choices can significantly influence the results and often lead to incorrect conclusions that are only detected at the final stage of the analysis, making the method difficult to apply reliably for less experienced or occasional users.

This paper presents an approach to systematically support and partially replace experience-based decisions at different stages of the experimental modal analysis process by means of automated evaluation methods. In addition to established techniques such as the Least-Squares Complex Frequency-domain (LSCF) estimator, innovative data-driven approaches, including neural network-based methods, are employed to guide critical parameter selections. The proposed workflow aims to reduce subjectivity, increase result reliability, and improve the accessibility of experimental modal analysis for non-expert users. The effectiveness of the approach is demonstrated using measurement examples.

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