A Monte Carlo Sampling Strategy for the Automated Operational Modal Analysis of Road Bridges.

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ABSTRACT

Automated Operational Modal Analysis (AOMA) is a highly convenient technique to identify the modal properties of a target system, based only on its measured output and without human supervision. In particular, AOMA is very useful for permanent and continuous bridge monitoring, as it would otherwise be impractical to perform input-output dynamic testing on such large and complex structures or to manually process the acquisitions on a daily basis.

Nevertheless, its implementation requires a fairly articulated algorithm, made up of several steps. Some of them have been well optimised throughout the years thanks to contributions by many researchers. Other aspects, however, are still open to improvements.

Specifically, the standard AOMA procedure operates on the so-called stabilisation diagram, i.e. a complete set of identified dynamic properties for different model orders. Traditionally, the model order n is increased from an initial (and arbitrary) minimum, n_{min}, up to a similarly arbitrary maximum n_{max}, with a constant step and no omissions.

However, feeding the AOMA algorithm with all the models included in the $[n_{min},n_{max}]$ range is here proved to not be the most efficient course of action. Instead, a Monte Carlo Sampling strategy is proposed, randomly picking a set of models with order $n \in [n_{min},n_{max}]$. This is verified on an experimental dataset, the Z24 bridge, to provide comparable results in terms of accuracy and at a lower computational cost. Specifically, acquisitions from different environmental conditions are included, with and without structural damage.