Optimised structural modelling for Inverse Analysis parameter identification relying on dynamic measurements

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Abstract

The present contribution develops an optimised structural modelling approach devised toward parameter identification, in the context of Inverse Analysis model updating of consistent digital twins, relying on dynamic measurements. A specific case study is considered, dealing with a historical infrastructure, a road three-span reinforced concrete arch bridge, with vibrational data previously acquired by standard wired accelerometers on the deck, under operational traffic conditions [1]. In particular, the present work aims at resolving two main identification issues: the definition of a maximum allowable threshold number of sought material parameters (e.g., Young's moduli and mass densities of different structural components), with respect to the amount of available measurement data, and the improvement of the inverse analysis discrepancy function to be optimised, in order to set the issue of multiple "realizations", in case of a plain use of modal properties, and in view of setting a well-posed optimisation problem. The methodologies of sensitivity analysis and numerical optimisation (see, e.g., [2]-[3]) are herein coupled with optimised structural modelling toward a robust and efficient identification strategy, to be effectively employed in structural assessment and diagnosis. Therefore, a structural model of the bridge under investigation is analysed and optimised with respect to the choice of constitutive modelling parameters in different portions/structural components and to the proper setup of the boundary conditions. Moreover, the set of available experimental data, in terms of deciphered modal properties, is enriched with additional information (namely additional type of measurements and measuring positions), possibly pseudo-experimental or estimated, aiming at defining a global optimum identification procedure and measurement configuration. The proposed methodology and collected results shall outline an efficient approach toward automated inverse identification, in the broad area of dynamic assessment and diagnosis of structures and infrastructures, such as e.g. bridges.

References

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