An Interval Based Technique for FE Model Updating

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Abstract

Model updating techniques [1] are largely used in civil and mechanical engineering to obtain reliable FE models. The model parameters are iteratively adjusted until the model response matches the measured structural response within a given tolerance. These techniques, as most of the inverse problems, suffer known problems, among which the lack of uniqueness and the possible lost of physics in the solution. These problems are further hampered by the unavoidable uncertainties in the measured response and in the modelling options.

In this work it is assumed to know the response of a structure in terms of uncertain modal quantities. Accordingly, the model response is computed accounting for uncertainty by defining the model parameters as intervals.
The updating problem is formulated in the framework of interval analysis by exploiting the inclusion theorem [2]. The solution is reached when the structural response is completely included by the FE model response and the parameters uncertainty is at a minimum.
The presented method offers some advantages that are: each model parameter is included in a physical interval hence the solutions are guaranteed to be physical; the uncertainties of the measured response are naturally embodied into the problem.
The method is discussed through numerical simulations. The effect of interval dependency in the accuracy of the inverse problem and the effect of modelling errors are discussed.

References

[1] Friswell, M.I., and Mottershead J.E.: "Finite element model updating in structural dynamics", *Kluwer Academic Publishers, Dordrecht, The Netherlands*, 1995.
[2] Gabriele S.: "FE Model Updating by Interval Analysis Techniques" (in Italian), *PhD Thesis: University "Roma Tre"*, 2004.