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PROBABILISTIC MODEL OF DYNAMIC BOUNDARY IMPEDANCE MATRICES IN HIGH DIMENSIONS AND FOR WIDE FREQUENCY BANDS OF ANALYSIS

P. Ropars[1] and C. Desceliers[2]

[1] GeM Université de Nantes, pierre.ropars@univ-nantes.fr
[2] MSME Université Paris-Est, christophe.desceliers@univ-paris-est.fr

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In many mechanical engineering applications, a dynamic boundary impedance matrix model is involved to represent the interactions of a given substructure through its boundary. This dynamic boundary impedance matrix can be obtained by experimental measurements and then, a computational model can be then constructed to study the dynamical response of the substructure. Nevertheless, it is well known that the solution of such computational model is very sensitive to the modeling errors related to the dynamic boundary impedance matrix model. In oder to improve its robustness, a probabilistic approach can be used to model the uncertainties related to the dynamic boundary impedance matrix model. Recent works by [1, 2, 3] have demonstrated that the "hidden variables method" brings an adapted framework to construct such a probabilistic model. Indeed, the "hidden variables method" allows the identification of mass, stiffness and damping matrices associated with a given dynamic boundary impedance matrix (which can be obtained by experimental measurement). Then, a probabilistic model has been constructed in [2, 3] by substituting the mass, stiffness and damping matrices by random matrices which probabilistic model has been developed in [5, 6]. Nevertheless, the numerical cost of "hidden variables method" increases drastically with the dimension (number of degrees of freedom) of the interface and the width of the frequency band of analysis. Consequently, such a method is limited to mechanical systems with a low dimension of its boundary and for narrow frequency bands of analysis [4, 7]. We then propose an enhanced approach which consists in constructing a functional basis which allow, for each sub-frequency band of a partition of the frequency band of analysis, a spectral expansion of the displacements on the boundary. This spectral expansion is truncated which allow to apply the "hidden variables method" in each sub-frequency band. As a consequence, the "hidden variables method" is applied on narrower frequency bands and with a lower dimensions of the boundary. We then obtain a collection of mass, stiffness and damping matrices for representing the dynamic boundary impedance matrix model. The probabilsitic model consists in substituting each of those matrices by random matrices whose probabilistic model has been developped in [5, 6].

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