Frequency response functions of discretized structural systems with uncertain parameters

G. Muscolino[1)], R. Santoro[1)] and A. Sofi[2)]

[1)]Department of Civil Engineering, University of Messina, Messina 98166, Italy, muscolin@ingegneria.unime.it; roberta.santoro@unime.it

[2)]Department of Architectonic and Urban Heritage, University *Mediterranea* of Reggio Calabria, Reggio Calabria 89124, Italy, alba.sofi@unirc.it

Keywords: *Frequency Response Function; Uncertain parameters; Complex Sherman-Morrison-Woodbury formula.*

Abstract

In Structural Dynamics, the frequency response function (FRF) is a complex function able to provide information about the behavior of a structure over a range of frequencies. Specifically, the FRF describes the relationship between a local excitation applied at one location on the structure and the resulting response at another and/or the same location.

As known, material properties, geometry and boundary conditions of a structure may experience fluctuations due to measurement and manufacturing errors or other factors. These sources of uncertainty are usually described following two contrasting points of view, known as probabilistic and non-probabilistic approaches.

In the framework of probabilistic approaches, the FRF has been evaluated by Falsone and Ferro (2005) by taking into account the properties of the natural deformation modes of the finite element discretized structure. In a non-probabilistic context, for comparison purposes, Manson (2005) employed both complex interval analysis and complex affine analysis for evaluating the FRF of systems with uncertain parameters.

In this paper, an alternative approach for the evaluation of the FRF of discretized structures with uncertain parameters is presented. The proposed procedure is based on the following steps: *i*) to decompose the deviation of the stiffness matrix via spectral decomposition so as to obtain a sum of rank-one matrices each associated to one uncertain parameter; *ii*) to evaluate the FRF in explicit form by an approximate complex Sherman-Morrison-Woodbury formula herein derived; *iii*) to apply the proposed procedure to obtain the FRF of structures with uncertain parameters modeled using either probabilistic or non-probabilistic models.

References

Falsone G. and G .Ferro. A method for the dynamical analysis of FE discretized uncertain structures in the frequency domain. *Computer Methods in Applied Mechanics and Engineering*, 194: 4544–4564, 2005.

Manson G. Calculating frequency response functions for uncertain systems using complex affine analysis. *Journal of Sound and Vibration*, 288: 487–521, 2005.