Approximation Concepts for Fuzzy Analysis in Structural Dynamics

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Abstract

The so-called non traditional approaches for uncertainty quantification in engineering have gained considerable attention in the last years, see Möller et al. (2000). In particular, fuzzy structural analysis offers the possibility of addressing problems where there is lack of knowledge or imprecision on the input parameters affecting the performance of a system. In this way, it is possible to identify sensitivities of the response of a structure with respect to the magnitude of imprecision of the input. However, practical application of fuzzy analysis is somewhat precluded by the fact its application demands significant numerical efforts. Hence, this contribution presents an approach for performing fuzzy analysis of linear dynamical structural systems in the frequency domain which is efficient from a numerical viewpoint. The proposed approach is formulated within the context of the α-level optimization strategy, see Möller et al. (2000). In order to identify the minimum and maximum values of the structural response (for a given membership value α), the optimization algorithm introduced in Li and Au (2010) is considered, which is based on Subset Simulation. In addition, the structural response is calculated approximately using explicit representations of the spectral properties with respect to the fuzzy input variables in order to avoid repeated structural analyses. In particular, the natural frequencies are approximated using *intervening variables*, which allow generating high quality approximations of the response. The application of such variables has already been shown to provide accurate approximations within the context of fuzzy analysis for static structures, see Valdebenito et al. (2016).

References

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