Reliability Analysis of Randomly Excited Structures with Interval Stiffness Parameters via Sensitivity Analysis

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Keywords: *Interval reliability function; Interval analysis, sensitivity analysis.*

Abstract

Since the pioneering study by Ben-Haim (1994), who first introduced a non-probabilistic concept of reliability, several efforts have been devoted to perform structural safety assessment relying on non-probabilistic uncertainty models.

The present study focuses on reliability analysis of linear discretized structures with interval stiffness parameters subjected to stationary Gaussian multi-correlated random excitation. The reliability function for the extreme value stress process is evaluated in the framework of the first-passage theory. Such a function turns out to have an interval nature due to the uncertainty affecting the stiffness parameters. The aim of the analysis is the evaluation of the bounds of the interval reliability function which provides a range of structural performance. This is a quite challenging task since the range of stress-related quantities may be significantly overestimated as a consequence of the so-called *dependency phenomenon* (Moore et al., 2009). To reduce overestimation, a sensitivity-based procedure is proposed in the context of the *Improved Interval Analysis* via *Extra Unitary Interval* (Muscolino and Sofi, 2012). The main advantage of this procedure is the capability of providing appropriate combinations of the endpoints of the uncertain parameters which yield accurate estimates of the bounds of the interval reliability function for the extreme value stress process.

A wind-excited structure with uncertain Young's modulus is analyzed to demonstrate the accuracy and efficiency of the proposed method.

References

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