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Hybrid Uncertain Static Analysis with Random and Interval Fields

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Abstract

Uncertain static analysis of an engineering structure with diverse type of non-deterministic system parameter is investigated in this study. Unlike the traditional hybrid uncertain static analysis involving random and interval variables, the concept of random and interval fields have been implemented to model the spatially dependent uncertainties associated with the system inputs. A novel computational approach, namely the extended unified interval stochastic sampling (X-UISS) method, is proposed to calculate the statistical characteristics (i.e., mean and standard deviation) of the extreme bounds (i.e., lower and upper bounds) of the concerned responses (e.g., displacement and stress) of engineering structure involving hybrid spatially dependent uncertainties. Subsequently, by utilizing either parametric or nonparametric statistical analysis, the probability density functions (PDFs), as well as the cumulative distribution functions (CDFs), of the extreme bounds of the concerned structural responses can be effectively established. Consequently, the upper and lower bounds of either the concerned responses of the engineering structure at any particular percentile of probability, or the structural reliability against any specified capacities can be effectively secured. The applicability and effectiveness of the proposed computational analysis framework are illustrated through the numerical investigations on various examples.

Keywords:

Random field; Interval field; Spatially dependent uncertainty; Extended Unified Interval Stochastic Sampling; Hybrid uncertainty analysis; Uncertain static analysis.

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