

Static Analysis of Structural Systems with Uncertain Parameters Using Probability-Box

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Abstract

A static analysis of structural systems with uncertain parameters is presented. Uncertain load and material parameters of the system are modeled by probability-boxes (or p-boxes), which do not require complete information about the statistical nature of the underlying random process. Arithmetic operations on p-boxes yield guaranteed lower and upper bounds on the probability distribution of the solution, regardless of the dependency among those uncertain parameters. In this paper, both load and material uncertainties for the first time are handled using a non-Monte-Carlo p-box approach that guarantees to enclose the exact solution. The governing linear equations are solved by an iterative approach that exploits a fixed-point formulation of the system of linear equations. In order to reduce overestimation and obtain the tightest bounds possible, a decomposition of the stiffness matrix of the structure is adopted. The resulting formulation gives guaranteed lower and upper bounds of the probability distribution of the structural responses, at a high computational efficiency and a low overestimation level.