

The Stochastic Finite Element Method: Theory and Applications

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A powerful tool in computational stochastic mechanics is the Stochastic Finite Element Method (SFEM). The considerable attention that SFEM received over the last decade can be mainly attributed to the spectacular growth of computing power rendering possible the efficient treatment of large-scale problems. A fundamental issue in SFEM is the modelling of the uncertainty characterizing the system parameters, which is usually quantified by using the theory of stochastic functions (processes/fields). The first half of this presentation is thus devoted to the simulation (generation of sample functions) of stochastic processes and fields. The most important simulation methods are presented, the theoretical background of each method is examined and their basic characteristics are investigated. In the second half, a thorough description of the available variants of SFEM is provided and some open issues are pointed out. Several applications of SFEM are finally presented including the calculation of the response variability of shells with random material and geometric properties, the stability analysis of shells with random imperfections as well as the nonlinear dynamic analysis of frames with stochastic material properties under seismic loading.