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Abstract

A Galerkin scheme-based approach is developed for determining the survival probability and first-passage probability of a randomly excited hysteretic systems endowed with fractional derivative elements. Specifically, by employing a combination of statistical linearization and of stochastic averaging, the amplitude of the system response is modeled as one-dimensional Markovian Process. In this manner the corresponding backward Kolmogorov equation which governs the evolution of the survival probability of the system is determined. An approximate solution of this equation is sought by employing a Galerkin scheme in which a convenient set of confluent hypergeometric functions is used as an orthogonal basis. This set is well documented in the literature, as it is related to the solution of the first-passage problem of a randomly excited linear oscillator with integer-order derivatives. Applications to oscillators with bilinear, Preisach, and Bouc-Wen hysteretic models are presented. Comparisons with pertinent Monte Carlo simulations data demonstrate the efficiency and reliability of the proposed semi-analytical approach.