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Non-Linear Oscillator Under Random Renewal-Driven Trains of Impulses

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A non-linear, non-hysteretic oscillator under a stochastic excitation in form of a random train of impulses driven by a renewal process is considered. The state vector of the oscillator is a non-Markov stochastic process. The class of renewal impulse processes considered is obtained by multiplying an Erlang renewal impulse process by an intermittent, zero-one auxiliary stochastic variable. This variable is governed by a stochastic differential equation driven by two independent Erlang renewal processes, each of which is exactly expressed, with the aid of a set of auxiliary variables, in terms of a Poisson process. Thus the augmented state vector, consisting of the original state vector and of auxiliary variables, is driven by two independent Poisson process, and becomes a Markov process. The Ito's differential rule is used to derive the differential equations governing the response statistical moments. The special cumulant-neglect closure technique is devised to truncate the hierarchy of moments equations. The mean value and variance of the response are obtained by numerical integration of moment equations and verified against Monte Carlo simulations.

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