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Stochastic bifurcation for a white-noise perturbed nonlinear oscillator

PETER BAXENDALE, University of Southern California

Consider the vibrations of a thin beam excited by longitudinal white noise. The amplitude of the first mode of vibration evolves according to a 2-dimensional nonlinear stochastic differential equation. The white noise enters in a multiplicative fashion and so the origin is a fixed point for the system. When the noise intensity is sufficiently small relative to the coefficient of linear dissipation the origin is almost surely stable; however as the noise intensity is increased beyond a critical level the origin becomes almost surely unstable and the system evolves as a recurrent diffusion on the rest of the 2-dimensional space. We will discuss rigorous results on the changes in behavior of the system, and in particular the nature of its stationary measures, as the noise intensity passes through its critical level. In particular we identify the critical noise level, and the scaling of stationary moments just above the critical level. These results validate earlier numerical simulations of Wedig, Springer Lect. Notes Math., Vol 1486 (1991). The techniques used extend to a wide class of finite dimensional stochastic differential equations with a fixed point.