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Noise Induced Switching and Extinction in Systems with Delay[1]
LORA BILLINGS, Montclair State University, IRA SCHWARTZ, US Naval Research Laboratory, TOM CARR, Southern Methodist University, MARK DYKMAN, Michigan State University — We consider the rates of noise-induced switching between multiple attractors of dynamical systems with delay, and the rates of noise-induced extinction in delayed systems modeling population dynamics. In the weak noise limit, the rates of inter-attractor switching and extinction are exponentially small. To logarithmic accuracy, the formulation of the rates is reduced to variational problems, which give the most probable paths followed in both switching or extinction dynamics. We show that the equations for the most probable paths are acausal and formulate the appropriate boundary conditions. Explicit general results of the rates are obtained for small delay compared to the relaxation rate, and verified using a direct variational method to find the rates. We find that the analytical results agree well with the numerical simulations for both switching and extinction rates.

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