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Path Integral Approach to Incipient Deviations

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Abstract

Non-linear stochastic ordinary or partial differential equations have been used to model out-of-equilibrium phenomena associated to non-gaussian processes. Prime examples are turbulence and financial models of various sorts. Asymptotic tails of probability distribution functions (PDFs) of interesting observables can be determined from action extrema (instantons) defined within the context of the response functional formalism. Having practical purposes in mind, however, one finds that this strategy may lead to fluctuation probabilities which are too small for the detection of significant events. We show, then, focusing on specific turbulent models, that dynamical regimes characterized by incipient - but already non-gaussian - deviations are amenable of treatment from the instanton point of view, provided that fluctuations around instantons are integrated out in the path integral representation of the stochastic dynamics. A pattern seems to emerge, where the related preasymptotic PDF tails are still obtained from extrema of renormalized actions, modified by perturbative corrections of their heat kernels and two-point noise correlation functions.