Numerical experiments on noisy chains: From collective transitions to nucleation-diffusion

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Abstract-

We consider chains of particles with nearest-neighbor coupling, independently subjected to noise, all initially in the same well of a symmetric double-well potential. If there are sufficiently few particles, transitions from one well to another are “collective”; i.e., all particles remain close together as they make the passage from one well to the other. In longer chains, only a fraction of the particles make an initial transition, creating a nucleated region that may grow or collapse by diffusion of its boundaries. Numerical experiments are used to explore the change of the scaling of the passage time as a function of the length of the chain, which distinguishes the two regimes. A suitable relationship between the noise amplitude, coupling, and number of particles in the chain yields convergence to the continuum φ4 or Allen–Cahn stochastic partial differential equations in one space dimension. We estimate the characteristic width of newly nucleated regions and construct a numerical effective potential describing the dynamics in the nucleation-diffusion regime.

Index Terms- Stochastics, nucleation, passage time

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