Front depinning by deterministic and stochastic fluctuations: A comparison

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Driven dissipative many-body systems are described by differential equations for macroscopic variables which include fluctuations that account for ignored microscopic variables. Here, we investigate the effect of deterministic fluctuations, drawn from a system in a state of phase turbulence, on front dynamics. We show that despite these fluctuations a front may remain pinned, in contrast to fronts in systems with Gaussian white noise fluctuations, and explore the pinning-depinning transition. In the deterministic case, this transition is found to be robust but its location in parameter space is complex, generating a fractal-like structure. We describe this transition by deriving an equation for the front position, which takes the form of an overdamped system with a ratchet potential and chaotic forcing; this equation can, in turn, be transformed into a linear parametrically driven oscillator with a chaotically oscillating frequency. The resulting description provides an unambiguous characterization of the pinning-depinning transition in parameter space. A similar calculation for noise-driven front propagation shows that the pinning-depinning transition is washed out.