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Pseudospectral versus finite-difference schemes in the numerical integration of stochastic models of surface growth

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Abstract-

We present a comparison between finite differences schemes and a pseudospectral method applied to the numerical integration of stochastic partial differential equations that model surface growth. We have studied, in 1+1 dimensions, the Kardar, Parisi, and Zhang model (KPZ) and the Lai, Das Sarma, and Villain model (LDV). The pseudospectral method appears to be the most stable for a given time step for both models. This means that the time up to which we can follow the temporal evolution of a given system is larger for the pseudospectral method. Moreover, for the KPZ model, a pseudospectral scheme gives results closer to the predictions of the continuum model than those obtained through finite difference methods. On the other hand, some numerical instabilities appearing with finite difference methods for the LDV model are absent when a pseudospectral integration is performed. These numerical instabilities give rise to an approximate multiscaling observed in earlier numerical simulations. With the pseudospectral approach no multiscaling is seen in agreement with the continuum model.

Index Terms- parisi-zhang equation, scale-invariance, kinetic-growth, instability, interfaces, continuum, universality, relaxation, diffusion

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