Critical Behaviors in a Stochastic One-Dimensional Sand-Pile Model

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Abstract: A one-dimensional sand-pile model (Manna model), which has a stochastic redistribution process, is studied both in discrete and continuous manners. The system evolves into a critical state after a transient period. A detailed analysis of the probability distribution of the avalanche size and duration is numerically investigated. Interestingly, contrary to the deterministic one-dimensional sand-pile model, where multifractal analysis works well, the analysis based on simple finite-size scaling is suited to fitting the data on the distribution of the avalanche size and duration. The exponents characterizing these probability distributions are measured. Scaling relations of these scaling exponents and their universality class are discussed.

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