A damage model based on failure threshold weakening

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A variety of studies have modeled the physics of material deformation and damage as examples of generalized phase transitions, involving either critical phenomena or spinodal nucleation. Here we study a model for frictional sliding with long range interactions and recurrent damage that is parameterized by a process of damage and partial healing during sliding. We introduce a failure threshold weakening parameter into the cellular-automaton slider-block model which allows blocks to fail at a reduced failure threshold for all subsequent failures during an event. We show that a critical point is reached beyond which the probability of a system-wide event scales with this weakening parameter. We provide a mapping to the percolation transition, and show that the values of the scaling exponents approach the values for mean-field percolation (spinodal nucleation) as lattice size L is increased for fixed R. We also examine the effect of the weakening parameter on the frequency-magnitude scaling relationship and the ergodic behavior of the model.