Abstract

Abrasion can be understood in many ways, but relies on the idea that at least two physical bodies see their characteristics modified after some kind of interaction. The study of this many-body problem often relies on local modeling of the interactions, and a study of the global behaviour of a large set of interacting particles proves impossible. These kind of systems however are expected to exhibit self-organization.

From a model of interaction with stochastic rules of evolution, we introduce a new formalism relying on probability density functions for the state variable of the system through a Fokker-Planck equation, allowing to study the behaviour of a large ensemble of interacting particles. The phase transition exhibited by the whole system is studied by means of these dual frameworks. Behavioural changes for the full set of particles are infered from one model or another, and the evolution of the system is simulated using different numerical methods.

We introduce a new physical way of modeling the dynamical loss of mass of pebbles under abrasion. The properties of this model along with their implications regarding the behaviour of the system are investigated by mean of numerical simulations. In particular, we show that the stochastic and analytic formalisms produce the same phase transition. Global properties of the system are showed for a large class of models of interaction. Asymptotic stability and self-similarity of the solutions are studied by analytic means.

We offer some insight about the implications. In particular, the phase transition offers very clear graphical features that could be used to decide the span of a parameter from on-the-field measurements.