

One-dimensional short-range nearest-neighbour interaction and its nonlinear diffusion limit

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1. Abstract

Repulsion between individuals within a finite radius is encountered in numerous applications, including cell exclusion, i.e. an overlap of cells to be avoided, bird flocks, or microscopic pedestrian models. We define such individual based particle dynamics in one spatial dimension with minimal assumptions of the repulsion force f and prove their characteristic properties. Moreover, we are able to perform a rigorous limit from the microscopic- to the macroscopic scale, where we could recover the finite interaction radius as a density threshold. Specific choices for the repulsion force f lead to well known nonlinear diffusion equations on the macroscopic scale, as e.g. the porous medium equation. At both scaling levels numerical simulations are presented and compared to underline the analytical results.