ABSTRACT

We give a brief introduction to computer simulations, random numbers, random walks and the Monte Carlo method. A few examples of application of Monte Carlo simulations are presented.

The trapping reaction in one, two and three dimensional lattices with a single trap in the center of the lattice was studied. The density profiles are presented for various lattice sizes in all geometries. The results of Monte Carlo simulation are compared with those of exact enumeration. We are also concerned with the kinetics of growth of depletion zone, which is monitored by the θ-distance, defined as the distance from the trap to the point where the concentration of the reactants reaches a given arbitrary fraction θ ($0<\theta<1$) of its initial value. We confirm that while in 1D and 3D the time scaling of the θ distance is independent of θ and constant, in 2D it actually depends on θ and hence the growing of the depletion zone is non-universal. We have also observed a finite size effect of smaller lattices and studied its impact on the dynamics of the depletion zone.

We also use Monte Carlo simulations to study the population dynamics of a predator-prey system. In this model, animals must eat in order to survive and reproduce. Part of the habitat serves as a cover for prey, where the animals however can neither eat nor breed. The population dynamics of such a system are studied over time, as well as the effect of cover on the population densities of both predator and prey. We have observed that the correlations are weakened in the density fluctuations of predator and prey when cover is introduced in the system, because their interaction becomes less straightforward. We also show that too much cover can be fatal not only for predators but for prey too.