Efficient algorithm for DLA problem in multiple dimensions

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Understanding critical properties of non-equilibrium processes [**?**] is still a challenging problem of contemporary statistical physics. Of particular interest (both theoretical and practical) are the dynamical growth phenomena. The model for the two-dimensional (2D) growth (Diffusion Limited Aggregation) was introduced almost thirty years ago by Witten and Sander [**?**]. Structures grown by DLA look very similar to those found in nature and society [**?**], for example, ice crystals on window, mineral dendrites on the surfaces of limestones, colony of bacteria, nano-size crystals grown on the crystal surface, monolayer polymer films, interfaces in Hele-Shaw cell, urban growth, etc.

It possible to generalize 2D DLA model for higher dimensions. In this case the general description of the model stays the same. But from computational point of view the problem complexity grows as the number of dimensions increases. There are several issues we have to solve. First, when space dimension is greater than 2 boundary conditions for random walk simulation change since there is finite possibility for random walker to walk to infinity. Second, simulation of random walk requires generation of uniformly distributed random numbers that reside on a unit sphere. This could be time consuming and efficiency issue arises. Third, DLA algorithm should implement a data structure that will allow fast nearest-neighbour search and require moderate amount of memory.

We present some results on estimation of efficiency of proposed algorithms for DLA simulation and discuss on further improvements.

References

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