On the KJMA lattice model with continuous nucleation

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Space tessellation resulting from random nucleations and growth processes is an interesting problem in many scientific field. One particular example, where the nucleation takes place only at the beginning of the process is the Poisson Voronoi tessellation [1]. The Kolmogrov-Johnson-Mehl-Avrami (KJMA) [2, 3, 4] is a natural model that incorporates "continuous" nucleation, as well. It has large applicability for describing several natural phenomena [5].

The KJMA model corresponding to our lattice model is the one which is known in the literature as the continuous nucleation model [2, 3, 4], where each cell (grain) is physically distinguishable from the others (or represent a different phase). The model is defined originally in continuous space and time. However, in our studies space and time discretization is considered. According to our lattice model, cells can grow with constant speed and new ones can continuously nucleate on the empty sites.

In case of 1D lattices we offer an alternative mean-field-like approach for describing theoretically the dynamics and derive an analytical cell-size distribution function [6]. The method reproduces well the scaling laws of the KJMA theory and it has the advantage that it leads to a simple closed form for the cell-size distribution function. It is shown that a Weibull distribution is appropriate for describing the final cell-size distribution. The results are discussed in comparison with Monte Carlo simulation data.

References

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