Ordering dynamics with two non-excluding options: Bilingualism in language competition

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Abstract

In the general context of problems of social consensus, we consider an extension of the voter model in which a set of interacting elements (agents) can be in either of two equivalent states (A or B) or in a third additional mixed (AB) state. The model is motivated by studies of language competition dynamics, where the AB state is associated with bilingualism. We study the ordering process and associated interface and coarsening dynamics in regular lattices and small world networks. Agents in the AB state define the interfaces, changing the interfacial noise driven coarsening of the voter model to curvature driven coarsening. We argue that this change in the coarsening mechanism is generic for perturbations of the voter model dynamics. Consensus is reached with probability one. However, in a two dimensional regular lattice we find two different time scales in the dynamics: while most of the simulations reach consensus through coarse graining, a fraction of them (around 1/3, depending on system size) get trapped in stripe-like dynamical metastable states, which eventually fall into an absorbing state following an exponential decay distribution. On the other hand, when interaction is through a small world network the AB agents restore coarsening, eliminating the metastable states of the voter model. The time to reach the absorbing state scales with system size as $\tau \sim\in N$ to be compared with the result $\tau \sim N$ for the voter model in a small world network. We compare our results to our previous work on the agent based Abrams-Strogatz model for the dynamics of language competition [1] (which is the voter model when the two languages are equivalent) where the AB state was not taken into account, discussing the role of this additional non-excluding state in the problem of social consensus.

References

[1] Stauffer D, Castelló X, Eguíluz V M, San Miguel M 2006 Physica A, doi:10.1016/j.physa.2006.07.036