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Exact asymptotics for Duarte and supercritical rooted kinetically constrained models.
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Summary: Kinetically constrained models (KCM) are a class of interacting particle systems which represent a natural stochastic (and nonmonotone) counterpart of the family of cellular automata known as U-bootstrap percolation. A key issue for KCM is to identify the divergence of the characteristic time scales when the equilibrium density of empty sites, $q$, goes to zero. In [the last two authors, ibid. 47, 324–361 (2019; Zbl 1466.60210); the second author et al., Comm. Math. Phys. 369, 761–809 (2019; Zbl 1419.82037)], a general scheme was devised to determine a sharp upper bound for these time scales. Our paper is devoted to developing a (very different) technique which allows to prove matching lower bounds. We analyse the class of two-dimensional supercritical rooted KCM and the Duarte KCM. We prove that the relaxation time and the mean infection time diverge for supercritical rooted KCM as $e^{\Theta((\log q)^2)}$ and for Duarte KCM as $e^{\Theta((\log q)^4/q^2)}$ when $q \downarrow 0$. These results prove the conjectures put forward in [R. Morris, European J. Combin. 66 250–263 (2017; Zbl 1376.82090); the second author et al., loc. cit.] for these models, and establish that the time scales for these KCM diverge much faster than for the corresponding U-bootstrap processes, the main reason being the occurrence of energy barriers which determine the dominant behaviour for KCM, but which do not matter for the bootstrap dynamics.

MSC:
60K35 Interacting random processes; statistical mechanics type models; percolation theory
60J27 Continuous-time Markov processes on discrete state spaces

Keywords:
Glauber dynamics; kinetically constrained models; spectral gap; bootstrap percolation; Duarte model

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References:


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