Biological lattice-gas cellular automata models for the analysis of collective cell behaviour

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A biological lattice-gas cellular automaton (BIO-LGCA) is a mesoscopic mathematical model for analysing collective behaviour in populations of biological cells. As a cellular automaton, a BIO-LGCA is defined on a regular lattice, where the nodes of the lattice take a certain number of discrete states. As a lattice-gas, the state space of a BIO-LGCA is related to the lattice geometry [1]. Each node can be occupied by ``biological agents", e.g. biological cells, characterised by their velocities which are restricted to the unit vectors connecting a node to its nearest neighbors. Agents may move along the links and interact on the nodes of the lattice. This interaction can change the number of agents at individual nodes (birth/death processes) and might depend on the states in neighbouring nodes which allows to model collective effects. The first BIO-LGCA was introduced as model for collective migration [1]. Meanwhile, the BIO-LGCA has been established as discrete lattice- and agent-based model which permits multi-scale analysis and efficient large-scale simulations of interacting, migrating and proliferating cell populations [3].

References:

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