Andreas Deutsch
Centre for Information Services and High Performance Computing, Technical University of Dresden
e-mail: andreas.deutsch@tu-dresden.de

Analyzing emergent behaviour in cellular automaton models of cancer invasion

Deciphering the principles of cancer invasion is crucial for the development of new therapy concepts. While molecular biology methods are required for a better characterization and identification of individual cancer cells, mathematical modelling and computer simulation is needed for investigating collective effects of cancer invasion. Here, we demonstrate how lattice-gas cellular automaton (LGCA) models allow for an adequate description of individual invasive cancer cell behaviour. We will then show how analysis of the LGCA models allows for prediction of emerging properties (in particular of the invasion speed). Furthermore, we propose that the transition to invasive tumour phenotypes in some brain tumours can be explained on the basis of the microscopic Go or Grow mechanism (migration/proliferation dichotomy) and oxygen shortage, i.e. hypoxia, in the environment of a growing tumour. We test this hypothesis again with the help of a lattice-gas cellular automaton. Finally, we will use our LGCA models for the interpretation of data from in vitro glioma cancer cell invasion assays.

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