Applications of global limit theorems for simulation of a cell population evolution

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We discuss a spatio-temporal evolutionary model of a cell population. In modelling a cell population evolution, the key characteristics are the existence or the absence of sources where cells can die, after having produced or not produced offspring and having migrated or not migrated to different compartments. Based on such characteristics, we can apply continuous-time branching random walks on multidimensional lattices to study the evolution of a cell population with migration and division of cells. Consider particles living independently of each other and of their history. Each particle walks on the lattice until it reaches the source where its behavior is changed. The spatio-temporal modeling is implemented as a stochastic evolutionary system on a multidimensional lattice. At first, we present an approach to investigate the number of cells in the system and in every point of the lattice under fixation of space coordinates in these spatial models. Secondly, we examine the effect of one-point potential on the spatial dynamics on the lattice in case when the spatial and temporal variables jointly tend to infinity. Further, we examine the effect of phase transitions on behavior of a cell population. Based on the obtained results, we discuss possible strategies that may delay a cell population progression to some extent. This work was supported by RFBR grant 13-01-00653.

Keywords: branching random walks; non-homogeneous environments, spatio-temporal structure; phase transitions.