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Migration processes of interacting cancerous cells: beyond the mean field approximation

One of the main aspects of studying diffuse tumors is understanding how they diffuse inside the hosting tissues and how fast they spread. To shed light on these issues, we use an approach based on a microscopical description of the cells' dynamics to reproduce the evolution at the meso-macroscopical scale. An example of a tumor is the glioblastoma which grows in the brain and is very invasive. The glioma cells of the glioblastoma interact with other cancerous cells exchanging small molecules and ions through very short links named gap junction connections [1]. In [2], the authors proposed a model in the framework of automaton for the migration of cancerous cells that takes into consideration gap junction type interactions. In [3], the hydrodynamic limit of the cells' diffusion equation in the mean field-approximation is found, and some differences with the numerical simulations are shown. Using the approach proposed in [3], we study and analyze the effects of the migration process of cancerous cells on the two-points correlation function. The cells move on a single occupancy hexagonal sites lattice with periodical border conditions and interact with the nearest neighbors. The interaction affects the motion of cells by imposing the condition of preserving at least one gap junction connection among the closest neighbors with a given probability. We show the continuous limit of the correlation function and the comparison between the theory and numerical simulations for different values of the cancerous cells' density and interaction parameter. The interaction introduces a short length correlation among cells that dynamically evolves toward stable values depending on the system variables. Numerical simulations show the stable condition differs from the uniform condition due to spatial inhomogeneity and clusters formation also in absence of sources and sinks.

References

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