A Mesoscopic Computational Model of Glioblastoma Growth

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Glioblastoma multiforme (GBM) is the most frequent and most malignant primary brain tumour. Sophisticated mathematical models may further augment our understanding of the dynamics of tumor growth, ultimately resulting in more effective therapies [1]. We develop a quantitative lattice-gas cellular automaton of GBM growth taking into account the two major aspects of this tumour, i.e. proliferative growth and invasion. The physical structure of the brain, in particular so called fibre tracks within the white matter, serve as a “highway” for tumor spreading. Malignant cells are described as moving particles, necrotic material explicitly as “necrotic particles”, and the brain as a porous medium. A local orientation gradient field models the fibre structure of the brain [3]. Recent advances in neuroimaging allow for visualization of these fibre tracks by Magnetic Resonance Imaging (MRI), so called DTI (Diffusion Tensor Imaging) [4]. Our goal is to incorporate these data into our model, as well as anatomical data derived from actual patients. We perform simulations of GBM growth and we analyse tumour invasion speed and pattern formation.

References

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