

Title: Computer Modeling of Tissue Development

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Abstract: This thesis describes hybrid individual cell-based approach to modeling of systems of biological cells. In the first part reaction-diffusion model of environment is introduced together with vax equilibrium and model of cell based on zygotic graph and cumulative states. Further, simulations modeling three biologically motivated situations are introduced: Lumen formation, tumour growth, and cellular migration in chronic inflammation. The first model shows a scenario of hollow structure formation based on directional division and cellular migration. The second model is concerned with the growth of a progeny of a slightly damaged cell. The resulting tumour exhibits three stages of malign transformation. Further, emergence of an aggressive tumour without detectable precursor is observed on one hand and a continual transformation of a benign neoplasm into a malign one is seen on the other hand. Each of these cases is a consequence of different parametrization of the model situation. The last model analyses the role of membrane enzymatic activity in migrating cells of the immune system in chronic inflammation. In this model it is observed that absence of this activity is responsible for occurrence of behavior corresponding to chronic inflammation instead of physiologically relevant immune response.

Keywords: hybrid model, agent-based modeling, digital biological cell, zygotic graph