Numerical implementation of a model of spatially-distributed growth of clonal populations of pre-cancerous cells

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Several partial differential equations have been proposed to model pattern formation in cell populations. An important step in analyzing these models is numerical approximation of their solutions. This work is devoted to the numerical implementation of the model of spatially-distributed growth of clonal populations of pre-cancerous cells, which remained under control of endogenous or exogenous growth factors diffusing in the extracellular medium and binding to the cell surface. The model is very different from classical Turing-type models and the spatial structure of the pattern emerging from the destabilisation of the spatially homogeneous steady state cannot be concluded based on linear stability analysis. The models exhibit qualitatively new patterns of behaviour of solutions, including, in some cases, a strong dependence of the emerging pattern on initial conditions and quasi-stability followed by a rapid growth of solutions. To ensure the feasibility of calculations and control the numerical error we apply a problem-dependent finite element formulation and adaptivity-based numerical approximation schemes. We study also a space-dependent steady state equation with an irregular right-hand-side.