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Optimal control and long-time behavior of solutions for a diffuse interface model of tumor growth

Elisabetta Rocca[1]*

[1]Mathematical Department of the University of Pavia

elisabetta.rocca@unipv.it (*)

We consider the problem of long-time behavior of solutions and optimal control for a diffuse interface model of tumor growth. The state equations couples a Cahn-Hilliard equation and a reaction-diffusion equation, which models the growth of a tumor in the presence of a nutrient and surrounded by host tissue. The introduction of drugs into the system through the nutrient serves to eliminate the tumor cells, hence, in this setting the control variable will act on the nutrient equation. Furthermore, we allow the objective functional to depend on a free time variable, which represents the unknown treatment time to be optimized. As a result, we obtain first order necessary optimality conditions for both the drug concentration and the treatment time. One of the main aim of the control problem is to realize in the best possible way a desired final distribution of the tumor cells which is expressed by a target function that can be taken as a stable configuration of the system, so that the tumor does not grow again once the treatment is completed. In view of this fact we consider here also the problem of long-time behavior of solutions.

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