

# Phase-field models for tumor growth:

## Optimal Control and Early states reconstruction

*Elisabetta Rocca*

Università di Pavia

In this course we present recent results on optimal control and inverse identification of the initial condition for two tumor growth models related to prostate and brain tumors.

The first model is described by a PDE system ruling the evolution of the tumor phase parameter, the nutrient and the prostate index and it consists of a coupling between an Allen-Cahn equation and two reaction-diffusion equations. The system is subjected to combined cytotoxic and antiangiogenic therapies, and we propose an optimal control framework to robustly compute the drug-independent cytotoxic and antiangiogenic effects enabling an optimal therapeutic control of tumor dynamics.

We also illustrate the inverse identification of the initial data, starting from a measurement at the final time. This can be useful in medical applications, after some diagnostic images are obtained, to locate with more precision the areas where the tumour started growing, as well as some information on the initial distribution of nutrient and PSA, which could still give more insight to the practitioners. These pieces of information can then be used to better calibrate therapies on the patients.

The last problem will be then investigated for a different PDE system coupling a Cahn-Hilliard type equation for the tumor phase and a reaction-diffusion equation for the nutrient proportion describing a brain tumor type model.

These are joint projects with A. Agosti, E. Beretta, C. Cavaterra, P. Colli, M. Fornoni, G. Lorenzo, A. Reali.