Adjoint method for a tumour growth PDE-constrained optimization problem

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Abstract:
In this paper we present a method for estimating unknown parameters that appear on an avascular, spheric tumour growth model. The model for the tumour is based on nutrient driven growth of a continuum of live cells, whose birth and death generate volume changes described by a velocity field.

The model consists on a coupled system of partial differential equations whose spatial domain is the tumour, that changes in size over time. Thus, the situation can be formulated as a free boundary problem.

After solving the forward problem properly, we use the model for the estimation of parameters by fitting the numerical solution with real data, obtained via in vitro experiments and medical imaging. We define an appropriate functional to compare both the real data and the numerical solution. We use the adjoint method for the minimization of this functional, getting a better performance than the obtained with the pattern search method.

Keywords: avascular tumour, PDE constrained optimization, inverse problem, mathematical modeling, adjoint method