Reconstruction of discontinuous coefficients in a semilinear parabolic equation: an inverse problem motivated by cardiac electrophysiology

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In this talk, I will tackle the problem of identifying the location of small regions in which the coefficients of a semilinear parabolic equation are altered with respect to a reference case, from the knowledge of the solution of the equation on the boundary of the domain.

The problem is motivated by the long-term task of identifying ischemic regions inside the cardiac tissue via non-invasive measurements of the electrical potential. The formulation shares some features with the Electrical Impedance Tomography problem, but shows many further difficulties, like the non-linearity of the direct problem and the small number of measurement at disposal.

I will discuss the well-posedness of the direct problem and report a one-shot reconstruction strategy for the inverse problem, which is based on the topological gradient of a suitable cost functional and exploits an asymptotic expansion of the boundary data in presence of small inclusions. I will show numerical results obtained in several test cases and discuss the feasibility and the stability of the technique.

This is a joint work with E. Beretta, C. Cavaterra, M.C. Cerutti and A. Manzoni