ABSTRACT

Source Localization of Reaction-Diffusion Models for Brain Tumors

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In this work, we propose a mathematical method for locating the brain tumor source starting from the following reaction diffusion model:

$$\begin{cases} \partial_t u - div(D(x)\nabla u) - f(u) &= 0 \quad \text{in } \Omega \times (0,T) \\ u(0) &= \varphi \quad \text{in } \Omega \\ D\nabla u \cdot n &= 0 \quad \text{on } \partial\Omega \times (0,T) \end{cases}$$

This equation describes the change over time of the normalised tumour cell density u as a consequence of two biological phenomena: proliferation and invasion. Our approach consists in recovering the initial spatial distribution of the tumor cells $\varphi = u(0)$ starting from a later state $\psi = u(T)$ which can be given by a medical image. For that, we use a regularization method posing the inverse problem as a sequence of well-posed forward problems. Simulation with synthetic images show the accuracy of our approach for locating brain tumor sources.
This work is a joint collaboration with George Baravdish (Linköping University) and Freddie Åström (Heidelberg University).