Ph.D. position at INRIA Sophia-Antipolis, France

Multi-scale computational models of brain tumors for medical image analysis.

Computational models of brain tumors have recently gained major attention. The Asclepios project-team of INRIA introduced one of the first couplings between these models and time series of medical images [1]. More recently, we designed advanced tools to (a) estimate tumor growth parameters for patient-specific diagnosis [2] and (b) extrapolate the tumor cell density beyond the visible tumor boundary of a medical image, with the objective to better plan radiotherapy [3].

The objective of this Ph.D. thesis is to improve the existing models and to develop new ones to include 1) the uncertainty on the growth of the tumor, 2) the effect of various therapies and 3) a multi-scale modeling approach from microscopic to macroscopic scales.

In a first stage, the research will be dedicated to the introduction of the notion of uncertainty into the existing tools, and of its representation and visualization in the medical images of a patient. The white matter parameters, so far considered as spatially constant, will be evaluated on specific fiber bundles. This will require identifying fiber clusters within the white matter.

In a second stage the Ph.D. candidate will explore how to model various therapies and how to identify their parameters from time series of medical images: existing microscopic models for radiotherapy and chemotherapy will be reviewed and adapted to the current models. Finally, a link between microscopic and macroscopic models will be sought.

This research will involve a number of advanced mathematical and algorithmic tools including Partial Differential Equations (PDEs), Stochastic differential equations (SDEs) Asymptotic approximation, Cellular automata, Homogenization methods, etc.

This research will be done within the Asclepios project-team at INRIA Sophia-Antipolis.
France in collaboration with Harvard Medical School (an associated team of Asclepios through the CompuTumor\(^1\) program), and a number of research groups in France and Europe.

**Requirements:**

- Master of Science in Computer Science / Applied Mathematics / Theoretical Physics.
- Experience in medical image analysis.
- Good mathematical skills
- Good experience with C/C++ programming
- Fluent in English (knowledgeable in French is a plus)

**Application:**

Please email your resume, letter of motivation and references to:

- Nicholas Ayache: nicholas.ayache@sophia.inria.fr
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- Hervé Delingette: herve.delingette@sophia.inria.fr

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