

2019-01514 - PhD Position F/M Personalized calibration of electroporation models for clinical routine

Type de contrat : CDD de la fonction publique
Niveau de diplôme exigé : Bac + 5 ou équivalent
Fonction : Doctorant

A propos du centre ou de la direction fonctionnelle

The MONC project-team aims at developing new mathematical models involving partial differential equations and statistical methods based on a precise biological and medical knowledge in order to build numerical tools based on available quantitative data about cancer. The goal is finally to be able to help clinicians and/or biologists to better understand, predict or control tumor growth and possibly evaluate the therapeutic response, in a clinical context or for pre-clinical studies. We plan to develop patient-specific approaches (mainly based on medical imaging) as well as population-type approaches in order to take advantage of available large data bases. We claim that our work may have a clinical impact that can change the way of handling certain pathologies.

Mission confiée

PhD Supervisors: Annabelle Collin and Clair Poignard

Collaboration with Olivier Seror (radiologist AP-HP, CHU Île-de-France)

Principales activités

Electroporation is a complex phenomenon that occurs when biological tissues are subjected to electric pulses. Electroporation makes it possible to either kill directly the cells in the target region (tumor) or to introduce molecules into living cells. However, one of the main limitation of using electroporation in the clinical routine comes from the technical difficulties raised by such therapies, in particular it is difficult to well determine the treated zone. Numerical modeling of the electric field magnitude provides a powerful strategy to assess the treatment efficacy: thanks to well-designed models [4], the computation of the distribution of the electric field is achievable, providing a numerical evaluation of the treatment. The objective of this thesis is to develop a strategy enabling to produce predictive simulations for a given patient. In this context, the available medical data - measurements of the electric intensity that flows through needles - can be used to identify the model parameters, and particularly the patient-dependent organ conductivity.

To do so, we will develop a specific joint state and parameter estimator inspired from [3] combining a Luenberger - also called nudging - state observer [1,2] and a parameter Kalman-based estimator. In particular, we will account for the availability of population data by considering that the parameters are divided into two types of uncertainties: an inter- and an intra-population variabilities. Our objective is then to demonstrate that the patient observer feedback can be modified to take into account all the available data on the population in order to sequentially estimate concurrently these two variabilities. In addition to these challenges, the PhD aims to address the HPC issue of real-time simulations to provide an instantaneous numerical assessment of the procedure. The strategy will be validated on a set of patients selected by our radiologist collaborator Olivier Seror (AP-HP, CHU Île-de-France).

[1] A. Collin, P. Moireau, and D. Chapelle. A Luenberger observer for reaction-diffusion models with front position data. *Journal of Computational Physics*, 300, 288-307.

[2] D.G. Luenberger. An introduction to observers. *IEEE Transactions on Automatic Control*, 16:596--602, 1971.

[3] P. Moireau, D. Chapelle, and P. Le Tallec. Joint state and parameter estimation for distributed mechanical systems. *Computer Methods in Applied Mechanics and Engineering*, 1987(6--8):659--677, 2008.

[4] D. Voyer, A. Silve, L. M. Mir, R. Scorretti, and C. Poignard. Dynamical modeling of tissue electroporation. *Bioelectro- chemistry*, 119:98 - 110, 2018.

Compétences

Profile

We look for a candidate specialized in applied mathematics, more specifically in PDE, modelling and in numerical simulation.

Qualities/Skills needed:

- Master thesis / Engineer diploma in applied mathematics
- Marked interest in applications in medicine

Avantages

- Subsidized meals
- Partial reimbursement of public transport costs
- Possibility of teleworking (after 6 months of employment) and flexible organization of working hours
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities
- Access to vocational training
- Social security coverage

Rémunération

1982€ / month (before taxes) during the first 2 years, 2085€ / month (before taxes) during the third year.

Informations générales

- **Thème/Domaine** : Modélisation et commande pour le vivant
Calcul Scientifique (BAP E)
- **Ville** : Talence
- **Centre Inria** : CRI Bordeaux - Sud-Ouest
- **Date de prise de fonction souhaitée** : 2019-10-01
- **Durée de contrat** : 3 ans
- **Date limite pour postuler** : 2019-06-06

Contacts

- **Equipe Inria** : MONC
- **Directeur de thèse** :
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A propos d'Inria

Inria, l'institut national de recherche dédié aux sciences du numérique, promeut l'excellence scientifique et le transfert pour avoir le plus grand impact. Il emploie 2400 personnes. Ses 200 équipes-projets agiles, en général communes avec des partenaires académiques, impliquent plus de 3000 scientifiques pour relever les défis des sciences informatiques et mathématiques, souvent à l'interface d'autres disciplines. Inria travaille avec de nombreuses entreprises et a accompagné la création de plus de 160 start-up. L'institut s'efforce ainsi de répondre aux enjeux de la transformation numérique de la science, de la société et de l'économie.

Consignes pour postuler

Thank you to send :

- CV
- Cover letter
- Master marks and ranking
- Support letter(s)

Sécurité défense :

Ce poste est susceptible d'être affecté dans une zone à régime restrictif (ZRR), telle que définie dans le décret n°2011-1425 relatif à la protection du potentiel scientifique et technique de la nation (PPST). L'autorisation d'accès à une zone est délivrée par le chef d'établissement, après avis ministériel favorable, tel que défini dans l'arrêté du 03 juillet 2012, relatif à la PPST. Un avis ministériel défavorable pour un poste affecté dans une ZRR aurait pour conséquence l'annulation du recrutement.

Politique de recrutement :

Dans le cadre de sa politique diversité, tous les postes Inria sont accessibles aux personnes en situation de handicap.

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