Offre n°2023-06403

PhD Position F/M Signal processing-based on the squared eigenfunctions of the Schrodinger operator. Application to EEG signals

Le descriptif de l'offre ci-dessous est en Anglais

Type de contrat : CDD

Niveau de diplôme exigé : Bac + 5 ou équivalent

Fonction : Doctorant

A propos du centre ou de la direction fonctionnelle

The Inria Saclay-Île-de-France Research Centre was established in 2008. It has developed as part of the Saclay site in partnership with **Paris-Saclay University** and with the **Institut Polytechnique de Paris** .

The centre has **39 project teams** , 27 of which operate jointly with Paris-Saclay University and the Institut Polytechnique de Paris; Its activities occupy over 600 people, scientists and research and innovation support staff, including 44 different nationalities.

Contexte et atouts du poste

Biomedical signals are usually characterized by the presence of peaks that provide direct or indirect information on the physiological and metabolic state. Usually, these pulse-shaped signals require preprocessing such as denoising and artifact removals. Further analysis and processing might be required in some specific situations to allow for the extraction of pertinent information from these signals. Despite the fact that the literature abounds with signal processing methods, there are still challenges that need to be overcome and further improvements can be achieved for processing pulse-shaped signals. In this context, a quantum-based signal processing method has been proposed in [1]. This method called the semi-classical signal analysis (SCSA) method decomposes the signal into a set of functions given by the squared eigenfunctions of the Schrödinger operator associated with its negative eigenvalues [1]. Thus, and unlike traditional signal decomposition tools, the SCSA expresses the signal through a set of functions that are signal dependent, that is, these functions are not fixed and known in advance but are computed by solving the spectral problem of the Schrödinger operator whose potential is the signal to be analyzed. Accordingly, these eigenfunctions capture more details about the signal and its morphological variations [2]. The SCSA has been successfully applied in many applications for signal representation, denoising, post-processing, and feature extraction. For example, it has been used for arterial blood pressure waveform analysis in [3,4] and for magnetic resonance spectroscopy (MRS) denoising [5], for MRS water suppression [6], and for MRS lipid suppression [7]. It has been also used for feature extraction in epileptic seizure detection [8] and for the characterization of PPG signals and blood pressure signals for non-invasive estimation of central pressure and arterial stiffness respectively [9]. Recent work on the characterization of EEG signals for epileptic seizure detection and seizure onset zone location has shown promising results [10], [11].

Mission confiée

The objective of this research project is to study the mathematical properties of the SCSA and compare the approach qualitatively and quantitatively to state-of-the-art methods such as Wavelets and empirical mode decomposition methods. A parallel between quantum and signal processing properties will be studied. In particular, the student will use some quantum properties of the operator to propose new criteria for the selection of the semi-classical parameter a key design parameter of the method for both denoising and signal characterization. Numerical properties of the algorithm will be also analyzed, with a focus on the optimization of the current codes. Applications to biomedical signals will be investigated with a particular focus on EEG signals for epileptic seizure detection and prediction and for monitoring the mental health of athletes.

Compétences

We seek a student with strong background and expertise in signal processing and mathematics.

Knowledge in biomedical signals and learning algorithms is a plus.

Avantages

- Subsidized meals
- Partial reimbursement of public transport costs
- Leave: 7 weeks of annual leave + 10 extra days off due to RTT (statutory reduction in working hours) + possibility of exceptional leave (sick children, moving home, etc.)
- Possibility of teleworking 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

- 1st and 2nd year : 2051€ gross/month
- 3rd year : 2158€ gross/month

Informations générales

- **Ville :** Palaiseau
- **Centre Inria :** Centre Inria de Saclay
- **Date de prise de fonction souhaitée :** 2023-10-01
- **Durée de contrat :** 3 ans
- **Date limite pour postuler :** 2026-09-30

Contacts

- **Équipe Inria :** AT-SAC
- **Directeur de thèse :**
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A propos d'Inria

Inria est l'institut national de recherche dédié aux sciences et technologies du numérique. Il emploie 2600 personnes. Ses 215 équipes-projets agiles, en général communes avec des partenaires académiques, impliquent plus de 3900 scientifiques pour relever les défis du numérique, souvent à l'interface d'autres disciplines. L'institut fait appel à de nombreux talents dans plus d'une quarantaine de métiers différents. 900 personnels d'appui à la recherche et à l'innovation contribuent à faire émerger et grandir des projets scientifiques ou entrepreneuriaux qui impactent le monde. Inria travaille avec de nombreuses entreprises et a accompagné la création de plus de 200 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.

Attention: Les candidatures doivent être déposées en ligne sur le site Inria. Le traitement des candidatures adressées par d'autres canaux n'est pas garanti.

Consignes pour postuler

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.