Offer #2025-08701

PhD Position F/M Analysis and model of MR-related artifacts on EEG signal when recorded during a fMRI sequence

Contract type : Fixed-term contract

Level of qualifications required : Graduate degree or equivalent

Fonction : PhD Position

About the research centre or Inria department

The Inria Rennes - Bretagne Atlantique Centre is one of Inria's eight centres and has more than thirty research teams. The Inria Center is a major and recognized player in the field of digital sciences. It is at the heart of a rich R&D and innovation ecosystem: highly innovative PMEs, large industrial groups, competitiveness clusters, research and higher education players, laboratories of excellence, technological research institute, etc.

Context

This PhD thesis is part and funded by the ANR NIRVANA project, which aims to unravel bimodal neurofeedback efficiency for dynamic non-invasive brain rehabilitation. The PhD thesis is part of the work-package 2 which challenge is to model online correction of EEG's MR-related artefacts, in collaboration with Elise Bannier MR-physicist at Rennes University Hospital, and Frédéric Grouiller Head of the Clinical MR imaging section of the CBIM at the University of Geneva. Some visits to Geneva are planed during the duration of the PhD thesis.

This project aims to clean EEG with as little lag time as possible, to accurately estimate EEG-NF scores when recorded under MRI. During EEG-fMRI recordings, EEG signals are altered by strong gradient artifacts that a hybrid mean and median moving average can fairly correct [REF]. EEG is also altered by artifacts induced by any motion or vibration in the strong static magnetic field (law of induction) such as head motion, pulsatile motion of scalp arteries or any cardiac-related motion and vibrations from the ventilation system or Helium pump.

Adding Carbon-Wire Loops (CWL) on the EEG cap appears to be the best asset today for EEG real-time correction under MRI [REF]. This project aims to understand how residual artifacts, mainly due to unpredictable movements, impact the EEG signals and to propose a method to evaluate in real-time the quality of the EEG signals across channels, to have the possibility to adjust the estimation of EEG features, and eventually have the possibility to use connectivity measures for the design of EEG-NF target. Indeed, it is not reasonable today to use EEG connectivity measures when recorded under MRI, as correlated artifacts across channels exist and can have a strong amplitude (for example the one due to cardiac activity).

In this project, we assume that collecting a ground truth dataset would be precious to split the recorded signal into the theoretical EEG signal and the MR-related artefacts. Using CWL, it will allow us to model the remaining artefacts and measure EEG signal distortions induced by artefact correction. I make the hypothesis that those remaining artefacts can be modeled and analysed using the ECG channel, well-known EEG features during specific tasks, electrodes polarities, and fMRI-derived head positions over time. Once the noise is modeled and characterised, we will be able to correct the EEG signal efficiently over time.

Assignment

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Main activities

The PhD candidate will have to :

- develop an acquisition protocol in Rennes for Alive Phantom, after a visit to Geneva where they already acquired such data from one participant.
- understand the physic behind the CWL.
- process the acquired signals
- develop a model to characterise the recorded noise on the EEG signals

Several visits to the CBIM at University of Geneva will be planned, to acquire data on other MRI scanners and to exchange with local partners of the project.

Skills

Signal processing

Knowledge in electromagnetism, EEG and/or MRI

Statistics

Machine learning (regression)

Benefits package

- Subsidized meals
- Partial reimbursement of public transport costs
- Possibility of teleworking (90 days per year) and flexible organization of working hours
- partial payment of insurance costs

Remuneration

monthly gross salary amounting to 2200 euros

General Information

- **Theme/Domain :** Computational Neuroscience and Medicine
  Data production, processing, analysis (BAP D)
- **Town/city :** Rennes
- **Inria Center :** Centre Inria de l'Université de Rennes
- **Starting date :** 2025-06-02
- **Duration of contract :** 3 years
- **Deadline to apply :** 2025-05-11

Contacts

- **Inria Team :** EMPENN
- **PhD Supervisor :**
  Cury Claire / claire.cury@inria.fr

About Inria

Inria is the French national research institute dedicated to digital science and technology. It employs 2,600 people. Its 200 agile project teams, generally run jointly with academic partners, include more than 3,500 scientists and engineers working to meet the challenges of digital technology, often at the interface with other disciplines. The Institute also employs numerous talents in over forty different professions. 900 research support staff contribute to the preparation and development of scientific and entrepreneurial projects that have a worldwide impact.

Warning : you must enter your e-mail address in order to save your application to Inria. Applications must be submitted online on the Inria website. Processing of applications sent from other channels is not guaranteed.

Instruction to apply

Defence Security :
This position is likely to be situated in a restricted area (ZRR), as defined in Decree No. 2011-1425 relating to the protection of national scientific and technical potential (PPST).Authorisation to enter an area is granted by the director of the unit, following a favourable Ministerial decision, as defined in the decree of 3 July 2012 relating to the PPST. An unfavourable Ministerial decision in respect of a position situated in a ZRR would result in the cancellation of the appointment.

Recruitment Policy :
As part of its diversity policy, all Inria positions are accessible to people with disabilities.