



Offre n°2024-08038

PhD Position F/M Neuroadaptive neurofeedback user training (NUT)

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 Centre at Rennes University is one of Inria's eight centres and has more than thirty research teams. The Inria Centre 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.

Contexte et atouts du poste

This PhD is not in the context of a funded partnership. However, a collaboration with Marius Klug from Brandenburgische Technische Universität Cottbus-Senftenberg is envisioned.

The goal of the project is to develop innovative and neuroadaptive neurofeedback interfaces. During neurofeedback training, people are provided with direct feedback regarding their own brain activity in order to learn to control it, often with the aim to improve their cognitive abilities. Previous research demonstrated that the state of neurofeedback trainees, such as their attentional state (workload, attention, motivation,...) influences their ability to learn to control their brain activity. Thus, the goal of this PhD is to adapt the neurofeedback training to better account for the state of the trainee.

No regular travel is foreseen for this position, but a mobility to a foreign research laboratory or industry will be encouraged.

Mission confiée

Keywords: Neurofeedback, modeling, adaptive tutoring

PhD topic: Controlling one's own brain activity when receiving direct information regarding the former is a skill that can be acquired using neurofeedback training. During such training, people's brain activity is acquired, often using electroencephalography (EEG), and converted into a feedback that people have to learn to control [Roc et al., 2021]. The ability to modulate one's own brain activity can be used for two main types of applications. First, to use brain-computer interfaces (BCIs), that enable the control of external digital systems by producing discriminatory and stable brain patterns each associated with a specific command for the system [Wolpaw et al., 2012 ; Roc et al., 2021]. For instance, BCIs can be used to control the direction of a character in a video game or the direction of a wheelchair by imagining right or left-hand movements [Tonin et al., 2022]. Second, for neurofeedback applications for which the end goal is that the modifications occurring in the brain activity lead to cognitive improvements, often in clinical applications [Batail et al., 2019]. For instance, neurofeedback can be used for motor rehabilitation after a stroke [Le Franc et al., 2022].

The state of a person is defined as his/her characteristics that are “temporary, brief, and caused by external circumstances”. It is already known that mental states, such as attention or workload, influence the ability to control one's own brain activity [Kadosh and Staunton, 2019 ; Tzdaka et al., 2021]. However, very few studies adapted the training to take into account the state of the user into account. One of the very first study to do so is the one from Myrden and Chau from 2016 during which they used self-reported levels of fatigue, frustration and attention to adapt a mental task neurofeedback user training. In another study, Talukdar et al., 2020, developed a method to potentially take into account the state of fatigue of the participants into the signal processing method, without testing the effect of such adaptation. In any type of training, the state of the learners are decisive in the outcome of the training [Keller and Keller, 2010]. Numerous types of applications are already taking advantage of these pieces of information, such as health [Jovanov et al., 2005], sport [Baca and Kornfeind, 2006] or intelligent tutoring systems [Woolf et al., 2010]. Assessing the states, including attention, working memory, emotions or motivation, of the users would thus be relevant to improve neurofeedback learning as well. Assessing the state of the users would not require further equipment as it could already be inferred using the neurophysiological data acquired for neurofeedback training.

Such adaptation could concern several main characteristics of the training, including the content, modality and timing of the feedback or the type of mental tasks that people are asked to perform. For instance, the number of mental tasks could be reduced or the type of mental tasks could be made easier when an increase in workload is detected in the neurophysiological data of the user. Another possibility would be to enrich the neurofeedback provided to the users to convey additional information related to their mental state. Few studies have been led in order to enrich the traditional evaluative feedback. For instance, Sollfrank et al. chose to add information concerning the stability of the EEG signals to the standard feedback based on classification accuracy [Sollfrank et al., 2016], while Schumacher et al. added an explanatory feedback based on the level of muscular relaxation to this classification accuracy-based feedback [Schumacher et al., 2015]. To our knowledge, none have provided feedback on the mental state of the learners during neurofeedback training.

On a fundamental level, this thesis will provide a better understanding of the neuromarkers of mental states as well as first computational models on their influence on neurofeedback performances. Experiments will make it possible to test, improve and validate the models, methods and algorithms created.

References:

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Collaboration: The PhD student recruited will be supervised by Léa Pillette (CNRS researcher in the Hybrid team at IRISA), Marc Macé (CNRS researcher in the Hybrid team at IRISA) and Anatole Lécuyer (Inria research director in the Hybrid team at IRISA). Marius Klug, young investigator and group leader from Brandenburgische Technische Universität Cottbus-Senftenberg will be involved in the co-supervision of the PhD student. Marius Klug’s expertise in the assessment of users’ state using physiological data, notably neurophysiological ones, and his expertise in developing engaging and immersive interfaces will be highly valuable in the supervision of the PhD student.

Principales activités

Main activities (5 maximum) :

- Literature review
- Experimental design
- Implementation of neurofeedback solutions
- Statistical and neurophysiological analyses
- Write scientific articles

Additional activities (3 maximum) :

- Present research results at conferences
- Potentially teaching classes
- Potential supervision of intern project

Compétences

We are looking for a highly motivated student with advanced skills in computational neuroscience and a good level in English.

Avantages

- 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

Rémunération

Monthly gross salary: 2100€ during the 2 1st years and 2200€ during the 3rd year.

Informations générales

- **Thème/Domaine** : Interaction et visualisation
Systèmes d'information (BAP E)
- **Ville** : Rennes
- **Centre Inria** : [Centre Inria de l'Université de Rennes](#)
- **Date de prise de fonction souhaitée** : 2024-10-01
- **Durée de contrat** : 3 ans
- **Date limite pour postuler** : 2024-09-24

Contacts

- **Équipe Inria** : [HYBRID](#)
- **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.

L'essentiel pour réussir

The success of this PhD will require a diversity of skills and personal characteristics. A successful PhD candidate must possess strong analytical and critical thinking skills to navigate complex research problems and develop innovative solutions. Dedication and motivation are essential, as a PhD is challenging. The candidate will also need effective time management and organizational abilities to balance various research tasks and deadlines. Strong written and verbal communication skills are crucial for presenting findings clearly and persuasively. Additionally, intellectual curiosity and a passion for the chosen field drive the continuous learning and exploration necessary for making significant contributions to the domain of research.

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

Please submit online : your resume, cover letter and letters of recommendation eventually

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.