

PostDoc position available:

Source localization and inverse problem in EEG/MEG/SEEG brain imaging

A 2 year PostDoc position is available at the [Signal-Image team](#) at I2M (Institut de Mathématiques de Marseille, the pure and applied mathematics laboratory at Aix-Marseille University, Marseille, France), together with the [DYNAMAP team](#) at INS (Institut de Neurosciences des Systèmes, Aix-Marseille University, France). The position is funded by [BMWs](#) (a project sponsored by ANR, the French research funding agency), whose aim is to develop advanced methods for brain source localization from joint EEG, MEG and intracerebral EEG data. There is a possibility of extending the position to a third year at DYNAMAP.

Research project:

BMWs (Bayesian Meets Wavelets in spacetime, ANR-20-CE45-0018) is a project funded by ANR (*Agence Nationale de la Recherche*) which aims at developing advanced methods and algorithms for the EEG/MEG inverse problems. The BMWs project involves *Institut de Mathématiques de Marseille (I2M, Signal-Image Team)*, *Laboratoire des Signaux et Systèmes (L2S, Inverse problem group, Paris-Saclay and Centrale Supélec, together with the PARIETAL team from INRIA)* and *Institut de Neurosciences des Systèmes (INS, DYNAMAP team, Marseille)*.

The EEG (electro-encephalography) and MEG (magneto-encephalography) source localization problems are strongly ill-conditioned. Current approaches suffer from severe limitations, among which a poor spatial resolution, the absence of modeling of temporal dynamics, and the difficulty to fuse modalities.

The main objective of BMWs is to develop and combine for the first time several state-of-the-art techniques to estimate the fine spatio-temporal dynamics of brain networks with unprecedented precision and with quantification of uncertainties

The goal of the PostDoc project is to develop and study new approaches for the MEG/EEG inverse problem, with a focus on structured sparsity, and test and validate developed approaches on datasets (benchmark datasets and datasets obtained at DYNAMAP). Current research in the team focus on penalized least squares approaches, with penalizations such as total variation, or sparsity enforcing penalizations in the wavelet domain using cortical wavelet bases developed by the team. This will be a natural starting point for the recruited researcher. Successful algorithms will be implemented into the freely available *mne-python* software, maintained (among others) by the PARIETAL team involved in BMWs. The recruited PostDoc will be invited to participate in the development.

A focus will be on inverse problem from multimodal data, for example joint EEG/MEG recordings, and more importantly joint MEG and intracerebral

EEG (SEEG) recordings, which are now routinely collected at DYNAMAP. An important goal will be to assess quantitatively the agreement of SEEG data with the output of the MEG inverse problem, and if possible the performances of source localization when SEEG is taken into account.

Independent component analysis (ICA) has shown good performance for the separation of components from MEG recordings, even though the theoretical grounds of these approaches are not established. Investigating the interplay between ICA and brain source localization algorithms would also be a natural research project.

The group at I2M gathers approximately 10 researchers, PostDocs and PhD students, with expertise in various fields of mathematical and statistical signal and image processing. The recruited PostDoc will also interact strongly with the DYNAMAP team in Marseille. He/she will also have occasions to interact regularly with the L2S group of BMWs.

Profile:

The candidate will either be an applied mathematician with experience (or a least interest) in signal processing, inverse problem, statistical modeling and applications to brain imaging, and good programming skills, or originate from signal processing and/or computer science, with good knowledge in statistics and applied mathematics.

Starting date:

between september 2021 and january 2022

Location:

I2M Marseille, CMI, 39 rue Joliot-Curie, 13453 Marseille Cedex 13, France
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