Post-Doctoral position (open until filled)

MultiGSP: Multimodal Graph Signal Processing for Neuroimaging

Research Team: IMT Atlantique Brest, BRAIn team

Funding: up to 18 months

Keywords: Graph Signal Processing, Neuroimaging, EEG, fMRI, Connectivity Gradients

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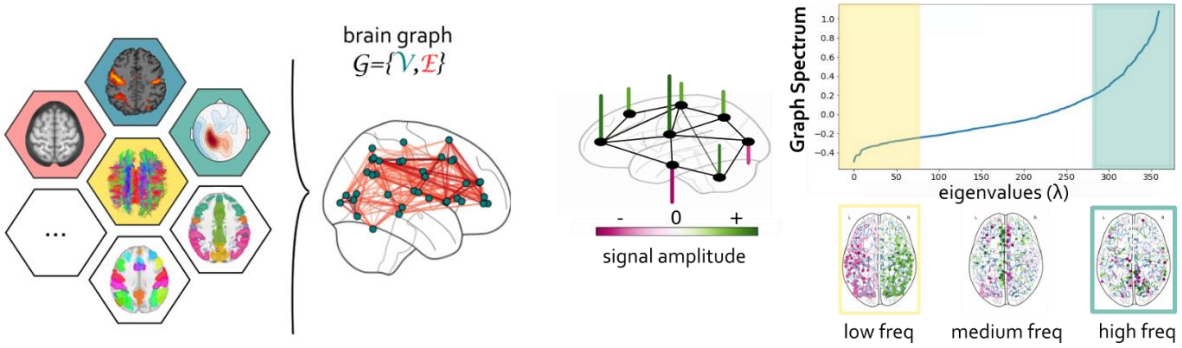

Job Description

The present postdoctoral fellowship is funded by the Sustainable Attractivity Strategy of the Brittany Region, with the goal of attracting high profile junior researchers from all over the world, offering exceptional conditions for long-term academic development. **To fulfill the criteria, the candidate must have spent a minimum 18 months outside France in the last 3 years.**

The BRAIn team at IMT Atlantique is seeking a highly qualified young researcher with experience and motivation in Computational Neuroscience and Machine Learning.

This position is open by IMT Atlantique Brest (France) within the framework of the MultiGSP (Multimodal Graph Signal Processing) research project. The objective of the MultiGSP project is to exploit the theoretical framework of Graph Signal Processing (GSP) for multimodal data fusion. We use the application framework of Neuroimaging to put in place models, and we aim for a long-term extension to other types of data.

GSP is an expanding research area[1] that extends classical analysis methods to non-regular domains, exploiting the topology of the underlying graphs. GSP is therefore a flexible tool to associate signals (i.e. brain activity) to an underlying structure (i.e. brain anatomical networks). The increasing interest that GSP is receiving also results from the powerful correspondence between graph Laplacian eigenvectors and frequency Fourier analysis. GSP represents an ideal yet mostly unexplored framework to integrate multi-modal brain signals[2], associating structural, electrophysiologic, metabolic and functional information.

The selected candidate will collaborate with the other members of the team and their collaborators to develop novel methods based on GSP to efficiently integrate information from different neuroimaging

techniques (e.g. Electroencephalography-EEG, functional Magnetic Resonance Imaging- fMRI, Diffusion Weighted Imaging, DWI). A secondary mission of the Post-Doc will be to contribute to the development of deep learning methods for Neuroimaging, in line with the research axes of the team.

IMT Atlantique is a technological university and offers very competitive salary packages, with postdoc wages corresponing to a junior assistant professor level. Successful candidates will also benefits from 49 days of annual paid holidays.

Research Environment

The BRAIn team is a reference for its work at the intersection between signal processing on graphs (Nicolas Farrugia, Vincent Gripon), deep learning (Vincent Gripon, Mathieu Leonardon), and neuroimaging (Giulia Lioi, Nicolas Farrugia), and has already contributed to the emerging field of GSP/Neuroimaging with a series of seminal works[3–5].

Within the context of the MultiGSP project, the BRAIn team closely collaborate with the IMAGINE team (Integration of multimodal information for decision making and optimization of therapies interventions) of the LATIM laboratory (François Rousseau).

Applicant Profile

The Ideal applicant should have:

- Theoretical, technical and practical knowledge in mathematics, linear algebra and graph theory.
- Strong programming skills using Python (e.g. machine learning and sklearn tool, PyTorch)
- Knowledge of neuroimaging processing tools such as nilearn, Fieldtrip, SPM, FSL, MNE-python
- Ability to work in a team
- Autonomy
- Mastery of French and English

How to apply

Applicants should send their complete application package by email to giulia.lioi@imt-atlantique.fr, nicolas.farrugia@imt-atlantique.fr

This includes:

- Motivation letter
- Complete CV with publication list
- PDF of one representative paper (or slideshow) of the candidate in connection with this project.
- Recommendation letters (preferably directly sent by the mentor)

References

1. Ortega, A., Frossard, P., Kovacevic, J., Moura, J. M. F. & Vandergheynst, P. Graph Signal Processing: Overview, Challenges, and Applications. *Proc. IEEE* **106**, 808–828 (2018).

2. Preti, M. G. & Van De Ville, D. Decoupling of brain function from structure reveals regional behavioral specialization in humans. *Nat. Commun.* **10**, 1–7 (2019).

3. Ménoret, M., Farrugia, N., Pasdeloup, B. & Gripon, V. Evaluating Graph Signal Processing for Neuroimaging Through Classification and Dimensionality Reduction. 618–622 (2017). doi:10.1109/GlobalSIP.2017.8309033

4. Brahim, A. & Farrugia, N. Graph Fourier Transform of fMRI temporal signals based on an averaged structural connectome for the classification of neuroimaging. *Artif. Intell. Med.* **106**, (2020).

5. Lioi, G., Gripon, V., Brahim, A., Rousseau, F. & Farrugia, N. Gradients of Connectivity as Graph Fourier Bases of Brain Activity. *bioRxiv* (2020).