

Neuroimaging population analyses with optimal transport

Internship proposal

Hubert Curien and INT laboratories propose a Master internship of 5-6 months to address open questions in the active field of neuroimaging with optimal transport.

Keywords Optimal transport, neuroimaging, noise stability.

Background Aggregating neuroimaging data across patients is an important research direction in the neuroscience community as it allows to obtain a meaningful representation of common brain MRI signals, eg activation zones, occurring across heterogeneous samples related to different patients. While optimal transport (OT) techniques has been used successfully to perform the averaging of real-world neuroimaging data [1,2,3], they are known to be strongly impacted by the noise that can be present in the MRI data [2]. In particular, this limitation is inherent to the popular Wasserstein barycenter approach used for averaging the imaging data represented as empirical probability distributions.

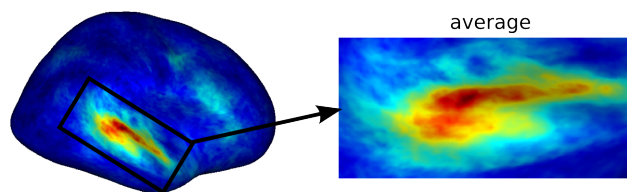


Figure 1: A flattened cortical surface representation onto which brain activation is overlaid

Work plan We intend to study the stability of OT-based algorithms by first showing that all existing Wasserstein barycenter approaches fail to provide a meaningful average when the imaging data is noisy. This demonstration will be carried out on the simulated data at first to further validate the findings on the real-world fMRI data available at the INT. Second step of the interenship would be to propose denoising regularization procedures and modifications to the OT-based averaging algorithms to make them robust to noise.

Context The expected duration of the internship is 5-6 months. The successful candidate will work in Hubert Curien laboratory under the supervision of Ievgen Redko, Amaury Habrard (LaHC) and Sylvain Takerkart (INT).

Skills We are looking for a student with a background in applied mathematics / computer science. Knowledge in optimal transport would be appreciated but is not mandatory. He/she will mainly work on the experimental analysis of the OT algorithms, so that strong coding skills are required.

How to apply? Send your CV, a motivation letter, and your academic records to

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Gratuity ≈ 550 €/month.

- [1] Alexandre Gramfort, Gabriel Peyré, Marco Cuturi: Fast Optimal Transport Averaging of Neuroimaging Data. IPMI 2015: 261-272
- [2] Qi Wang, Ievgen Redko, Sylvain Takerkart: Population Averaging of Neuroimaging Data Using Lp Distance-based Optimal Transport. PRNI 2018: 1-4
- [3] Hicham Janati, Marco Cuturi, Alexandre Gramfort: Debiased Sinkhorn barycenters. ICML 2020