Offer #2021-03531

PhD Position F/M [Campagne CORDI-S] - Deep learning for rating of atypical anatomical patterns on MRI data

Level of qualifications required : Graduate degree or equivalent

Fonction : PhD Position

Context

You will work within the ARAMIS lab (www.aramislab.fr) at the Paris Brain Institute. The institute is ideally located at the heart of the Pitié-Salpêtrière hospital, downtown Paris.

The ARAMIS lab is dedicated to the development of new computational approaches for the analysis of large neuroimaging and clinical data sets. With about 35 people, the lab has a multidisciplinary composition, bringing together researchers in machine learning and statistics and medical doctors (neurologists, neuroradiologists).

The project will be conducted in collaboration with the Empenn team at Inria Rennes (Claire Cury). We also have close links with the University of Southern California at Los Angeles, USA (Ho-Sung Kim, Paul Thompson) and with the University of Queensland at Brisbane, Australia (Peter Visscher, Naomi Wray) which are relevant to the topic. Part of the research done in this project could be done in collaboration with these two universities.

The internship/thesis will be directed by Olivier Colliot (Research Director, HDR) and co-supervised by Claire Cury (Research Scientist, Inria Rennes) and Baptiste Couvy-Duchesne (Postdoc, AramisLab).

We have access to a supercomputer with 1044 nVIDIA V100 GPU.

Assignment

Incomplete hippocampal inversion (IHI) is an atypical anatomical pattern of the brain. Although quite common in the general population (15%-20%), it has been linked to several major neurological and psychiatric disorders, mainly epilepsy and schizophrenia. The causes of this atypical pattern remain mostly unknown. We recently published a study suggesting a potentially strong effect of genetic factors (Cury et al, 2020). Nevertheless, the study included a moderate sample size and larger scale studies are needed. The presence of the IHI pattern can be assessed on magnetic resonance imaging (MRI) data. This is currently done using visual inspection using standardized scales. Such scales assess different features of IHI, their combination being used to determine the presence of absence of IHI. Such approach is reliable and reproducible. However, it does not scale to very large samples.

The aim of this project is to design and validate a deep learning method for automatic assessment of IHI from MRI data and apply it to study the genetic bases of IHI.

The first objective will be to develop a deep learning method for detection of IHI. We propose to set-up the problem as a joint training task, predicting simultaneously individual anatomical criteria as well as the overall presence of the whole IHI. Such an approach has the advantage of making the trained model potentially more interpretable. We will perform ablation studies to understand the importance of the different components of our model. In order to train and validate the model, we have a dataset of around 2000 subjects with annotations. Our collaborators also have annotated datasets in different diseases (schizophrenia, depression...). We will aim to extend the model to make it robust to variations of the MRI acquisition sequences.

Then, we propose to apply the model to several datasets in order to study the genetic bases of IHI. More specifically, we plan to apply the model to the UKBIOBANK comprising over 20,000 participants with MRI and genetic data, to the Queensland Twin Imaging Study as well as to some datasets of the ENIGMA consortium. The developed tool will be distributed as Open Source software following the framework developed in our previous research (Wen et al, 2020).

- Burgos N, Bottani S, Faouzi J, Thibeau-Sutre E, and Colliot O. Deep learning for brain disorders: from data processing to disease treatment. Brief Bioinform. 2020 Dec 15:bbaa310. doi: 10.1093/bib/bbaa310. Online ahead of print
- Wen J, Thibeau-Sutre E, Diaz-Melo M, Samper-González J, Routier A, Bottani S, Dormont D, Durrleman S, Burgos N, and Colliot O. Convolutional neural networks for classification of Alzheimer's disease: Overview and reproducible evaluation. Medical Image Analysis. 2020 Jul;63:101694. doi: 10.1016/j.media.2020.101694. Epub 2020 May 1.
- Cury C, Scelsi MA, Toro R, Frouin V, Artiges E, Grigis A, Heinz A, Lemaître H, Martinot J-L, Poline J-B,

Smolka MN, Walter H, Schumann G, Altmann A, and Colliot O, Genome wide association study of incomplete hippocampal inversion in adolescents, PloS One, 15:1, e0227355, 2020.

Main activities

Activities

- Develop research in the field of deep learning for brain imaging

- Write scientific articles for publication in international journals and conference proceedings

- Present results at international conferences

- Contribute to the implementation and dissemination of open source software

Skills

- Strong interest for applications in neuroscience
- Strong interest for machine learning
- Good programming skills in Python
- Knowledge in medical imaging
- Good writing skills
- Good relational and communication skills

Benefits package

- Subsidized meals
- Partial reimbursement of public transport costs
- Leave: 7 weeks of annual leave + 10 extra days off due to RTT (statutory reduction in working hours) + possibility of exceptional leave (sick children, moving home, etc.)
- Possibility of teleworking (after 6 months of employment) and flexible organization of working hours
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities
- Access to vocational training

Remuneration

Monthly gross salary : 1982 € during the first and second years. 2085 € the last year.

General Information

- **Theme/Domain :** Computational Neuroscience and Medicine
  Scientific computing (BAP E)
- **Town/city :** Paris
- **Inria Center :** Centre Inria de Paris
- **Starting date :** 2021-10-01
- **Duration of contract :** 3 years
- **Deadline to apply :** 2021-05-24

Contacts

- **Inria Team :** ARAMIS
- **PhD Supervisor :**
  Colliot Olivier / Olivier.Colliot@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.

The keys to success

Please provide the following documents:

- Application letter ("lettre de motivation")
- CV
- Grades obtained during the master
- Recommandation letters

Do not hesitate to directly contact the PhD advisor at:olivier.colliot@inria.fr

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

The application must contain:

- CV
- Cover letter
- Master's notes
- Letters of recommendation

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.