Postdoctoral Fellow - Machine Learning in Diffusion MRI

Position description

Diffusion-weighted magnetic resonance imaging (dMRI) is the most promising non-invasive tool for assessing the brain microstructure. Classical methods for estimating microstructural parameters rely on fitting complex models to the dMRI signal in each imaging voxel. They demand a large number of high-quality measurements, hence long scan times, to produce accurate and reliable results. Such measurements may be difficult or impossible to obtain in many applications involving neonatal and pediatric subjects, where the data quality is inherently low. This has significantly limited our ability to study brain development and neurological disorders.

The overall goal of this project is to develop and validate accurate and reliable methods for analyzing dMRI measurements for neonatal and pediatric subjects. While standard methods are based on suboptimal biophysical models and mathematical optimization, the new methods developed in this project will establish a new paradigm that relies on data-driven and machine learning techniques. The tremendous potential of these methods has been demonstrated in recent studies. In this project, using high-quality dMRI data provided under the Human Connectome Project (HCP), we will develop methods for estimating a wide range of micro-structural parameters, ranging from diffusion tensor to advanced multi-compartment models. The new methods will offer superior accuracy and robustness when applied on fewer and lower-quality measurements that are typical of neonatal and pediatric dMRI scans. We will also develop techniques for detecting the failures of these ML methods, for computing their estimation uncertainty, and for enhancing the explainability of their predictions. The new methods will significantly improve the accuracy, reproducibility, and reliability of the results, while also reducing the required scan times for neonatal and pediatric dMRI studies.

Location

This research will be conduced at the Computational Radiology Lab (CRL) at Boston Children's Hospital (BCH), Harvard Medical School (HMS). The mission of CRL is to improve our understanding of the structure and function of the brain and other organs of the human body, in order to improve our ability to diagnose and treat diseases. The US News ranking has placed BCH as rank #1 in pediatric hospitals and HMS as rank #1 in medical schools. Opportunities for training and networking are enormous with universities, hospitals, medical centers, and biotechnology and pharmaceutical companies in the area.

Minimum requirements

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- Ph.D. in Electrical or Biomedical Engineering, Computer Science, Medical Physics, or a related field.
- Knowledge of machine learning and deep learning. Proficiency in Python and at least one of the deep learning frameworks such as TensorFlow or PyTorch.
- Good communication skills.

Desired qualifications:

- Knowledge and hands-on experience in image processing, computer vision, and pattern recognition.
- Experience in medical image analysis and diffusion MRI.

How to apply

Please send an email and your CV to `davood.karimi@childrens.harvard.edu`.