Boston Children's Hospital
Until every child is well™

HARVARD MEDICAL SCHOOL

Projects in machine learning for medical image analysis

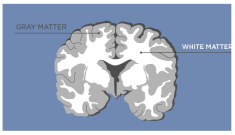
Intelligent Medical Imaging (IMAGINE) research group at Boston Children's Hospital

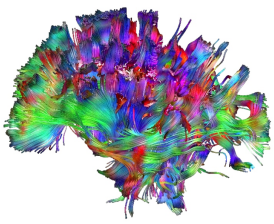
The main research theme: Developing machine learning and image processing technology and knowledge for studying normal and abnormal brain development before and early after birth.

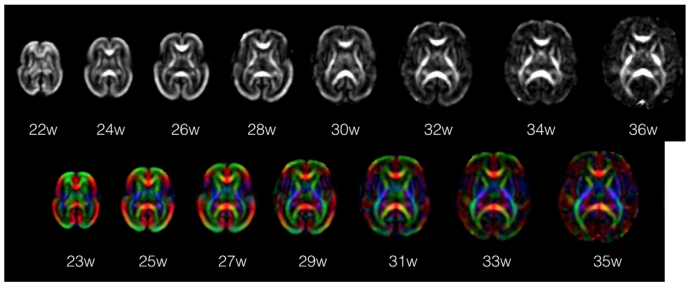
Example open projects:

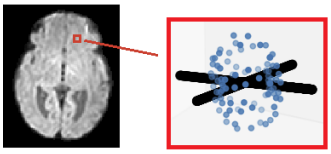
- **Estimation of diffusion parameters from under-sampled measurements with deep learning**

  Parameters inferred from the diffusion signal measured at every voxel in diffusion-weighted magnetic resonance imaging, such as mean diffusivity and fractional anisotropy, reflect upon tissue characteristics and are, therefore, used in many clinical applications. We would like to explore deep learning methods and develop solutions to estimate these parameters from a small number of measurements, to shorten the patient scan times and enable such analyses in vulnerable patient populations such as fetuses, and pediatric patients who cannot stay still in the MRI scanner for long imaging sessions.



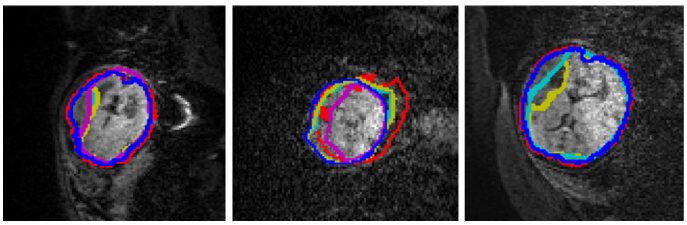






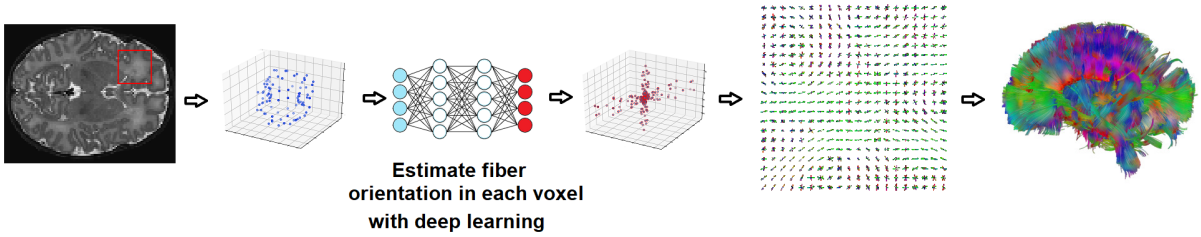
- **Automatic image quality assessment and brain segmentation in diffusion-weighted images**

  Real-time assessment of the quality of diffusion-weighted images is very important. Segmentation of the brain in these images is also necessary and very challenging due to complex image intensity variations. We seek methods that can accomplish these accurately and in real time.



- **Deep learning based estimation of fiber orientation distribution from diffusion weighted MRI.**

  Existing methods for estimating brain fiber orientations use mathematical models that are based on the physics of the diffusion process. We seek machine-learning based methods that avoid relying on such models, which can be sub-optimal or even wrong.



- **Fetal and newborn brain tract segmentation using deep learning**

  Segmentation of major brain white matter tracts is essential in studying brain development and degeneration. The common methods to accomplish this task involve complex multi-step procedure. We would like to explore the potential of deep learning to replace these complex pipelines.

- **Deep learning based spherical deconvolution for fiber orientation distribution**