

High Angular Resolution Diffusion Imaging (HARDI)

Target audience:

New graduate students working in diffusion MRI and researchers/clinicians seeking to know how to go beyond diffusion tensor imaging (DTI).

OUTCOME/Objectives:

The audience will learn how to go beyond DTI and be cautious of the limitations of diffusion MRI. In particular, the audience will learn how HARDI data is processed and how fiber tractography can handle fiber crossings.

PURPOSE:

The purpose is to perform robust fiber tractography that is necessary in many neuroscience applications. At the era of human connectomics studies, it is important to know how to go from HARDI acquisition to whole brain tractography and be aware of the current pitfalls and limitations of the techniques.

METHODS:

Several methods will be presented: i) HARDI acquisition and techniques to reduce acquisition time. ii) Diffusion data pre-processing (denoising and upsampling) and artefact corrections. iii) Algorithms to reconstruct the local diffusion phenomenon at every voxel. iv) Fiber tracking algorithms. v) Visualisation techniques and post-processing of tractography results.

RESULTS:

The impact of the methods mentioned above will be shown on healthy brain datasets and in neurosurgical applications. Some results can be found here: <http://scil.dinf.usherbrooke.ca>

DISCUSSION:

A special attention will be given to the pitfalls and limitations of the methods, and also, to the false interpretations that can be made from the diffusion metrics and tractography results. Validation is a bottleneck for the diffusion MRI community and will be discussed (see <http://tractometer.org>).

REFERENCES:

1. Behrens, T.E.B. H. Johansen-Berg. Diffusion MRI. Elsevier. 2009.
2. Jones, D.K., Knösche, T.R., Turner, R. White Matter Integrity, Fiber Count, and Other Fallacies: The Do's and Don'ts of Diffusion MRI. NeuroImage. 2012 S1053-8119
3. Descoteaux, M., Poupon, C. Diffusion-Weighted MRI. In Comprehensive Biomedical Physics, Elsevier. 2013, *in press*.