Diffusion MR Imaging: from physics to brain networks

Organisers: P. Hagmann, E. Fornari, M. Bach Cuadra

2.5 ECTS

Course description

Summary
Diffusion MR imaging of the living brain allows mapping tissue microstructure and axonal fiber bundles connecting different cortical regions. As such it has become an essential neuroimaging tool that is largely used in clinical and basic neuroscience research. The course will provide relevant theory and practical exposure for the participant to become familiar with the various aspects of this technology such that one can integrate it into own research.

Objectives
At the end of the course the student will be able to:
- Explain the physical principles as well as the processing, analysis methods and statistical approaches relevant to diffusion imaging
- Explain basics of bio-physical modeling, tractography, connectome mapping and functional connectivity mapping

At the end of the course the student will have:
- Performed a voxel based morphometry and a simple connectome analysis on provided data
- Read representative diffusion papers

Discovered the power of inter-disciplinary interaction by working on questions and hands-on exercises in a group of two.

Format
- Inverted classes
  - Pre class and in class reading
  - In class quizzes and discussion
- Frontal classic but interactive teaching
- Hands-on exercises with processing of provided data in groups of two persons
Technology used
- FSL, Freesurfer
- Matlab
- Mrtrix

Evaluation
- Multiple Choice Questions at the end of the course (50% of the final mark)
- 2 page report on hands-on exercise to be handed in one week after end of course (50% of the final mark)
- Participation to all sessions is mandatory to get the credits

Reading materials
Course materials are stored on the UNIL e-learning platform Moodle. You can access by doing the following:
- go to "https://moodle2.unil.ch"
- log in with your institutional/university address
- click on "Faculté de Biologie et de Médecine" > "Ecole doctorale / doctoral school" > "Lemanic Neuroscience Doctoral School"

The materials are stored under "Diffusion MR Imaging: from physics to brain networks". Please use the self-enrollment method to access them.

Location
The course will take place in Lausanne (Switzerland) @ the Amphipôle building, UNIL-Sorge. Theoretical sessions will be held in room 321. The practical sessions (marked in light blue in the table below) will take place in room 204.2 in the basement of the Amphipole building.

Registration
The course is limited to 16 participants. Lemanic PhD students register before January 5, 2018 by writing a mail to lndsCourses@gmail.com (with your supervisor in copy) and stating "Diffusion MR Imaging" as subject.

Dates and schedule
The course will take place the week from January 29 - February 5, 2018.
<table>
<thead>
<tr>
<th>Day 1</th>
<th>Monday January 29th 2018</th>
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| 8.00-8.45 | Introduction | P Hagmann  
|         |             | E Fornari 
|         |             | M Bach  
| 9.00-9.45 | Overview from diffusion to microstructure with diffusion MRI | JP Thiran  
| 10.00-10.45 | Basics of diffusion MRI | P Hagmann  
| 11.00-11.45 | In-class reading of allocated resources | P Hagmann  
| 12.00-13.00 | Lunch time |  
| 13.00-13.45 | Diffusion MRI | P Hagmann  
| 14.00-14.45 | Pre-processing | M Bach  
| 15.00-15.45 | Tour of available software and tools | Y Aleman  
| Day 2 | Tuesday January 30th 2018 |
| 9.00-9.45 | Diffusion-based scalars and group analysis | E Fornari  
| 10.00-10.45 | In-class reading of allocated resources | E Fornari  
| 11.00-11.45 | Voxel-wise, ROI and TBSS contest | E Fornari  
| 12.00-13.00 | Lunch time |  
| 13.00-13.30 | Q & A |  
| 13.30-16.30 | Hands on group analysis of diffusion scalar maps | E Fornari  
|              |             | M Bach  
| Day 3 | Wednesday January 31st 2018 |
| 9.00-9.45 | In-class reading of allocated resources | A Daducci  
| 10.00-10.45 | Diffusion MR reconstruction | A Daducci  
| 11.00-11.45 | Tractography | A Daducci  
| 12.00-13.00 | Lunch time |  
| 13.00-15.45 | Hands on Reconstruction and Tractography | A Daducci  
| Day 4 | Thursday February 1st 2018 |
| Home | reading of allocated resources |  
| Day 5 | Friday February 2nd 2018 |
| 9.00-9.45 | In-class reading of allocated resources | A Griffa  
| 10.00-10.45 | Connectomics | A Griffa  
| 11.00-11.45 | Clinical applications | P Hagmann  
| 12.00-13.00 | Lunch time |  
| 13.00-13.30 | Q & A |  
| 13.30-16.30 | Hands on connectomics | A Griffa  
| Day 6 | Monday February 5th 2018 |
| 9.00-10.00 | Functional connectivity | D Van De Ville  
| 10.30-11.30 | MCQ Exam | P Hagmann  
|              |             | E Fornari  
|              |             | M Bach  
| 12.00-13.00 | Lunch time |  
| 13.00-16.00 | Optional – Hands On selected lab report | P Hagmann  
|              |             | E Fornari  
|              |             | M Bach  