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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 he can integrate it in his 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

All course materials are stored on the UNIL e-learning platform Moodle. You can access them in advance 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 2019"**. Please use the self-enrollment method to access them.

Course location

The course will take place in Lausanne @ the Biophore building, UNIL-Sorge.

Theoretical sessions (marked in greenish colors below) will be held in room 2917.2 on the ground floor of the Biophore building. The practical sessions (marked in light blue in the table below) will take place in room 1929 in the basement of the Biophore building. On February 18, the entire course will be held in room 1929. .

Course registration

The course is limited to 16 participants. Register before February 1, 2019, by writing a mail to lndscourses@gmail.com (with your supervisor in copy) and stating "Diffusion MR Imaging" as subject.

Dates and final schedule

The course will take place the week from February 11 to 18, 2019.

Day 1	Monday, February 11, 2019	
8.30-9.00	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	Introduction to clinical applications	P Hagmann
15.00-15.45	Pre-processing	M Bach
Day 2	Tuesday, February 12, 2019	
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, February 13, 2019	
9.00-9.45	In-class reading of allocated resources	M. Pizzolato & G. Girard
10.00-10.45	Diffusion MR reconstruction	M. Pizzolato
11.00-11.45	Tractography	G. Girard
12.00-13.00	Lunch time	
13.00-15.45	Hands on Reconstruction and Tractography	S. Tourbier / Y. Aleman-Gomez
Day 4	Thursday, February 14, 2019	
	Home reading of allocated resources	
Day 5	Friday, February 15, 2019	
9.00-9.45	In-class reading of allocated resources	A Griffa
10.00-10.45	Connectomics	A Griffa
11.00-11.45	Tour of available software and tools	Y Aleman
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 18, 2019	
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 labo report	E Fornari, S. Tourbier ,Y. Aleman