Neurotech[EU] Summer School on "Preclinical Magnetic Resonance Imaging and Spectroscopy: from the bench to the bedside"

Dates: 24-26 July 2023

This course is intended to give a complete overview on preclinical Magnetic Resonance Imaging and Spectroscopic techniques. It will cover theoretical bases and the most used techniques (relaxometry, diffusion-based, functional), their main biomedical and neuroscientific applications, and a real hand-on session of MRI data acquisition and analysis.

Coordinators:
Silvia De Santis & Santiago Canals (Instituto de Neurociencias, CSIC-UMH, Alicante).
Teachers:
Pilar López-Larrubia (Instituto de Investigaciones Biomédicas, CSIC, Madrid)
Pedro Ramos-Cabrer (CIC-Biomagune, Donostia)
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Mohamed Selim (Instituto de Neurociencias, CSIC-UMH, Alicante)
Silvia De Santis
Santiago Canals

Day 1:
9h00 - 10h30

- Theoretical basis of Magnetic Resonance Imaging
  - physical basis of MRI signal
  - from NMR to MRI: principles of imaging
  - MRI artefacts

10h30 - 12h00:

- Contrast agents in MRI
  - Concept
  - Applications

Coffee break

12h30 - 14h00:

- Theoretical basis of MR spectroscopy
  - physical and chemical basis of spectroscopy
  - Single and multi-voxel MR spectroscopy

Lunch break

15h00 - 16h30:

- Applications of MR spectroscopy
  - Metabolomics
  - Biomarkers in cancer research

16h30 - 18h30:

- First practical session of data collection.
  - Setting up the acquisition
  - Structural images

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Day 2:

9h00 - 10h30

- Theoretical basis of functional Magnetic Resonance Imaging (fMRI)
  - Origin of the BOLD signal
  - Neurobiological correlates of the BOLD signal

10h30 - 12h00:

- Applications of fMRI
  - Evoked and resting state fMRI studies
  - Combination of fMRI with direct brain stimulation (optogenetics, fMRI)
  - Combination of fMRI with calcium recordings

Coffee break

12h30 - 14h00:

- Theoretical basis of Diffusion Tensor Imaging (DTI)
  - water diffusion in biological tissues
  - diffusion tensor & diffusion tensor imaging

Lunch break

15h00 - 16h30:

- Applications of DTI
  - Tractography
  - Microstructural Biomarkers in brain research

16h30 - 18h30:

- Second practical session of data collection.
  - Diffusion Tensor Imaging
  - fMRI

Day 3:

9h00 - 10h30

- Imaging brain vessels and perfusion
  - Cerebral blood volume and flow using contrast agents
  - Arterial spin labelling

10h30 - 12h00:

- Basic MRI data pre-processing and analysis
  - Most common pre-processing pipelines in MRI
  - Most common MRI data analysis

Coffee break

12h30 - 14h00:

- First practical session of data analysis
  - exporting the data from the scanner
  - the NIfTI and BIDS formats
  - basic tools to handle medical imaging

Lunch break

15h00 - 16h30:

- Second practical session of data analysis: DTI
  - DTI processing
  - Tract-base spatial statistics

16h30 - 18h30:

- Third practical session of data analysis: fMRI
  - Basic pre-processing
  - Statistics

Dinner & social activity