+ PhD program IMAGING

Institute Marseille Imaging
Aix*Marseille Université

+ Affiliated Doctoral School: ED352

Course title	MRI Physics
Keywords	MRI, biophysical models, biomarkers
Priority Audience	PhD students, Master Students
Registration	For doctoral students: on ADUM Site For master students: contact cecile.lavoute@univ-amu.fr
Location of the course	CRMBM, CEMEREM, Hopital la Timone, Bat F.264 rue St Pierre - 13385 Marseille
Course duration	2.5 days/15 HETD
Next Session	12-13-14 February 2024
Objectives	Introduction to MRI: *quantum basis, macroscopic magnetization, localization principle, signal processing and image reconstruction, instrumentation* To understand the different types of MRIcontrasts and their association with biophysical models for *in vivo* applications
Program	- Basics: from the spin to the image - MR contrasts - Parametric imaging - Hands on
Possible prerequisites	Quantum Physics, Modelling, numerical physics,signal processing
Skills targeted at the end of the course	- Theoretical basis of Nuclear MagneticResonance & Magnetic Resonance Imaging - Advanced parametric MRI - Relationship between biophysicalmodels and MR contrasts

Teaching method	Powerpoint presentations & hands on in CRMBM lab
Team or speaker	L. de Rochefort, O. Girard, S.Rapacchi, L. Soustelle, G. Duhamel - groupe *« Physics and digital technologies for quantitative imaging ofthe central nervous system »*
Number of participants	5 - 40

Training affiliated to Marseille Imaging Institute

+ MRI physics courses

+ Basics: from the spin to the image – (Ludovic de Rochefort)

- Quantum basis: spin ½, Larmor Resonance, Thermal equilibrium, MagnetizationMacroscopic
- Magnetization: Spin Echo, Gradient Echo
- NMR Relaxation T1, T2, T2*
- Instrumentation (B0, gradient, RF coil)
- Spatial coding / Localization principle / parallel imaging
- Contrasts and basis for image interpretation

+ MRI Contrast Mechanisms - (Guillaume Duhamel, Olivier Girard)

- Diffusion
- Perfusion (DSC, DCE, ASL, BOLD)
- Relaxation (multicomponent)
- Magnetization Transfer (MT, CEST)
- Magnetic Susceptibility

+ Parametric imaging - (Lucas Soustelle, Stanislas Rapacchi)Analytic and

matrix formalism
- Direct model / inverse model (fitting)
- Regularization
- Regularization

· Advanced MR techniques (MR Fingerprinting, Compressed sensing, Artificial Intelligence)

+ Hands on – **Demo on Imaging Plateform**

- In vivo MRI experiment: Parametric image acquisition on the (pre)clinical MRI scanner of CRMBM / Image processing