UNIVERSITÀ DI PAVIA

Anno Accademico 2021/2022

QUANTITATIVE MRI: SIGNAL, IMAGES AND MODELS

Enrollment year	2021/2022
Academic year	2021/2022
Regulations	DM270
Academic discipline	ING-INF/06 (ELECTRONIC AND INFORMATION BIOENGINEERING)
Department	DEPARTMENT OF ELECTRICAL,COMPUTER AND BIOMEDICAL ENGINEERING
Course	BIOENGINEERING
Curriculum	Sensoristica e strumentazione biomedica
Year of study	1°
Period	1st semester (27/09/2021 - 21/01/2022)
ECTS	6
Lesson hours	50 lesson hours
Language	Italian
Activity type	WRITTEN AND ORAL TEST
Teacher	CASTELLAZZI GLORIA - 2 ECTS GANDINI CLAUDIA - 4 ECTS
Prerequisites	n/a
Learning outcomes	This course aims at forming students by giving thm the knowledge of magnetic resonance signal formation and of how to form an image by coding spatial information. The course will present quantitative MRI methods through biophysical models that allow explaining the signal behaviour in different circumstances. To do so it will be necessary to deal with the physics principles that make MRI sensitive to microstructural properties as well as functional properties of tissues under investigation, which are affecting macroscopic properties even if the source is at molecular level. The course will tackle how to set up an MRI protocol depending on the research question exploiting specific sequences (which are the programmes that drive the MRI scanner). Finally the course will

	describe how from the acquired data one can get to indices that are useful biomarkers for clinical problems, both for prediction of disease evolution and for the understanding of the mechanisms behind a disease.
Course contents	• Nuclear magnetic resonance: basic principles • Relaxometry: how do protons interact • Spatial encding: the images • Standard MRI sequences • Fast MRI sequences • Safety and ethical considerations of human MRI • Magnetization transfer principles: macromolecules • Chemical shift imaging and metabolites • Microstructural characterization: the diffusion tensor • Advanced models of microstructure: beyond the diffusion ensor • Measuring brain function • Sensitization of MRI signal to different functional regimes • Perfusion imaging • Structural connectomic • Functional connectomic • Graph theory • How to build an acquisition protocol • How to plan and perform data analysis • High field MRI • Non-proton imaging - imaging sodium ions
Teaching methods	Face to face lessons, practical sessions
Reccomended or required readings	Slides with annotations
Assessment methods	Written exam (multiple choice) or oral exam
Further information	n/a
Sustainable development goals - Agenda 2030	$lbl_legenda_sviluppo_sostenibile