
Testi del Syllabus

Resp. Did.	LONGO RENATA	Matricola: 003135
Docenti	BATTAGLINI PIERO PAOLO, 2 CFU LONGO RENATA, 3 CFU	
Anno offerta:	2018/2019	
Insegnamento:	895SM - TECNICHE NEUROFUNZIONALI	
Corso di studio:	SM54 - NEUROSCIENZE	
Anno regolamento:	2017	
CFU:	10	
Settore:	FIS/07	
Tipo Attività:	C - Affine/Integrativa	
Anno corso:	2	
Periodo:	Primo Semestre	
Sede:	TRIESTE	



Testi in italiano

Lingua insegnamento

English

Contenuti (Dipl.Sup.)

Part 1: (prof. Renata Longo) Neuroimaging techniques. Computed Tomography: basic principles, recent techniques and application in brain imaging. Magnetic resonance imaging (MRI): basic principles. Functional MRI (fMRI): physics and physiological basis. fMRI experimental design: blocks and event related paradigms. Data analysis in fMRI: images processing and statistical analysis. Diffusion weighted images (DWI) and diffusion tensor imaging (DTI): basic principles. DTI in brain imaging: a technique for neurons bundles study. Fiber tracking based on DTI data set. Guided exercises in small groups at the MRI unit of the Cattinara hospital: (A) Block design experiments, image acquisition and data analysis. (B) DTI experiments, image acquisition and data analysis. Radioisotopes imaging: single photon emission tomography (SPECT) and positron emission tomography (PET). Physics and physiological basics. Introduction to biological effects of ionizing radiation and radiobiology. The challenge of integration: EEG and MRI or PET, PET and CT or MRI.

Part 2: (prof. Pier Paolo Battaglini) APPLIED ELECTROPHYSIOLOGY
Recording signals from the brain.
Invasive techniques (action potentials): microelectrodes, tetrodes, multi electrodes. Invasive techniques (field potentials): electrocorticography. Non invasive techniques (field potentials). Transcranial direct current stimulation (tDCS). Transcranial magnetic stimulation (TMS). Signal processing and machine learning. Frequency domain: Fourier transform, Fast Fourier transform, spectral features: power spectrum. Wavelets. Kalman filter. Spatial filters. Non invasive techniques (field potentials): electroencephalography. Stimulating the brain. Invasive techniques (electrical currents): micro electrodes, direct cortical electrical stimulation (DCES), Deep brain stimulation (DBS).

Spatial filters: principal component analysis, independent component analysis.

Machine learning. Classification (linear discriminant analysis). Regression: linear regression. Artificial neuronal networks. The back propagation algorithm.

Building a BCI

Major types of BCI: invasive (intracortical), semi-invasive (electrocorticography), non invasive (electroencephalography). Synchronous (VEP, SSEV, SSEP, P300) and asynchronous (ERD) BCI. Brain responses useful for BCI.

Spellers. BCI for Parkinson disease. BCI for paralyzed patients.

Part 3 (Lecturer to be defined):

Introduction to the principles of non-invasive brain stimulation (NIBS) methods such as Transcranial Magnetic Stimulation and Transcranial Electric Stimulation.

Introduction to the different protocols of NIBS useful to investigate neurophysiology of healthy and pathological systems; introduction to the different protocols of NIBS useful to enhance neuro-rehabilitation and neural plasticity; introduction to combination of NIBS with different neuroimaging and neurophysiological techniques: possible artifacts, technical problems, solutions and expected outcomes. Exercise in small groups at the Neurophysiology unit: meaning and interpretation of the recorded signals.

Testi di riferimento

The essential of functional MRI. P. W. Stroman CRC press 2011
Relevant slides and pdf files will be provided during classes.

Obiettivi formativi

1) Knowledge and understanding The purpose of the course is to provide theoretical, conceptual and practical basis about the functioning of the principal neuroimaging and neurophysiologic techniques (as well as their combinations), useful to investigate the different aspects of the characteristics of the Central Nervous System, in the field of Cognitive Neuroscience. More specifically, the different advantages and the different limits of the techniques should be acquired.

2) Applying knowledge and understanding The acquired knowledge will be useful to develop the needed capability to design the most appropriate experimental plans to investigate the characteristics of the Central Nervous System, both from a structural and a functional point of view, mainly on a neural networks basis.

3) Making judgements The students will develop critical abilities useful to better understand the functioning of neuroimaging and neurophysiologic tools. More specifically, they will be able to evaluate the different cases in which the different techniques may be applied, depending on the experimental purposes.

4) Communication skills The requested written reports about MRI/NIBS experiments, and the oral examination will encourage the students to develop scientific writing abilities and oral communication skills.

5) Learning skills By the end of the course, the students will be able to critically evaluate the scientific literature using neurofunctional techniques, ranging from MRI to EEG, BCI and NIBS. Furthermore, they will be able to understand the functioning of these neuroimaging and neurophysiologic tools. This will allow them to obtain the propaedeutic knowledge to realize research projects in the field of Cognitive Neuroscience.

Metodi didattici

Lectures
Small group tutorials at the MRI unit and at the Neurophysiology unit.

Modalità di verifica dell'apprendimento

Students are required to take a final oral examination, also preparing a report of the MRI/NIBS experiments.
The oral examination consists in a discussion of 45 min, during which the student is invited to describe and comment on a few topics covered in the course.



Testi in inglese

English

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