

14:332:---- Introduction to Functional NeuroImaging:
Methods and Data Analysis

Overview:

This graduate-level course (also open to senior undergraduate students) will offer an introduction to the theoretical and practical aspects of existing functional neuroimaging techniques, with special focus on Electroencephalography (EEG) and optical imaging modalities. The course will also demonstrate how advanced signal processing techniques are being employed to study and interpret brain functionality.

The aim of this course is to familiarize students with the applications of engineering concepts in the field of functional brain imaging, and prepare them to pursue research in neuroscience-related fields.

Requirements:

The course is designed for students with strong background in fundamental physics, mathematics, and digital signal processing. It is expected that students are familiar with Matlab.

Course Number:

Graduate Students: 16:332:539 (Advanced Topics in Signal Processing: Introduction to Functional NeuroImaging, Methods and Data Analysis)

Senior Undergraduate Students: 14:332:4930:05 - Index Number: 39631 (Topics in ECE: Introduction to Functional NeuroImaging, Methods and Data Analysis)

Time and Location:

Mondays and Wednesdays, 1:40 PM-3:00 PM, CoRE 538.

Instructor:

Dr. Laleh Najafizadeh, email: laleh.najafizadeh@rutgers.edu, Office: CoRE 520.

Topics Covered:

- Basics of brain anatomy and function
- Action Potential, Neuronal Activity and Hemodynamic Response
- Overview of Functional Neuroimaging Techniques and Experiments
- EEG Systems : Theory and Instrumentation
- Optical Imaging Systems: Theory and Instrumentation
- Data Analysis: Preprocessing, de-noising, extracting event-related potentials and hemodynamic responses, time-frequency analysis

Grading:

Student knowledge of the course will be assessed through Assignments, Project and Final exam.

Tentative Syllabus:

Week 1: Introduction to brain anatomy and function
Week 2: Basics of neuronal activity and hemodynamic response
Week 3: Overview of functional neuroimaging techniques
Week 4: Data collection and paradigm design
Week 5: Building blocks of an EEG system, electrodes, issues and challenges
Week 6: Optical properties, absorption and scattering, light transport in tissue
Week 7: Optical tomography, optical topography
Week 8: Data Acquisition, sampling in time, aliasing
Week 9: Artifacts, physiological noise, preprocessing of EEG/NIRS signals and filtering
Week 10: Principal component analysis, independent component analysis
Week 11: EEG signal modeling, event related potentials, activity detection
Week 12: Modeling the hemodynamic response
Week 13: Time-Frequency Analysis
Week 14: Time-Frequency Analysis (cont'd), Feature Extraction
Week 15: Student Presentations