

Psyc 555
Introduction to Functional Magnetic Resonance Imaging

Class Number: 52720D

Instructors: Professor Bosco Tjan (SGM 1016, 213-821-2953/4, btjan@usc.edu)

Class Time: 10:00 – 11:50 pm, Mondays and Wednesdays

Office Hours: noon – 1:30 pm, Tuesdays

Location: Conference Room, 2nd floor, Dornsife Imaging Center

Required Textbook: *Functional Magnetic Resonance Imaging*, by S. A. Huettel, A. W. Song, G. McCarthy, Sinauer Associates, Inc. Sunderland, MA, USA (2004).

Course Description: A general introduction to the physical bases of Magnetic Resonance Imaging (MRI), the physiological bases and principles of functional MRI, MRI related safety issues, design and analysis of fMRI experiments, and the operation of the Siemens 3T Trio system with hands-on experience.

Course Requirements: The course consists of lecture and lab components. Students are required to pass safety training, and are required to participate in several group projects. There will be a mid-term and a final exam. Class grades will be assigned according to the following weights: Homework & Lab: 30%; Midterms I and II, 20% each; Group Project with written report, 30%.

Tentative Syllabus

- 1/12 (M) Lecture 1: Class logistics, MRI safety. Lab 1: Control room tour, subject preparation, basic scanner operations, The First Scan
(W) Lecture 2: Brain imaging, an introduction
- 1/19 (M) MLK Day
(W) Lecture 3: Basic principles of MR signal generation
- 1/26 (M) Lecture 4: Basic principles of MR image reconstruction
(W) Lecture 5: Contrast mechanisms pulse sequences (I)
- 2/2 (M) Lab 2: Protocol development: T1 and T2 contrast weighing with spin-echo sequences, constraints on slice coverage and resolution
(W) Lecture 6: Contrast mechanisms pulse sequences (II)
- 2/9 (M) Lab 3: contrast weighing in gradient-echo sequences, inversion recovery, T1-weighted 3D gradient-echo (MPRAGE) – Dr. Jiancheng Zhuang
(W) BV 1: Introduction to BrainVoyager, anatomical image processing, and cortical segmentation – Dr. Xiangrui Li
- 2/16 (M) Presidents' Day
(W) **Midterm I**
- 2/23 (M) Lecture 7: Hemodynamic activity, BOLD, and Echo Planar Imaging
(W) Lecture 8: Spatial and temporal properties of fMRI
- 3/2 (M) Lecture 9: Experiment design
(W) Lab 4: BOLD Imaging (block and rapid-event-related designs)

- 3/9 (M) Lecture 10: fMRI data analysis (I): General Linear Model
(W) Lecture 11: fMRI data Analysis (II): deconvolution and statistical efficiency of a design
- 3/16 [Spring Break]
- 3/23 (M) **Project pre-proposal presentation**
(W) BV 2: Signal & noise of fMRI, functional data preprocessing, single session GLM
- 3/30 (M) BV 3: Single session GLM, FMR-VMR coregistration
(W) BV 4: ROI analysis, deconvolution, multi-session GLM
- 4/6 (M) BV 5: Group-level random effect analysis
(W) BV 6: Cortical-based ROI
- 4/13 (M) Lecture 12: A review on experiment design and data analysis
(W) **Midterm II**
- 4/20 (M) Lecture 13: Advanced topics (I): Visual field mapping
(W) Lecture 14: Advanced topics (II): Functional “connectivity”
- 4/27 (M) Project Clinic
(W) Project Clinic

Final project presentation: TBA