Functional MRI Applications
EE 317: W 6:30-8:00 PM

Instructors: Dr. Gregory G. Tamer, Jr. (gtamer@purdue.edu)
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Office Hours: TBD (see website)

Class Homepage: http://mri.ecn.purdue.edu/labmodule/

Course Description:

- The intention of this lab module is to instruct students in the use of the Purdue MRI Facility and its General Electric (GE) 3T imager. Students will gain knowledge regarding the procedures and policies of the Facility, practical knowledge about the general operation of the MR imager and associated imaging peripherals (e.g., coils, physiologic monitoring, real-time MRI computer), and specific knowledge regarding common applications, such as high-resolution anatomical imaging, diffusion tensor imaging, and functional MRI experimentation. Regarding this last common application, students will additionally be instructed in the use of common fMRI peripherals for presentation of audio-visual stimuli, recording of responses, and the basic analysis and interpretation of fMRI data. The course will culminate in each student briefly presenting findings from a self-designed experiment.

Required Text:

- S.A. Huettel, A.W. Song, G. McCarthy, *Functional Magnetic Resonance Imaging*, Sinauer Associates, 2004. (ISBN 0-87893-288-7)

Laboratory Activities:

Lab Groups: In addition to attendance at lectures, students will form groups of two (2) in which all laboratory exercises will be performed. Each group will (independently) schedule a two-hour laboratory period during the week between lectures, during which both students in a group will have an opportunity to operate the MRI while performing specific activities that will provide training for more general MRI applications.

Supervision: At least one of the instructors and TA for the course will be present for laboratory activities, to act as supervisor to ensure that no damage is done either to the students, test subjects or equipment.

Human Subjects: Many of the laboratory activities conducted during this course will require the use of a human subject. The students are encouraged to serve as subjects for their laboratory partners, but this is **not required**. Rather, if an individual cannot or does not want to be a subject, the students should find an individual to participate as their test subject. *The Primary Operators cannot serve in this capacity.*

Observation: All students are **required** to observe three (3) human subjects MRI sessions, conducted outside of the course.

Primary Operator Certification (Optional):
All students are encouraged to complete the process of becoming a Primary Operator for the Purdue MRI Facility. Such an individual has the ability to schedule and conduct imaging sessions at her/his convenience. This is of particular value to students and/or faculty who wish to use MRI, MRS or fMRI as an avenue of research. For this purpose, two non-required activities must be completed: (1) the individual should complete or provide documentation of *active* CPR certification, (2) the individual can, in the final week of the course, undergo a "check-out" procedure to be observed by one of the instructors. Upon completion of the lab module and these two **optional** activities, the individual will receive a Purdue MRI Facility badge, keys and requisite codes to enable access to the system.

Grading:

Pre-/Laboratory exercises	75%
Final Project (Oral Presentation)	20%
Peer Evaluations	5%
Total	100%

Ethics in Functional MRI Applications

Along with the rest of the BME faculty, I expect every member of the Purdue community to practice honorable and ethical behavior both inside and outside the classroom. Any actions that might unfairly improve a student's score on homework, examinations or projects will be considered cheating and will not be tolerated.

From the Purdue Dean of Students "Student Code of Conduct" web page:

The following actions constitute misconduct for which students may be subject to administrative action or disciplinary penalties.

> ***Dishonesty in connection with any University activity. Cheating, plagiarism, or knowingly furnishing false information to the University are examples of dishonesty. The commitment of the acts of cheating, lying, stealing, and deceit in any of their diverse forms (such as the use of ghost-written papers, the use of substitutes for taking examinations, the use of illegal cribs, plagiarism, and copying during examinations) is dishonest and must not be tolerated. Moreover, knowingly to aid and abet, directly or indirectly, other parties in committing dishonest acts is in itself dishonest.***

Once again, I encourage you to speak with me prior to engaging in any activity that may be construed as cheating or any other form of academic dishonesty.

*Please note: Functional MRI uses **human** subjects, and ethical behavior is paramount!*

Planned Schedule

Week #1 (14 Jan 09)
Lecture: Overview of MRI; MRI Safety; MRI Facility website; Human Subjects
Pre-Lab: None
Lab: Tour of facility; Examination of 3T MRI; Basic MRI usage demonstration

Week #2 (21 Jan 09)
Lecture: GE interface; MRI imaging sequences (anatomical, DTI, spectroscopy)
Pre-Lab: CITI Human Subjects Certification
Lab: Set up and conduct imaging and spectroscopy study on a phantom

Week #3: (28 Jan 09) --- *Lecture at Purdue MRI Facility*
Lecture: MRI Facility experimental equipment; Real-Time imaging computer
Pre-Lab: Obtain IRB forms; Conduct MRI subject screening interview
Lab: Set up and conduct imaging and DTI study on human volunteer

Week #4: (04 Feb 09)
Lecture: Physiological basis of fMRI; fMRI pulse sequences, protocols
Pre-Lab: Download stimulus videos and prepare paradigm files for use in lab
Lab: Conduct blocked fMRI experiments on human volunteer

Week #5: (11 Feb 09)
Lecture: fMRI experimental paradigms; Real-Time monitoring and quality control
Pre-Lab: Written review of potential experimental confounds and their control
Lab: Conduct event-related fMRI experiments on human volunteer

Week #6: (18 Feb 09)
Lecture: fMRI analysis and associated software packages (AFNI, SPM)
Pre-Lab: Design fMRI experiment for course project
Lab: Conduct student-designed experiments on human volunteer

Week #7: (25 Feb 09)
Lecture: Interpretation of fMRI findings; Constraints and limitations
Pre-Lab: Preliminary analysis of experimental findings
Lab: Conduct student-designed experiments on human volunteer — *or* — Receive consultation on experimental results

Week #8: (04 Mar 09)
Lecture: Presentation of outcomes of student-designed experiments
Pre-Lab: CPR Certification **(optional)** {*earlier completion recommended*}
Lab: Primary Operator check-out **(optional)**