

Syllabus: IPH 5025 Human Brain Mapping with fMRI I  
Spring 2021

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Course Objective: This course covers magnetic resonance imaging-based brain mapping tools, focusing on functional MRI, diffusion tensor imaging, and resting state fMRI. Lectures and literature review will be combined. Students will learn principles, methodologies, analyses, and sample applications, so that they are better equipped to understand the literature in MR-based neuroimaging and to conduct their own studies.

Course Meeting Time: Wednesday 12:00 to 14:45 am, Room 86106

Office Hours: By appointment (N center 86338)

Reference Book: Functional Magnetic Resonance Imaging, Authors: Huettel SA, Song AW and McCarthy G, Publisher: Sinauer Associates

Reading Materials: Assigned weekly

Evaluation:

Grades will be based on participation in course sessions (20%), one mid-term exam (30%), and a final oral presentation (20%), and a written paper about their research project (30%). The term-paper research topic should be chosen by the mid-term of the semester, with consultation with the course instructors.

Class experiment write-up:

During this course, you will conduct a class fMRI experiment and analyze the data. This process will culminate in the class experiment write-up. The write-up will consist of the following sections: the introduction describing the background of your study, the methods you used to conduct your experiment, the results that you found, and the discussion including interpretations, implications, and conclusions of your study. The write-up should contain a level of detail and completeness similar to articles published in the empirical literature.

Class presentation:

Students will do 20 minutes presentations in class (Jun 18) to share their findings based on their experiments. PowerPoint/Keynote presentations are required. You can add relevant material to your presentation that is not in your write-up, such as drawings and pictures and use anything that will help communicate your ideas clearly. Your classmates will also evaluate the presentations.

### Course Outline

- Week 1 (2/24): Introduction of course and Introduction of MRI (SGK, WMS)  
Week 2 (3/3): MRI formation and techniques (SGK)  
Week 3 (3/10): Diffusion imaging and diffusion tensor imaging (SGK)  
Week 4 (3/17): Basic fMRI Biophysics (SGK)  
Week 5 (3/24): Experimental design (WMS)  
Week 6 (3/31): fMRI data preprocessing (WMS)  
Week 7 (4/7): Research topic discussion (SGK, WMS)  
Week 8 (4/14): Midterm week – Take-home exam + Research proposal (2 pages)  
Week 9 (4/21): fMRI Physiology & Dynamics (SGK)  
Week 10 (4/28): fMRI SNR and Resolution (SGK)  
Week 11 (5/5): The general linear model, Modeling single subject data (WMS)  
                    Children's day - Makeup class during the week  
Week 12 (5/12): Statistical tests & ROIs (WMS)  
Week 13 (5/19): Advanced fMRI data analysis I (MVPA, RSA, encoding model)  
                    Buddha's birthday - Makeup class during the week (WMS)  
Week 14 (5/26): Advanced fMRI data analysis II (functional connectivity,  
                    intersubject correlation, others)  
                    Data analysis wrap-up and help session (WMS)  
Week 15 (6/2): Student presentations (SGK, WMS)  
Week 16 (6/4): Final report due

### Reading Materials:

- Week 1 (2/24):  
                    Reading materials: Chapter 2 and 3
- Week 2 (3/3):  
                    Reading materials: Chapter 4 and 5