

**Introduction to Diffusion Tensor Imaging
Cognitive Science 260 - Winter 2009**

Instructor: Lawrence Frank, Ph.D.
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Course Time/Location: Tues/Thurs 2-3:20pm; Cognitive Science Building Rm. 003
Course Web site: www.courses.ucsd.edu/cogs260

Teaching Assistant: Greg Balls, Ph.D.
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Office Hours: TBA

Course Overview: Diffusion Tensor Imaging (DTI) is a new and emerging technique that is finding applicability in a broad range of disciplines. This course will be the first at UCSD to provide a comprehensive introduction to DTI. Participants will gain an understanding of the physical principles underlying DTI, as well as theoretical and practical considerations in research design. The course will provide practical tools for acquisition and analysis of DTI data so that participants will be better prepared to critique, design, and conduct DTI studies, appreciate the limitations of current technology, and know the options for implementing advanced measurement techniques.

Prerequisites: None.

Course Attendance: Students are encouraged to register for the course. Researchers, fellows, residents, and faculty are invited to attend as well.

Course Requirements: Students will be expected to attend and participate in bi-weekly lectures and complete assigned readings. They will also be expected to complete weekly homework assignments and a final exam. Grading is based on attendance (30%), completed homework assignments (40%), and the final exam (30%). Assignments will be distributed each Thursday and are to be completed by Tuesday of the following week.

Required Texts/Readings:

Frank, L.R. Introduction to Diffusion Tensor Imaging. Course Reader. Cognitive Science 260 – Fall 2008.

Course Schedule:

| <u>Date</u> | <u>Topic</u> | <u>Readings</u> | <u>Assignment</u> |
|----------------|---|-----------------|-------------------|
| Week 1 | | | |
| Jan 6, 2009 | Introduction and class outline | | |
| Jan 8, 2009 | Diffusion in biological systems | | HW 1 |
| Week 2 | | | |
| Jan 13, 2009 | Basic Mathematics: Vectors, Matrices and Tensors | | |
| Jan 15, 2009 | Magnetic Resonance Imaging I: Physical principles | | HW 2 |
| Week 3 | | | |
| Jan 20, 2009 | Magnetic Resonance Imaging II: Image formation | | |
| Jan 22, 2009 | Magnetic Resonance Imaging III: Artifacts | | HW 3 |
| Week 4 | | | |
| Jan 27, 2009 | Diffusion and its MRI sensitivity | | |
| Jan 29, 2009 | Diffusion Tensor Imaging: Basic Acquisition | | HW 4 |
| Week 5 | | | |
| Feb 3, 2009 | Diffusion Tensor Imaging: Basic Analysis | | |
| Feb 5, 2009 | Lab 1: DTI Visualization and Analysis Software | | HW 5 |
| Week 6 | | | |
| Feb 10, 2009 | Diffusion Tensor Imaging: Artifacts and Corrections | | |
| Feb 12, 2009 | Diffusion Tensor Imaging: Noise and Sampling | | HW 6 |
| Week 7 | | | |
| Feb 17, 2009 | Group comparisons of DTI data | | |
| Feb 19, 2009 | Fiber Tract Mapping | | HW 7 |
| Week 8 | | | |
| Feb 24, 2009 | High Angular Resolution DTI: Conceptual Framework | | |
| Feb 26, 2009 | High Angular Resolution DTI: Data Analysis | | HW 8 |
| Week 9 | | | |
| Mar 3, 2009 | DTI applications: Neuro | | |
| Mar 5, 2009 | DTI applications: Bioengineering | | |
| Week 10 | | | |
| Mar 10, 2009 | What are we really seeing? Diffusion simulation | | |
| Mar 12, 2009 | Lab 2: Fiber Tract Mapping | | |
| Finals | | | |
| Final Exam | TBA | | |