

EE 691: Advanced MRI

Fall 2012, Tuesday & Thursday, 9:30 - 10:50am, Location TBD
USC University Park Campus

Instructor: Prof. Krishna Nayak, knayak@usc.edu, (213) 740-3494
EEB 406, OH: by appointment

Prerequisite: EE 591 Magnetic Resonance Imaging and Reconstruction
(or equivalent)

Helpful Prep: EE 441 Linear Algebra
EE 562a Random Processes

This course is a follow-up to EE 591 Magnetic Resonance Imaging and Reconstruction, and is meant for individuals interested in pursuing research related to the development and/or translation of new MRI techniques. An emphasis will be placed on recent developments that 1) have had high impact on the field and/or show strong promise, 2) involve novel pulse sequence design or image reconstruction, and/or 3) enable imaging of anatomy and function in a way that surpasses what is currently possible with any modality.

There will be one or two handouts or online lectures assigned each week. Students are expected to watch the lectures (or read the handouts) prior to class. Each class meeting will consist of a 30 minute group discussion, followed by problem solving, which will include programming in Matlab.

Required Course Materials:

- Handouts and online lectures (from recent ISMRM scientific sessions)
- <http://ee-classes.usc.edu/ee691/>

Grading:

- 40% Class Participation + Homework
- 30% Midterm Project (individual)
- 30% Final Project (groups allowed)

Useful References:

- DG Nishimura, Principles of Magnetic Resonance Imaging
- MA Bernstein et al., Handbook of MRI Pulse Sequences, Academic Press
- EM Haacke et al., Magnetic Resonance Imaging: Physical Principles and Sequence Design, Wiley
- ZP Liang and PC Lauterbur, Principles of Magnetic Resonance Imaging: a Signal Processing Perspective, Wiley-IEEE

Software:

- MATLAB
- SpinBench MRI simulator

TIMELINE and TOPICS are subject to change:

Week	Topic
1	Logistics; Flipped Classroom; Online Resources; Review of MRI Physics; Imaging Assumptions
2	Image Artifacts
3	Flow & Motion & Diffusion
4	Motion Compensation
5	Parallel Imaging
6	Clinical Neuro and MSK Imaging
7	Clinical Body Imaging
8	Functional MRI: BOLD, ASL
9	Industry: Markets, IP, Startups, Regulatory
10	Constrained Reconstruction (including CS)
11	Steady State Free Precession Imaging
12	Stimulated Echoes; Recalled Echoes; Phase Graphs
13	RF Pulse Design: Shinnar-LeRoux
14	RF Pulse Design: Other (adiabatic, half, multidim)
15	Gradient Waveform Design
x	Elastography
x	Fat-Water Imaging
x	Hyperpolarized ^{13}C Imaging

STUDENTS WITH DISABILITIES:

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m. – 5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776.