M229: Advanced Topics in Magnetic Resonance Imaging

Spring 2019: 4 Units
Room: 300 Medical Plaza, B500
Lectures: Tue/Thu 10:00 AM – 11:50 AM
https://mrrl.ucla.edu/pages/m229

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Course Description: This course will explore recent MRI developments that 1) have had high impact on the field, 2) involve novel pulse sequence design or image reconstruction, and/or 3) enable imaging of anatomy or function in a way that surpasses what is currently possible with any other modality. Simulations and programming exercises in MATLAB will provide hands-on experience for students. Students will propose and carry out a final project along current directions of advanced MRI research.

Prerequisites: This course is a follow-up to M219 (Principles and Applications of MRI) and is meant for students interested in pursuing research related to the development or translation of new MRI techniques.

Course Schedule:

#1. April 2, Tue **Introduction** – Advanced MRI Techniques and Applications
#2. April 4, Thu **RF Pulse Design** – Adiabatic Pulses
#3. April 5, Fri **RF Pulse Design** – Excitation k-space / MATLAB Demo
[Homework 1]
#4. April 11, Thu **Pulse Sequences** – SSFP / GRE / SPGR
#5. April 16, Tue **Pulse Sequences** – RARE & Bloch Simulation (MATLAB demo)
#6. April 18, Thu **Pulse Sequences** – Extended Phase Graphs and Simulation
[Homework 2]
#7. April 23, Tue **Project Discussion**
#8. April 25, Thu **Fast Imaging** – EPI, PROPELLER
#9. April 30, Tue **Fast Imaging** – Non-Cartesian Sampling I
#10. May 2, Thu **Fast Imaging** – Non-Cartesian Sampling II
#11. May 7, Tue **Managing Motion in MRI**
#12. May 9, Thu **MR Temperature Mapping**
[ISMRM 5/11 – 5/17]
#13. May 21, Tue **Image Reconstruction** – Partial k-space
#14. May 23, Thu **Image Reconstruction** – Parallel Imaging I
#15. May 28, Tue **Image Reconstruction** – Parallel Imaging II / k-t Reconstruction
#16. May 30, Thu **Image Reconstruction** – Compressed Sensing
#17. June 4, Tue **Advanced Application Topic** – Guest Lecturer: TBD
#18. June 6, Thu **Advanced Application Topic** – Guest Lecturer: TBD
[Final Project Presentation]

Course Assignments:

- Reading book chapters and research papers
- Programming assignments x2 (MATLAB)
- Final project presentation (1 page abstract and 10+10 min oral presentation)

Grading Structure:

- Participation (10%), Homework (30%), Final Project (60%), Extra Points.

Reading List:

- Handbook of MRI Pulse Sequences. M. A. Bernstein, K. F. King, and X. J. Zhou. Elsevier Academic Press, 2004. ISBN-13: **978-0120928613**.
- Research papers as assigned