

M229: Advanced Topics in Magnetic Resonance Imaging

Spring 2018: 4 Units

Room: 300 Medical Plaza, B500

Lectures: Tue/Thu 10:00 AM – 11:50 AM

<https://sites.google.com/site/bmp229ucla/>

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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 3 **Introduction** – Advanced MRI Techniques and Applications
 - #2. April 5 **RF Pulse Design** – Adiabatic Pulses
 - #3. April 10 **RF Pulse Design** – Excitation k-space I
 - #4. April 12 **RF Pulse Design** – Excitation k-space II / Matlab Demo
 - [Homework 1]**
 - #5. April 17 **Pulse Sequences** – SSFP / GRE / SPGR
 - #6. April 19 **Pulse Sequences** – RARE & Bloch Simulation (Matlab demo)
 - #7. April 24 **Pulse Sequences** – Extended Phase Graphs and Simulation
 - #8. April 26 **Project Discussion**
 - [Homework 2]**
 - #9. May 1 **Fast Imaging** – EPI, PROPELLER
 - #10. May 3 **Fast Imaging** – Non-Cartesian Sampling I
 - #11. May 8 **Fast Imaging** – Non-Cartesian Sampling II
 - #12. May 10 **Water-Fat Imaging**
 - #13. May 15 **MR Temperature Mapping**
 - #14. May 17 **Image Reconstruction** – Partial k-space
 - #15. May 22 **Image Reconstruction** – Parallel Imaging I
 - #16. May 24 **Image Reconstruction** – Parallel Imaging II / k-t Reconstruction
 - #17. May 29 **Image Reconstruction** – Compressed Sensing
 - #18. May 31 **Advanced Application Topic** – Guest Lecturer: TBD
 - #19. June 5 **Advanced Application Topic** – Guest Lecturer: TBD
- [Final Project Presentation, either 6/7 or 6/8]**

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