M229: Advanced Topics in Magnetic Resonance Imaging
Spring 2022: 4 Units
Lectures: Tue/Thu 10:00 AM – 11:50 AM
Bauer Auditorium, CHS BH-173
https://mrrl.ucla.edu/pages/m229

Instructors: Holden Wu, PhD (holdenwu@mednet.ucla.edu)
Kyung Sung, PhD (ksung@mednet.ucla.edu)

Office: 300 UCLA Medical Plaza, Suite B119

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. Mar 29, Tue   **Introduction** – Advanced MRI Techniques and Applications
2. Mar 31, Thu   **Pulse Sequences** – Rapid GRE
3. April 5, Tue   **Pulse Sequences** – RARE / Bloch Simulation MATLAB demo
4. April 7, Thu   **Pulse Sequences** – Extended Phase Graphs (EPG) / MATLAB demo
5. April 12, Tue   **RF Pulse Design** – Adiabatic Pulses
6. April 14, Thu   **RF Pulse Design** – Excitation k-space / MATLAB Demo
7. April 19, Tue   **Image Reconstruction** – Partial k-space
8. April 21, Thu   **Project Discussion**
9. April 26, Tue   **Fast Imaging** – EPI, PROPELLER
10. April 28, Thu   **Fast Imaging** – Non-Cartesian Sampling I
11. May 3, Tue   **Fast Imaging** – Non-Cartesian Sampling II
12. May 5, Thu   **Managing Motion in MRI**
    [ISMRM: May 7 – May 12]
13. May 17, Tue   **Image Reconstruction** – Parallel Imaging
14. May 19, Thu   **Image Reconstruction** – Compressed Sensing
15. May 24, Tue   **Image Analysis** – Deep Learning (DL) by Dr. Zabihollahy
16. May 26, Thu   **Image Analysis** – Challenges in Applying DL by Dr. Zabihollahy
17. May 31, Tue   **Advanced Application Topic** – **TBD** by Dr. William Hsu
18. June 2, Thu   **Advanced Application Topic** – **TBD** by Dr. Ida Sonni
19. June 6-10,   **Final Project Presentations**

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