
Project Discussion

M229 Advanced Topics in MRI

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2023.04.27

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Homework #1 and #2

- Homework 1 due on 4/28 Fri by 5 pm
- Homework 2 due on 5/5 Fri by 5 pm
- Office Hours
- Submit your answers (PDF) and MATLAB code by email

Class Survey

- Pace
 - A. too fast
 - B. a bit fast
 - C. just right
 - D. a bit slow
 - E. too slow

Class Survey

- Office hours (instructor or TAs)
 - A. helpful
 - B. not helpful
 - C. haven't gone yet

Class Survey

- Final project
 - A. have a topic
 - B. thinking about some topics
 - C. need some more inspiration
 - D. no clue

MRI Research

Technical Developments

Physics
Contrast mechanisms
Mathematical models
Hardware
Data acquisition
Data reconstruction
Data processing
Quantitative analysis
Data integration
Software



Clinical Applications

Anatomical imaging
Functional imaging
Multi-modal imaging
Quantitative imaging

for
Diagnosis / screening
Treatment planning
Procedural guidance
Treatment assessment
Monitoring

Course Topics

- Pulse Sequences
- RF Pulse Design
- Fast Imaging Trajectories
- Parallel Imaging
- Compressed Sensing
- Deep Learning Recon
- Motion in MRI
- Susceptibility Imaging
- Invited Speakers
 - Neurological MRI
 - Cardiovascular MRI

Final Project

- ~6 weeks; start thinking now!
 - come to office hours
- Can be your own research
 - incorporate course topics
- Can be from list of ideas
 - can combine several ideas
- Components
 - Proposal (1 page), due 5/8 Mon by 5 pm
 - Abstract (1 page), due 6/8 Thu by 5 pm
 - Presentation + Q&A, 6/13 Tue and 6/15 Thu

Project Ideas

- Pulse sequences
 - bSSFP catalyzation
 - bSSFP banding artifact reduction
 - Design of variable flip-angle TSE
 - Simulation of diffusion-weighted SSFP
 - RF + seq simulator (Bloch, EPG)
 - MR fingerprinting
 - Motion and flow encoding
 - Gradient waveform optimization

Project Ideas

- RF pulse design
 - Low SAR / wide bandwidth adiabatic pulse
 - Velocity selective RF pulse
 - 2D excitation RF pulse
 - Spectral-2D spatial pulse design (e.g., fat suppression + 2D excitation)
 - Low SAR multi-band RF pulse

Project Ideas

- Fast imaging
 - Trajectory design (EPI, PROP, spiral, etc.)
 - Gradient waveform optimization
 - Fast 3D re/gridding (or nuFFT) recon
 - Gradient measurement / calibration
 - Off-resonance correction
- Motion compensation
 - Self navigation
 - Model-based reconstruction

Project Ideas

- Image reconstruction
 - Coil combination (preserve phase, etc.)
 - Parallel imaging (e.g., GRAPPA vs. SENSE)
 - Sparsity and low-rank constraints
 - k-t methods
- Image analysis
 - Measure/reduce geometric distortion in DWI
 - B_1+ mapping with improved spatial interpolation
 - Denoising
 - Multi-component tissue signal modeling

Project Ideas

- Deep learning / machine learning
 - Image enhancement / reconstruction
 - Super-resolution MRI
 - Texture analysis for multi-parametric MRI
 - Prediction models for disease diagnosis
 - Image segmentation
 - Contrast synthesis

Project Ideas

- Quantitative imaging
 - Relaxometry (T_1 , T_2 , T_2^* mapping)
 - Diffusion
 - Perfusion
 - Fat/water
 - Temperature
 - Tissue stiffness
 - Acquisition and signal modeling/fitting

Final Project

- Proposal due 5/8 Mon by email
 - Template on course webpage
- Ask about sample datasets
- Come to office hours!

Thanks!

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<http://mrrl.ucla.edu/wulab>