Project Discussion

M229 Advanced Topics in MRI

Kyung Sung, Ph.D.
Holden H. Wu, Ph.D.

2021.04.22

Department of Radiological Sciences
David Geffen School of Medicine at UCLA

Homework #1 and #2

- HW #1 due this Fri 4/23 by 5 pm
- HW #2 due on Fri 5/7 by 5 pm
- Office Hours
  - Sevgi (TA for HW #1): email
  - Jiahao (TA for HW #2): Fri 2-3 pm
  - Instructors: Fri 10-11 am
- 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
  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

<u>Technical Developments</u>

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

<u>Clinical Applications</u>

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
- Motion in MRI
- Parallel Imaging
- k-t Reconstruction
- Compressed Sensing
- Artificial Intelligence
- Invited Speakers
  - Cardiac T1 mapping
  - TBD

Final Project

- ~6 weeks; start thinking now!
  - come to office hours
- Can be your own research
  - overlap with course topics
- Can be from list of ideas
  - can combine many ideas
- Components
  - Proposal (1 page), due 5/10 Fri
  - Abstract (1 page), due 6/4 Fri
  - Presentation, in early/mid June
  - Q&A

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

Project Ideas

- RF pulse design
  - low SAR / wide bandwidth adiabatic pulse
  - velocity selective RF pulse
  - 2D excitation RF pulse
  - spectral-2D spatial pulse design (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
  - adaptive coil combine (preserve phase, etc.)
  - partial Fourier
  - GRAPPA vs SENSE
- Image analysis
  - image analysis for geometric distortion in DWI
  - B1+ mapping with improved spatial interpolation
  - Multi-modality image registration (MRI and H&E stained histological imaging)

Project Ideas

- Deep learning / machine learning
  - Texture analysis for prostate multi-parametric MRI
  - Prediction model for placenta insufficiency
  - Super-resolution MRI in TSE-T2 using deep learning
  - Deep learning based image segmentation
  - Prostate multi-parametric MRI synthesis
  - Anomaly detection via adversarial training using baseline MRI

Project Ideas

- Quantitative imaging
  - relaxometry (T_1, T_2, T_2*)
  - diffusion
  - perfusion
  - fat/water
  - temperature
  - acquisition and signal modeling/fitting

Final Project

- Proposal due 5/10 Mon by email
  - Template on course webpage
- Ask about sample datasets
- Come to office hours!
  - Instructors and TAs

Thanks!

Kyung Sung, Ph.D.

KSung@mednet.ucla.edu

http://mrrl.ucla.edu/sunglab

Holden H. Wu, Ph.D.

HoldenWu@mednet.ucla.edu

http://mrrl.ucla.edu/wulab