

Project Discussion

M229 Advanced Topics in MRI

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Homework #1

- Due 4/26 by 5pm!
- Office Hours
 - Xinran Zhong (TA) - 3-5pm today
 - Kyung - 3-5pm tomorrow
- 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

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

- RF Pulse Design
- Pulse Sequences
- Fast Imaging Trajectories
- Motion in MRI
- Temperature Mapping
- Parallel Imaging
- k-t Reconstruction
- Compressed Sensing
- Invited Speakers
 - Dr. Le Zhang
 - Dr. Xiaodong Zhong
 - Dr. Debiao Li

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)
 - Oral presentation (10 min), Q&A (10 min)

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

- 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

- 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

Final Project

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