

BioE 422 – Magnetic Resonance Imaging Spring 2020

Instructor: Muge Karaman, PhD
Office at Outpatient Care Center (9.4 T Program):
1740 West Taylor Street MC 931
Office at Advanced Imaging Center (3T Program)
2242 West Harrison Suite 103
Phone: 312-413-7849
Email: mkaraman@uic.edu

Time: Tuesday and Thursday
12:30 – 1:45 pm, Room 227 SEO
Office hours: By appointment

Text: Principles of Magnetic Resonance Imaging: A Signal Processing Approach
Zhi-Pei Liang and Paul C. Lauterbur
IEEE Press, 2000 (UIC e-book)
<https://ieeexplore.ieee.org/book/5264284>

Additional References:

- DG Nishimura, Principles of Magnetic Resonance Imaging
- MA Bernstein et al., Handbook of MRI Pulse Sequences
- EM Haacke et al., Magnetic Resonance Imaging: Physical Principles and Sequence Design

Software: Matlab

Grading:	Homework	20%
	Midterm Exam	30%
	Project Final Report	20%
	<u>Project Oral Presentation</u>	<u>30%</u>
	Total	100%

BioE 422 – Magnetic Resonance Imaging

Course Objectives:

The course objective is to help the student to acquire a basic knowledge of the principles of magnetic resonance imaging (MRI) from a signal processing perspective. Progress toward this objective is based upon developing an understanding of MR signal generation and detection, NMR signal characteristics, RF signal localization and MR image reconstruction. By the end of the course, the student should be able to describe the origin of NMR signals, the basic relaxation phenomena, and the standard imaging pulse sequences used in experimental and clinical MRI. The course will focus on MRI from the perspectives of image acquisition, formation, and analysis.

Major Topics:

	Class Hours		
	Tue	Thur	Total
Introduction to MRI	1		1
Signal Generation and Detection			4
Magnetized Nuclear Spin Systems		1	
RF Excitations	1		
Free Precession and Relaxation		1	
Signal Detection	1		
Signal Characteristics			4
Free Induction Decays		1	
RF Echoes	1	1	
Gradient Echoes	1		
Signal Localization			4
Slice Selection		1	
Spatial Information Encoding	1		
Basic Imaging Methods		1	
Sampling of k-Space	1		
Image Reconstruction	1	1	2
Image Contrast			4
Saturation- and Inversion-Recovery Sequence		1	
Basic Spin-Echo Imaging	2		
Basic Gradient-Echo Imaging		1	
Image Resolution, Noise, and Artifacts	1	1	2
Fast Imaging			2
Fast Spin-Echo Imaging	1		
Echo-Planar Imaging		1	
MR Image Analysis	2	2	4
Midterm Exam			1
Project Presentations and Discussion (Class and guests)			2
Visit to 3T MRI Scanner at Center for Magnetic Resonance Research			TBD
Total			30