

EECE4649 Biomedical Imaging Course

Revised for 2018

This course will explore a wide variety of modalities for biomedical imaging in the pathology laboratory and *in vivo*. After an introductory discussion of tissue properties, waves used in imaging, and contrast mechanisms, we will discuss modalities such as microscopy, endoscopy, x-ray, computed tomography, ultrasound, and MRI. With each modality, instrument descriptions, underlying scientific principles, contrast mechanisms, resolution, and depth of penetration will be considered. Students will work in groups to complete a project in which they will examine one modality in detail and either generate synthetic data using a computational model or processing available image data.

This course will require considerable collaboration among students beyond the class time. The total workload will be comparable to that of a typical 4-semester-hour course at Northeastern, with 45 hours of class time and 90 hours of homework, reading, programming, and preparing presentation material, spread over 5 weeks. Mandatory weekly workshops will provide some opportunity for outside work but students will need to find additional time for collaboration.

Because of the short schedule the 45 hours of lecture are presented in less than 20 sessions. Therefore, attendance is mandatory for all students at every session. Because of the unusual schedule, students from UAndes will be given alternatives in their other courses so that they may participate fully in this course.

Syllabus for EECE-4649
International Biomedical Imaging
Revised 4 May 2017

Date	Day		Topic
1:	Tue		Wave Theory. Tissue Properties.
2:	Wed		Absorption, Scattering, and Reflection
3:	Thu		Contrast, Resolution, and penetration
	Fri		Workshop
	Mon	HW 1	Waves (Including Fourier Transform) and Tissues
4:	Mon		X-Ray
5:	Tue		X-Ray CT
6:	Wed		MRI 1
7:	Thu		MRI 2
	Fri		Workshop
	Mon	HW 2	Radon Transform
8:	Mon	JD	Inverse Problems
9:	Tue	Students	Student Progress Reports
10:	Sed		Ultrasound 1
11:	Thu		Ultrasound 2
	Fri		Workshop
	Mon	HW 3	Inverse Problems
12:	Mon		Microscopy in the laboratory
13:	Tue		<i>In-vivo</i> Microscopy
14: 1	TWed		Optical Coherence Tomography
15:	Thu		Endoscopy
	Fri		Workshop
	Mon	HW4	Microscopy (FDTD?)
16:	Mon	JA	TBD
17:	Tue		Experimental Techniques
18:	Wed		Review and Summary
	Thu		Workshop
19:	Fri?	Students	Student Final Presentations

Grading:

- Prepared Presentations 20%
- Classroom Interaction 10%
- Homework Projects and Teamwork 30%
- Final Projects and Teamwork 20%
- Overall Participation 20%

Course Objectives: Students will be able to

- Apply some of the concepts of waves,— including absorption, scattering, and diffraction,— to different medical imaging systems.
- Understand how the tissue properties generate contrast in normal and diseased tissue.
- Be able to select appropriate imaging modalities for different imaging applications.
- Apply computational techniques to predict sensor response.
- Understand and explain the different analytical techniques for solving simple inverse problems.