

MAS.S67: Design and Fabrication of Imaging Systems

Style: *Flexible*; small-teams projects of 2-3 people (at least 2 per team).

To pass, you must: (i) attend at least 3/4 of the class sessions, (ii) complete the homeworks, (iii) complete the small-team project. By the end of Class #1, students must decide whether to register or drop the course.

Overview: This is a special topic on ultrasound imaging for medical devices. The course focuses on developing a holistic theoretical and practical understanding of ultrasound imaging system design - including signal processing theory for array design and its relation to imaging behavior, materials design and device fabrication methods, electronics used for data acquisition, and image reconstruction algorithms.

The main deliverable is a class project, where students will design novel ultrasound imaging devices, fabrication techniques, and/or algorithms, and finally produce working devices - with an aim towards publication.

Objectives:

1. To develop a theoretical understanding of ultrasound imaging and device design.
2. To learn about and apply design techniques and fabrication processes for ultrasound arrays.
3. To develop new ultrasound devices, fabrication techniques, and algorithms.
4. To write and submit papers based on the class projects.

Schedule:

Class 1: February 7th, 2024 (E15-466)

Signal Processing: Correlation and Fourier Transform

Class 2: February 14th, 2024 (E15-466)

Signal Processing: Convolution and Filtering

Class 3: February 21st, 2024 (E15-466)

Spatial Fourier Transforms, Apertures, and Arrays

Class 4: February 28th, 2024 (E15-466)

Transducer Design, Layers, and Modeling

Class 5: March 6th, 2024 (E15-466)

Complete Imaging System Modeling

Class 6: March 13th, 2024 (E15-466 & E15-443a)

Transducer Fabrication

Class 7: March 20th, 2024 (E15-466)

Pulsed Beamforming

Class 8: April 3rd, 2024 (E15-466)

Excitation Methods

Class 9: April 10th, 2024 (E15-466)

Coexistence Methods, Orthogonal Signaling

Class 10: April 17th, 2024 (E15-466)

Ultrasound System Architectures

Class 11: April 24th, 2024 (E15-466)

Time-Space Processing

Class 12: May 1st, 2024 (E15-466)

cDAQ Architecture and Beamforming

Class 13: May 8th, 2024 (E15-466 & E15-443a)

TBD / Project Workshopping