ENGG*4660/6070 Medical Imaging

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Schedule:
Class times:
Tuesday and Thursday 08:30-09:50, MACK 228

Lab times (optional):
Wednesdays 15:30-17:20 Thorn 2336

Course Description:
Medical imaging is a rapidly developing field within biomedical engineering. There is a demand both within the research community and in clinical support for people with knowledge of the imaging process for the various modalities and the digital image processing techniques for enhancing, restoring and manipulating digital images.

The course material will be divided into two parts. The first part will cover digital image processing techniques from a linear systems perspective. It will be assumed that the students have some background in linear systems theory and signal processing. The second will deal with the
various imaging modalities such as x-ray radiography, CT, MRI, ultrasound, etc. The basic physics of image formation will be covered with emphasis on the parameters which affect image quality.

**Course Objectives:**

By completion of this course, you should be able to:

- Enumerate the factors affecting image quality for each imaging modality.
- Explain the physics of image formation for the various modalities.
- Contrast the uses of the different imaging techniques w.r.t. their advantages and disadvantages.
- Identify the sources of image degradation for the different modalities.
- Relate the point spread function to image resolution both in terms of spatial and spatial-frequency measurements.
- Perform filtering operations in both the spatial and spatial-frequency domains.
- Explain the effects and uses of the various image processing techniques on digital images.
- Given a corrupted image, justify a choice of image processing operators to restore or enhance the image, design and implement the operators, and evaluate both qualitatively and quantitatively the results.

**Texts:**

**Course Text**


**Reference Texts**

Evaluation:

**ENGG*4460**

- Computer Labs/Assignments (4): 40%
- Midterm exam: March 7 In class 25%
- Final Exam: April 8 19:00-21:00 35%

**ENGG*6070**

- Computer Labs/Assignments (4): 60%
- Project: 40%

**Tentative Topics:**

**Image Processing**

- Digital imaging fundamentals: spatial resolution; quantization; analog to digital conversion
- Linear systems: point spread functions; convolution; Fourier analysis
- Point operations: contrast enhancement; histogram equalization; H and D curves
- Geometric operations: geometric distortions and corrections; bilinear interpolation
- Linear filtering: low pass filters; high pass filters; high frequency emphasis filters
- Image restoration: inverse, deconvolution; least squares restoration; nonlinear methods

**Imaging Modalities**

- X-ray radiography
- Computed tomography (CT)
- Magnetic resonance imaging (MRI)
- Nuclear medicine
- Ultrasound
- Positron emission tomography (PET)