BMED/ECE 4783 Introduction to Medical Image Processing

Credit: 3-0-3

Prerequisite(s): ECE 2025 and (MATH 3770 or ISYE 3770 or CEE 3770)

Catalog Description
A study of mathematical methods used in medical image acquisition and processing. Concepts, algorithms, and methods associated with acquisition, processing, and display of two- and three-dimensional medical images are studied.

Text
Digital Image Processing, R. C. Gonzalez, R. E. Woods, Second Edition, Prentice Hall.

Objectives
To overall objective of this course is to provide an overview of mathematical tools used in medical imaging and an introduction to medical image processing.

Outcomes
By the end of the course the students should be able to:

1. know the basics of methods common to medical image acquisition and medical image processing (Program Outcome 1)
    a. distinguish continuous from discrete images
    b. distinguish linear from nonlinear image operators
    c. understand and apply discrete and continuous two- and higher-dimensional Fourier transform
    d. understand image formation and representation

2. understand and apply basic image processing techniques - enhancement and restoration (Program Outcomes 1, 2)
    a. understand the mathematics behind these techniques
    b. implement these techniques in Matlab

3. understand and apply advanced image processing techniques - segmentation, registration, and motion analysis - to medical problems (Program Outcomes 1, 2)
    a. understand the mathematics behind these techniques
    b. use basic image processing techniques to improve the performance of advanced ones
    c. implement these techniques in Matlab and apply them to real-life medical problems

Topical Outline
1. Linear 2-D Transforms
    a. Linear systems and convolution
    b. Continuous Fourier transform

   c. Discrete Fourier transform
   d. Generalization to N-D transforms
2. Image Formation and Representation
   a. Sampling and sampling theorem
   b. Quantization
   c. Color images
3. Image Enhancement and Restoration
   a. Image noise
   b. Histogram equalization and matching
   c. Low and high pass filtering
   d. Median filtering
   e. Inverse filtering
   f. Wiener filtering
4. Image Analysis
   a. Edge detection
   b. Segmentation
   c. Registration
   d. Motion analysis
   e. Mathematical morphology
5. Image Compression
   a. Error-free compression
6. Reconstruction from Projections
   a. Radon transform
   b. Filtered backprojection
   c. Iterative Reconstruction