Syllabus

Faculty of Biomedical Engineering

Introduction to Medical Image Processing

336027

Spring 2021

(2.5 credit points)

Description

Medical imaging is an exploding field. The technologies for visualizing the body (the imaging modalities) are becoming very powerful, providing exquisite images of tissue morphology, and revealing tissue function. Imaging is at the core of medical practice; nearly all patients have imaging of some sort during care, and many studies produce thousands of images. The growth in digital imaging is necessitating techniques for medical image processing and analysis.

This course will provide an overview of fundamental image processing concepts and algorithms applied to medical imaging data.

Instructor: Dr. Moti Freiman, Silver 239, moti.freiman@bm.technion.ac.il,

Reception hour: see below.

T.A.: Yan Ziselman, yanivzis@campus.technion.ac.il

Reception hour: Wed. 15:30-16:30 (Pre-arrangement by email)

Course location:

Due to the coronavirus outbreak and per the updated guidelines, the course will be delivered online until further notice. We will use the Technion's zoom online meeting system for both lectures and reception hours. Please schedule reception hour meetings by email. To facilitate communication, email subject must be: impr: <your subject> where <your subject> is the topic you would like to discuss with us.

The online meeting details are available at the course website.

Course times:

Lecture: Sun. 15:30-17:30

Recitation: Sun. 17:30-18:30

Prerequisites

1. 044131 אותות ומערכות
2. 104016 אלגברה 1מ
3. 094423 סטטיסטיקה

4. הסתברות 104034

Recommended prior knowledge:

1. Basic python programing
2. Basic Oobject oriented programming concepts

Textbook

1. Gonzalez and Woods, Digital Image Processing 4th edition, Pearson, 2017.
2. Birkfellner, Applied Medical Image Processing: A Basic Course, CRC press, 2010.

Course Objectives

1. To introduce the main concepts of medical imaging
2. To introduce the main concepts of medical image processing algorithms:
   a. 2D Fourier transform
   b. Medical image reconstruction
   c. Image enhancement
   d. Image quantization
   e. Image compression
   f. Image restoration
   g. Deep-leanring methods for medical image processing
3. To introduce the DICOM format for medical imaging data storage
4. To gain hands-on experience in developing image prrocessing algorithms for medical imaged MRI using the python programming language.

Learning outcomes:

At the end of the course, students will know:

1. To implement medical image processing algorithms in Python programming language
2. To determine which algorithm is suitable to solve a specific challenge in medical image processing
3. To develop algorithms to solve specific challenges in medical image processing

Course Topics

The course will cover the following topics:

Introduction to the field of medical image processing and its applications, 2D signal processing, 2D discrete Fourier transform and its application in medical imaging (MRI and CT reconstruction), Image enhancement (histograms, denoising, sharpening), Image quantization, Image Restoration, compression, DICOM format, Deep-learning methods for medical images, Python programming language for medical image processing.

Assignments

1. 4-5 assignments during course duration. Each assignment will include both theoretical questions and programming assignment in the python programming language.
2. Final exam – the exact format will be determined during the progress of the course due to the coronavirus outbreak.

Course grade: 50% exam + 50% assignments.

Online resources

1. Course website on the Technion's moodle: TBD
   all lecture notes/supplementary material/slides are available there.