CAP6516: Medical Image Analysis

Prerequisites: CAP5416 or some Image Processing background is desired. Proficiency in Matlab or C/C++ and any image display software that is freely available to you for use in doing the programming assignments and project is a MUST. If you do not have any of the above, you must get the consent of the instructor prior to registering for this class.

What will you learn from this course: At the end of the course, you will be able to write programs to denoise medical images, segment them into meaningful parts even when anatomical structures do not have high contrast, achieve reconstruction of medical image data from sparse sampling, register/align uni-modal and multi-modal medical image data sets (e.g., MR and CT etc.). You will get an idea of what the MR Scanners look like from a trip to the UF Brain institute.

Texts and Other Material: There is NO text book for this class. However, there are several references and they are:

1. Medical Imaging Signals and Systems, by Jerry Prince & Jonathan Links, Publisher: Prentice Hall.
2. Digital Image Processing, by Rosenfeld and Kak (Vol. 1); Publisher: Academic Press.
8. Other Material: Papers from the following journals, IEEE TMI, MedIA, PAMI, IJCV, JMIV, and IEEE TIP; Some of these material will be handed out in class.

Instructors: Prof. Baba C. Vemuri.
Office hours: M:4.00-5.00pm and by appointment.
Grading:

1. Hwks. & Programs: 10% – All programming assignments will involve submission of a report with the results in the form of images and Matlab code.
2. Midterm : 20%
3. Presentations: 30% – All presentations must use multimedia (laptop-based).
4. Project: 40% – All projects will involve a short (at most 10 pages including figures and refs.) report and a live demo.

Make Ups There will be no make ups for any of the assigned work unless the student has medical reasons for missing the deadlines. In this case, the student will be asked to furnish a letter from the attending physician.

Honor Code Students are required to submit original work. There should be no collaboration in any of the assigned work. Plagiarism is a serious offense and will be reported to the Office of the Dean of Student Affairs for appropriate action. For more details, refer to the honor code of the University of Florida at http://www.dso.ufl.edu/sccr/honorcodes/honorcode.php
Syllabus

Medical image formation, reconstruction mathematics (Fourier slice theorem, Abel, Hankel and Radon transforms), Compressed Sensing (MRI/CT), PDE-based denoising, active 2D/3D models and segmentation, segmentation via Bayesian estimation, shape priors, Image matching/registration with application to uni- and multi-modal co-registration, diffusion MRI analysis, shape/image classification.

Tentative schedule of lectures

1. Image data acquisition: CT, MR.
2. Fourier, Abel, Hankel transforms, sampling theorem.
3. CT reconstruction mathematics, back-projection.
5. Compressed Sensing
7. Geometric active contours and image segmentation
8. Clustering and Bayesian segmentation methods.
9. Matching and image registration.
10. Diffusion MRI analysis
11. Shape/image classification.