

## CAP6516: Medical Image Analysis

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

1. *Digital Image Processing*, by Rosenfeld and Kak (Vol. 1); Publisher: Academic Press.
2. *The Fourier Transform and its Applications*, by Bracewell, McGraw Hill.
3. *Level-set Methods*, by J. A. Sethian, Cambridge University Press.
4. *Geometric Partial Differential Equations*, G. Sapiro, Cambridge University Press.
5. *Mathematical Problems in Image Processing*, G. Aubert and P. Kornprobst, Springer Verlag.
6. *Numerical Solution of PDEs in Science and Engineering* Lapidus and Pinder, McGraw Hill.
7. *Other Material:* Papers from the following journals, *IEEE TPAMI*, *IEEE TMI*, *CVGIP*, *IJCV*, *JMIV*, and *IEEE TIP*; Some of these material will be handed out in class.

**Instructors:** Prof. Baba Vemuri.

**Office hours:**

**Grading:**

1. Homeworks: 10%
2. Programs: 20
3. One Midterm: 20%
4. Presentations: 20
5. Project: 30%

### Syllabus

Medical image formation, reconstruction mathematics (Fourier slice theorem, Abel, Hankel and Radon transforms), PDE-based denoising, multi-dimensional splines, active 2D/3D models and segmentation, segmentation via bayesian estimation, basic differential geometry of curves and surfaces, Image matching/registration with application to multi-modal co-registration.

### Tentative schedule of lectures

1. Image data acquisition: CT, MR, ultrasound.
2. Fourier, Abel, Hankel transforms, sampling theorem.
3. CT reconstruction mathematics, backprojection.
4. Discrete and Fast Fourier Transforms.
5. Image Restoration via diffusion filtering.
6. Active Models and Image Segmentation
7. Clustering and Bayesian Segmentation methods.
8. . Differential geometry of curves & surfaces.
9. Advanced applications of the geometry of surfaces: characteristic surface curves, points and regions.
10. Matching and Image Registration