

# Syllabus

## CS 791 / 593: Medical Image Analysis

### Spring 2006

**Home page:** <http://www.csee.wvu.edu/~tmcgraw/cs791spring2007>

**Instructor:** Dr. Tim McGraw

- **Office:** 821 ESB
- **Office Hours:** 4:00–5:00pm, Monday, Wednesday, Friday
- **EMAIL:** [tmcgraw@csee.wvu.edu](mailto:tmcgraw@csee.wvu.edu)

**Class Meets:** G78B ESB, 3:00–3:50pm, Monday, Wednesday, Friday

**Final Exam:** None

### Prerequisites

- None required. Previous image processing, Matlab, calculus, linear algebra and numerical methods experience suggested.

### Description

This is an advanced topics course in medical image analysis. The course will focus on the topics of restoration, segmentation, registration and visualization.

### Required Reading

- 1 P. Perona, J. Malik, "Scale-Space and Edge Detection Using Anisotropic Diffusion.", IEEE PAMI 1990.
- 2 J. Weikert, "A Review of Nonlinear Diffusion Filtering.", Proceedings of the First International Conference on Scale-Space Theory in Computer Vision, 1997.
- 3 L. Rudin, S. Osher, E. Fatemi, "Nonlinear Total Variation Based Noise Removal Algorithms.", Physica D, 1992.
- 4 C. Tomasi, R. Manduchi, "Bilateral Filtering for Gray and Color Images.", IEEE ICCV, 1998.
- 5 M. Kass, A. Witkin, D. Terzopoulos, "Snakes: Active Contour Models.", International Journal of Computer Vision, 1988.
- 6 R. Malladi, J. Sethian, B. Vemuri, "Shape Modeling with Front Propagation : A Level Set Approach.", IEEE PAMI, 1995.

- 7 T. Chan, L. Vese, "Active Contours Without Edges.", IEEE TIP, 2001.
- 8 J. Marroquin, E. Santana, S. Botello, "Hidden Markov Measure Field Models for Image Segmentation.", IEEE PAMI, 2003.
- 9 Y. Boykov, V. Kolmogorov, "An Experimental Comparison of Min-Cut/Max-Flow Algorithms for Energy Minimization in Vision", IEEE PAMI, 2004.
- 10 J. Maintz, M. Viergever, "A Survey of Medical Image Registration.", Medical Image Analysis, 1998.
- 11 F. Maes, A. Collignon, D. Vandermeulen, G. Marchal, P. Suetens, "Multimodality Image Registration by Maximization of Mutual Information", IEEE TMI, 1997.
- 12 W. Lorensen, H. Cline, "Marching Cubes : A High Resolution 3D Surface Construction Algorithm.", ACM SIGGRAPH, 1987.
- 13 B. Cabral, L. Leedom, "Imaging Vector Fields Using Line Integral Convolution.", ACM SIGGRAPH, 1993.
- 14 T. Preusser, M. Rumpf, "Anisotropic Nonlinear Diffusion in Flow Visualization.", IEEE Visualization, 1999.

## Work in the Course and Grades

The work in the class consists of class participation, quizzes, homeworks, a midterm exam, a final project and presentation.

- 24% - 12 Quizzes
- 36% - 4 Homework / Programming Assignments
- 15% - Midterm Exam
- 12% - Final Project Report
- 8% - Final Project Presentation
- 5% - Class Participation

**Quizzes and Midterm.** Quizzes and the midterm exam will cover material from the required reading **and** class notes. **No makeup quizzes** will be given.

**Homework.** There will be 4 homework assignments, each involving written problems and/or programming. Matlab, C, C++, and Java are acceptable environments for programming problems.

**Final Project.** The final project may be done individually or in teams of 2. A list of sample topics will be given after the midterm exam.

## Ethics

West Virginia University is committed to social justice. I concur with that commitment and expect to maintain a positive learning environment based upon open communication, mutual respect, and non-discrimination. Our University does not discriminate on the basis of race, sex, age, disability,

veteran status, religion, sexual orientation, color or national origin. Any suggestions as to how to further such a positive and open environment in this class will be appreciated and given serious consideration.

## Announcement

If any student needs special accommodations because of a disability, please contact the instructor during the first week of classes.

## Tentative Schedule of Topics

WEEK	DATES	READING	QUIZ	TOPIC
1	1/8, 10, 12	–	–	Course overview, denoising, isotropic diffusion.
2	1/17, 19	1, 2	1	Inhomogeneous diffusion, Tensor anisotropic diffusion.
3	1/22, 24, 26	3, 4	2	TV norm minimization, Bilateral Filtering.
4	1/29, 31, 2/2	5	3	Segmentation, snakes.
5	2/5, 7, 9	6	4	Level set methods.
6	2/12, 14, 16	7	5	Active contours without edges.
7	2/19, 21, 23	8	6	Markov random fields, Hidden Markov measure fields, Midterm exam.
8	2/26, 28, 3/2	9	7	Graph Cuts.
9	3/5, 7, 9	10	8	Image registration, transformations, metrics.
10	3/12, 14, 16	11	9	Multimodal image registration, Mutual Information.
11	3/19, 21, 23	12	10	Scalar field visualization, marching cubes, volume visualization.
12	3/26, 28, 30	–	–	Spring Break.
13	4/2, 4, 6	13	11	Vector field visualization, line integral convolution.
14	4/9, 11, 13	14	12	Diffusion tensor imaging, Tensor field visualization.
15	4/16, 18, 20	TBA	–	Advanced topics, Final Presentations.
16	4/23, 25, 27	–	–	Final Presentations.