

CSci 6967 and ECSE
Image Registration
Spring 2004 Syllabus

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Hours: Tue, Fri after class;
Wednesday 1-3pm

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URL

The course web page will be

<http://www.cs.rpi.edu/courses/spring04/imagereg>

All material, including powerpoint lectures and voice recordings, will be posted there. Material will also be posted at the CenSSIS website (access instructions to be provided later).

Overview

This course covers all aspects of image registration, including the underlying mathematics, the images themselves, algorithms, implementations, and applications. Applications will range from medical imaging to automatic geometric modeling. Special emphasis will be given to software toolkits for image registration.

This course is being taught in conjunction with the NSF Center for Subsurface Sensing and Imaging Systems (CenSSIS), and is being offered simultaneously at the four CenSSIS universities: Rensselaer, Northeastern, Boston University, and the University of Puerto Rico-Mayaguez. All lectures will be recorded in voice-annotated powerpoint, and will be made available through the CenSSIS website. Office hours for remote students will be held using conference calls.

Prerequisites

This course has four categories of prerequisites:

- A course in data structures

- Calculus and linear algebra (vectors and matrices)
- Experience working with images
- C++ programming experience, including templates

We will be working with two extensive software toolkits, both written in C++ using templates. The Insight Toolkit (ITK), in particular, is heavily templated and was written using the principles of generic programming. Without prior C++ experience, students will be too far behind.

Requirements

There are four requirements:

- **(30%)** Weekly homeworks and small programming assignments. These assignments will be designed to help you understand the main techniques in registration as well as their implementations in the two toolkits we'll discuss.
- **(30%)** An extended programming project, due Tuesday, April 6.
- **(30%)** A 10-page research paper on some aspect or application of registration, due Tuesday, May 4.
- **(10%)** Each student in the on-campus course will be responsible approximately 2 times during the semester for being the “scribe”, recording supplemental material written during class.

You will have at least a week for each homework assignment and at least four weeks each for the programming project and research paper. Late assignments will not be accepted for anything other than personal emergencies, verified by the appropriate person at your institution. Plan your time accordingly.

We will proceed in alphabetical order with the role of scribe. Each scribe will record all supplemental material written on the overhead projector during class. S/he will present it in electronic form (pdf file) for the course website so that all students have access. The job of scribe must be completed by the end of the day on which the lecture is held. We will start with Lecture 3. This is a pass-fail requirement. Off-campus students, who are at a disadvantage, will automatically pass this requirement.

Course Material

All lecture notes will be made available on-line in the form of voice-annotated powerpoint. Important papers from the research literature will also be made available.

Schedule

The following is a schedule for the “live” lectures at Rensselaer.

Dates	Lecture	Topic
1/13	1	Introduction
1/16, 1/20	2, 3	Mathematical background
1/23, 1/27	4, 5	First examples
1/30 - 2/13	6 - 10	Intensity-based registration and the Insight Toolkit
2/20 - 3/5	11 - 15	Feature-based registration and the Rensselaer / CenSSIS Toolkit
3/16, 3/19	16, 17	Initialization techniques
3/23	18	Multiresolution techniques
3/26	19	Mutual information
3/30 - 4/6	20 - 22	Deformable registration
4/9 - 4/16	23 - 25	Video sequences and mosaics
4/20, 4/23	26, 27	Trends and research questions
4/27	Catch-up, if necessary	

Notes:

- There is no class on Tuesday, February 17th because Rensselaer will be following a Monday schedule on that day.
- Rensselaer Spring Break is March 6-14, so there will be no lectures that week.
- If class is missed at Rensselaer due to bad weather or if the instructors are traveling and have to miss class, the associated lecture will still be recorded and made-available on-line. Announcements about missed classes due to travel will be made as far in advance as possible.

Academic Integrity

Students will be allowed to discuss homework assignments in detail, but must write their solutions individually and in their own words. The extended programming project and the research paper must both be individual work, with appropriate citations to the research literature provided. A serious incident of academic dishonesty will result in the student receiving an “F” in the course and being reported to the appropriate official at their academic institution. Please direct any questions or concerns about the policy on academic integrity to Professor Stewart.