CSCI–6280: Mobile Robotics
Spring 2005

Times:	Mondays and Thursdays, 10:00 – 11:20am
Classroom:	Sage 2715
Text:	none (course notes, handouts)
Web:	`http://www.cs.rpi.edu/academics/courses/spring05/mr/`

Instructor:	Prof. Wes Huang
email:	`whuang@cs.rpi.edu`
office:	Amos Eaton 107
office hours:	Mondays 3:00 – 4:30pm

Course description

This course will cover mobile robot localization and mapping in depth. We will develop a thorough understanding of the current state-of-the-art, including Kalman filter and Markov/Monte Carlo approaches to localization. We will be reading papers from the research literature, and there will be a final project for the course. We will spend some time looking at related work in computer vision, as well as approaches to multiple robot mapping and localization.

The only formal prerequisite is DSA (CSCI–2300 Data Structures and Algorithms). I assume that students are reasonably mature programmers after taking this class. Familiarity with the basic ideas/mathematics of localization (least squares estimation and probability and statistics) as well as a reasonably sophisticated math background (linear algebra and probability) is also expected. This is a graduate-level class.

Course activities

Assignments There will be three assignments, most of which will include a programming component. At least some the assignments will be done in pairs. Assignments will explore topics in greater depth by asking you to implement or analyze certain algorithms/techniques.

Exercises There will be occasional exercises that ask you to work out some problem. These will be designed to reinforce material we have covered in class. Since exercises will be tied to what material we actually get through in class, I have not scheduled them in advance. Exercises will generally be due the next class after they are handed out, but you can expect that I will notify you of an impending exercise at least 1 week before it is due. I expect an exercise should take around an hour to complete.

Reading reports We will be reading research papers from the robotics literature. I will ask you to write a reading report that gives a concise summary and critique of the paper. We will be discussing papers in class, and I will expect you to participate in these discussions.

Final project There will be a final project to be done in teams of 2 (maybe 3). This project should implement and analyze some mapping and/or localization technique. In most cases, I expect your project will use publicly available data sets (e.g., scanning laser rangefinder data and odometry measurements) to create a map or to localize a robot. Each group will present the results of their project at the end of the semester, and a written report on your project will also be required.

Grading

Your final grade will be determined according to the following (tentative) breakdown:

36%	Assignments
12%	Exercises
12%	Reading reports
4%	Class participation
36%	Final project

Course policies

The following policies will be clarified or revised as necessary during the semester. The course home page will be updated with the current versions.

Late work

Unless you make *prior* arrangements, assignments are due at the beginning of class (10:00am) on the day they are due. (However, I usually don't collect papers until the end of class.)

I am experimenting with late policies; here is what we will try this semester. Late work by default is not accepted; however, each student has 3 "late days" that they may use to turn in work after the deadline. These are used in increments of 0.5 days, rounded up to the next highest multiple of 0.5 days. For assignments done in pairs, the late time will be rounded up to a whole number of days, and that time will be split between the two students.

Academic honesty

I encourage you to discuss course material and activities with others. However, I expect that any assignment, exercise, reading report, and final project that you turn in to be your own work — the product of your understanding of the course material and your own efforts in completing the assignment, quiz, or examination. For activities done in pairs or teams, the same applies with respect to you and your partner(s). Here are a few specific guidelines:

- For assignments, teams may discuss general issues, logistics, or approaches with other teams. I will generally make it clear what code I expect you to write yourself and what code you may find external sources for. I expect you to properly cite things that you did not come up with yourself. Any programming should be done independently, without any interaction with others.

- For reading reports and exercises, students may discuss a research paper or an exercise problem together, but each person must write their reading report independently. Any discussions should never reach the level of specifically outlining the components of a solution.

The Rensselaer Handbook of Student Rights and Responsibilities defines several types of academic dishonesty, all of which are applicable to this class, as well as procedures for responding to academic dishonesty. While a first infraction may result only in a 0 for that activity or a reduction in that student's final grade, a repeated or egregious infraction may result in the student receiving a failing grade for this course.

Please contact the instructor if there is any question about academic (dis)honesty.

Attendance

I expect you to attend class; however, I do not take attendance. You are responsible for knowing all material covered in class. If you should miss a class, please contact a classmate first to learn what was covered that day.

Extensions and excuses

If there is some good reason that you will need an extension on an assignment, contact me *in advance*. If you do not contact me in advance, I may ask you to get a letter from the Dean of Students. They will verify excuses and write a memo. This way I can be assured of a valid excuse without needing to know details of students' personal lives.

Tentative Schedule

Week	Dates		Topic
1		R Jan 20	Introduction
2	M Jan 24	R Jan 28	Navigation/localization systems (GPS, Loran)
3	M Jan 31	R Feb 3	Kalman filter
4	M Feb 7	R Feb 10	Kalman filter
5	M Feb 14	R Feb 17	Markov methods (including particle filtering)
6	T Feb 22	R Feb 24	Markov methods
7	M Feb 28	R Mar 3	SLAM (EM, etc.)
8	M Mar 7	R Mar 10	SLAM
	SPRING BREAK		
9	M Mar 21	R Mar 24	Sensor interpretation
10	M Mar 28	R Mar 31	Computer vision, factorization
11	M Apr 4	R Apr 7	Multiple robots
12	M Apr 11	R Apr 14	Inertial navigation
13	M Apr 18	R Apr 21	TBA
14	M Apr 25	R Apr 28	Project presentations
15	M May 2		Project presentations

	Assignments	
1	GPS simulation	out R Jan 28, due R Feb 17
2	Kalman filter	out R Feb 17, due R Mar 3
3	Markov/SLAM	out R Mar 3, due R Mar 31