CSCI-4290/6290: Robot Motion Planning
Fall 2003

1 Course Information

Instructor:	Srinivas Akella
Email:	sakella@cs.rpi.edu
Office:	Amos Eaton 112, x8770
Office hours:	Tuesday 2:30-3:30pm

Lectures:	Tuesday, Friday 12:00noon–1:50pm
Classroom:	Amos Eaton 214
Credits:	4 (undergraduates)/ 3 (graduate students)
Prerequisites:	Data structures and algorithms (CSCI-2300), Multivariable calculus and matrix algebra (MATH-2010), or permission of instructor.

Course web page: Course announcements and information will be available at
http://www.cs.rpi.edu/~sakella/rmp

Textbooks:
Readings will primarily be from two new textbooks-in-progress:
Robotic Motion Planning: Foundation and Implementation by H. Choset, K. M. Lynch, L. Kavraki, W. Burgard, S. A. Hutchinson, G. Kantor, and S. Thrun.
Planning Algorithms by Steven M. LaValle.

Optional textbook:
Robot Motion Planning by J.-C. Latombe, Kluwer, 1991.

We will supplement the textbook readings with additional readings for broader coverage of the course topics and to reflect recent work in the field.

2 Course Overview

This course is an introduction to algorithmic techniques for robot motion planning. Topics will include configuration space representations, roadmap methods, cell decomposition and potential field techniques, randomized path planning, collision detection, nonholonomic motion planning, multiple robot coordination, and manipulation planning. We will motivate these techniques by applications of motion planning to mobile robots and robot manipulators, assembly planning, computer aided design, computer graphics, and bioinformatics.

Prerequisites: This course does not require a prior background in robotics. Prerequisites for the course are Data Structures and Algorithms (CSCI-2300) and Multivariable Calculus and Matrix Algebra (MATH-2010). Students should be interested in geometrical concepts and algorithms, and have good programming skills. Knowledge of C++ and Unix will be assumed for the programming assignments.

3 Syllabus

This is the tentative sequence of topics to be covered.

1. Introduction to Robot Motion Planning
2. Configuration space representations and geometric transformations
3. Roadmap methods
4. Cell decomposition
5. Potential field techniques
6. Collision detection
7. Sampling-based techniques
8. Nonholonomic motion planning
9. Multiple robot coordination
10. Articulated robots
11. Manipulation planning
12. Advanced topics and new directions

4 Grading

The course activities consist of homework and programming assignments, occasional in-class quizzes, a midterm exam, and a final course project (or a final exam, as discussed in class). Students taking the graduate version of the course (CSCI-6290) will also be required to make a classroom presentation on a topic to be selected with the instructor. There will be four or five homework assignments, which will be a combination of written homeworks, reading reports on research papers, and programming assignments. The final course project will be an implementation of a motion planning algorithm. In addition to a demonstration and presentation of the project, students must submit a written summary of the project. Projects are to be done individually. A tentative schedule of homework, exam, and project dates will be posted on the course web page.

Undergraduate students and graduate students will be graded separately. The tentative grading scheme for the course is as follows:

CSCI-4290
Homework and programming assignments: 50%
Class participation and quizzes: 5%
Midterm exam: 15%

Course project (or Final exam): 30%

CSCI-6290
Homework and programming assignments: 45%
Class presentation, participation, and quizzes: 10%
Midterm exam: 15%
Course project (or Final exam): 30%

The maximum lower bound cutoffs for A, B, C, and D grades will be 90%, 80%, 70%, and 60%, respectively. Lower cutoffs may be established at the end of the semester when assigning grades. If you feel there is a grading error on a programming assignment, homework, or exam, you should bring this to the attention of the instructor as soon as you receive your grade and no later than a week after you receive the grade. **All grades will be treated as final two weeks after they are issued.**

Attendance Policy: Attendance in class is expected and students are responsible for knowing all material covered in class. A portion of the grade will be determined by class attendance and participation.

Lateness Policy: If there is a good reason you will need an extension on a homework assignment, contact me **in advance**. Each student will be given three days (whole or partial) of grace for late assignments. Use these late days carefully. Once you have exhausted these days, **late assignments will not be accepted** without a written excuse from the Dean of Students' office. This includes late days for illnesses, plant trips, etc. USE YOUR LATE DAYS WISELY, IF AT ALL.

5 Academic Honesty

Students are encouraged to discuss course material to improve their understanding of the subject. However they must submit their own work for homework assignments, exams, and the course project.

To ensure academic integrity on programming assignments while permitting students to learn and get help from each other, the following rules will be in force. Students are allowed to work together in interpreting error messages and in finding bugs, but NOT in writing code. Students may not share code, copy code, or discuss code in detail while it is being written or afterwards. Students may not "show" their code to other students as a means of "helping them". Students may not leave their code (either the electronic versions or the printed copies) in publically accessible areas. Students may not use code obtained on the web or from other sources (unless permitted by the instructor). Shared or copied code is easy to spot manually and is easily detected using a variety of software tools. Students caught illegally collaborating in writing code or violating the above rules will receive a 0 on the assignment plus a 5 percentage point penalty on their semester grade and a report to the Dean of Students office. Students caught a second time will receive an F in the course and will be reported to the Dean of Students office.

Students are allowed to discuss homeworks. Students must however write their homeworks individually. Again, copying on this course work is not allowed and will result in a 0 for the submission plus a 5 percentage point penalty on the semester grade and a report to the Dean of Students office.

Copying, sharing answers, or using disallowed materials during an exam is cheating, of course, and will result in a 0 on the exam, plus a 5 percentage point penalty on the semester grade and a report to the Dean of Students office.

Any student violating these academic honesty rules for a second time will receive an F in the course and will be reported to the Dean of Students office.

Refer to the Rensselaer Handbook of Student Rights and Responsibilities, which defines various forms of academic dishonesty and procedures for responding to them. Students found in violation of academic honesty policies will receive a failing grade for the course.