ECE780 T08 Topics in Motion Coordination and Planning Spring 2012
Thurs 11:30–2:20pm EIT 3141

Calendar Description

This course will cover aspects of path planning, dynamic vehicle routing, and coordination for mobile robots. Topics include: 1) Path planning: graph search methods; traveling salesman problems 2) Multi-robot coordination: the consensus and rendezvous problems; sensor coverage; workspace partitioning/load balancing. 3) Dynamic vehicle routing: overview of Poisson processes and birth-death processes; path planning for tasks arriving in real-time; relation to automated material handling, mobility-on-demand.

Instructor

Prof. Stephen L. Smith (stephen.smith@uwaterloo.ca).
Office: EIT 3108. Office hours will be announced at the beginning of the semester.

Course Outline

Class	General Topic	Specific Content
#01 May 03	Intro and path planning	overview, graph decomposition, Dijkstra's
#02 May 10	Single robot path planning	A^*, and traveling salesman problems
#03 May 17	DVR*: single robot	review of Poisson processes, birth-death processes
#04 May 24	DVR: single robot	policies for dynamic traveling repairman problem
#05 May 31	DVR: single robot	adaptive routing policies
#06 Jun 07	Multi-robot coordination	review of graphs, adjacency matrices, connectivity
#07 Jun 14	Multi-robot coordination	consensus and rendezvous problems
#08 Jun 21	Multi-robot coordination	sensor coverage problems
#09 Jun 28	Multi-robot coordination	partitioning for workload balancing
#10 Jul 05	DVR: multi-robot	distributed policies and limited communication
#11 Jul 12	DVR: multi-robot	pickup-and-delivery problems, mobility-on-demand
#12 Jul 19	Project presentations	individual presentation on class project

*DVR is an abbreviation for Dynamic Vehicle Routing

Project

Two types of projects are possible in this course.

1. Solution to a research problem in the student's area of research through the application of techniques presented in this course.

2. Independent study of a topic not covered in class through reading research papers or book chapters. A list of possible topics will be given at the beginning of the term.

Each project will consist of a written report along with an in-class presentation.

Grading

The course will consist of four homeworks, a class project, and a final exam. The grading scheme is

- Homework: 25%
- Project: 25%
- Final Exam: 50%

Late Turn-in Policy

Homework will be due in class on Thursday. Homework received by the Monday of the following week will be accepted with a 20% late penalty. Homework will not be accepted after the Monday.

Recommended Background

There are no formal prerequisites for the course. A familiarity with probability, and matrices will be helpful. In addition, some background in mathematical proofs and reasoning is recommended.

Textbook

There is no required textbook. Course notes will be available and will contain all material. The following two texts will be used for parts of the course.

1. Steven M. LaValle, *Planning Algorithms*, Cambridge University Press, 2006. `http://planning.cs.uiuc.edu/`
2. Francesco Bullo, Jorge Cortés, and Sonia Martínez, *Distributed Control of Robotic Networks*, Princeton University Press, 2009. `http://coordinationbook.info/`.

Both books are freely available online. The first text will be used in single robot path planning, and the second text will be used for multi-robot coordination.