ASEN 5519 Special Topics – Section 002
Algorithmic Motion Planning

Fall 2019

Lecture information

Tuesday and Thursday 2:30-3:45pm in AES 111

Instructor

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Office hours: Wednesday 1-2pm

Course description

This class provides an overview of the "lessons" learned by the robot path planning research community in the last 30 years. We will examine approaches based on potential functions, graphs (roadmaps and cell decompositions) and sampling methods. We will also examine basic modeling and localization techniques, as well as basic approaches in planning under uncertainty.

More broadly, this class provides a set of *tools* that can be used in tackling new problems and enables the pursuit of complex research questions such as planning for autonomous systems.

Prerequisites

A significant part of the performance evaluations (homework, final project) will involve coding, implementing, and evaluating algorithms. This requires at least the knowledge of how to plot 2-D/3-D functions, manipulating arrays and other data structures in addition to standard constructs (loops, functions, etc). C++ and Python are the preferred languages, but MATLAB is also acceptable. Basic knowledge of differential equations and linear algebra is also required.

Grading and Evaluation

Classwork consists of some homework exercises worth 30%, a mid-term exam worth 30%, and a substantive project worth 40% of the grade.

Course Textbooks

Required:

- *Principles of Robot Motion: Theory, Algorithms, and Implementations*
  H. Choset, K.M. Lynch, S. Hutchinson, G. Kantor, W. Burgard, L.E. Kavraki and S. Thrun
  MIT Press
  2005
  e-book through CU library: https://libraries.colorado.edu/record=b9646308~S3

- *Planning Algorithms*
  Steven LaValle
  Cambridge University Press
  2006
  Free download: http://planning.cs.uiuc.edu/

Additional Resources:

- *Probabilistic Robotics*
  S. Thrun, W. Burgaard, and D. Fox
  MIT Press
  2005

- *Robot Motion Planning*
  Jean-Claude Latombe
  Kluwer, 1991.

- *Handbook of Robotics*
  B. Siciliano et al
  MIT Press, 2018

Course Outline

- Planning to move and configuration space
- Gradient-based algorithms
- Roadmap and cell decomposition graph-based algorithms
- Sampling-based algorithms
- Filtering-based localization
- Modeling of mechanical systems
- Motion planning under uncertainty
- Task and motion planning