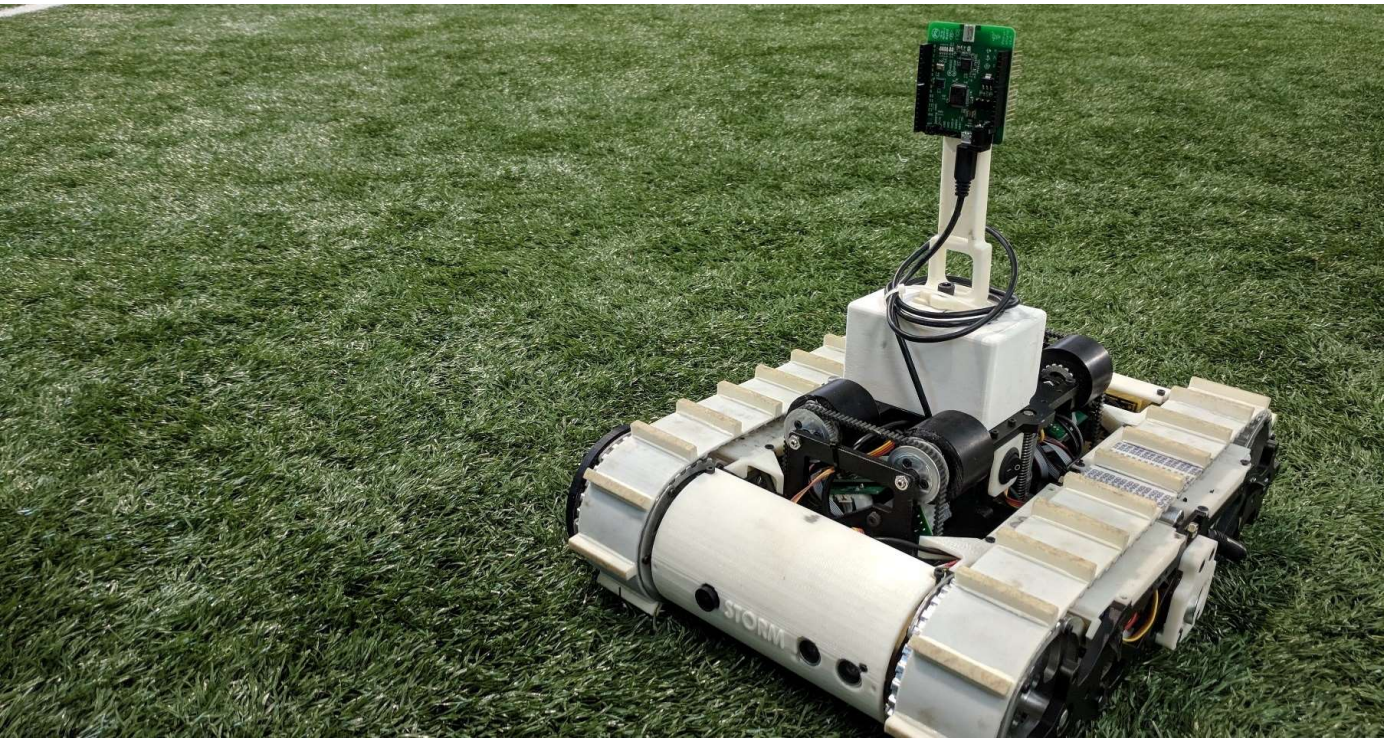


ED 5215

INTRODUCTION TO MOTION PLANNING

COURSE DETAILS

ED 5215 - Introduction to Motion Planning

Instructors:

Bijo Sebastian (bijo.sebastian@iitm.ac.in)
Nirav Patel (nirav.robotics@gmail.com)
Department of Engineering Design

Teaching Assistants:

To be announced

9 credit course → Three lectures per week

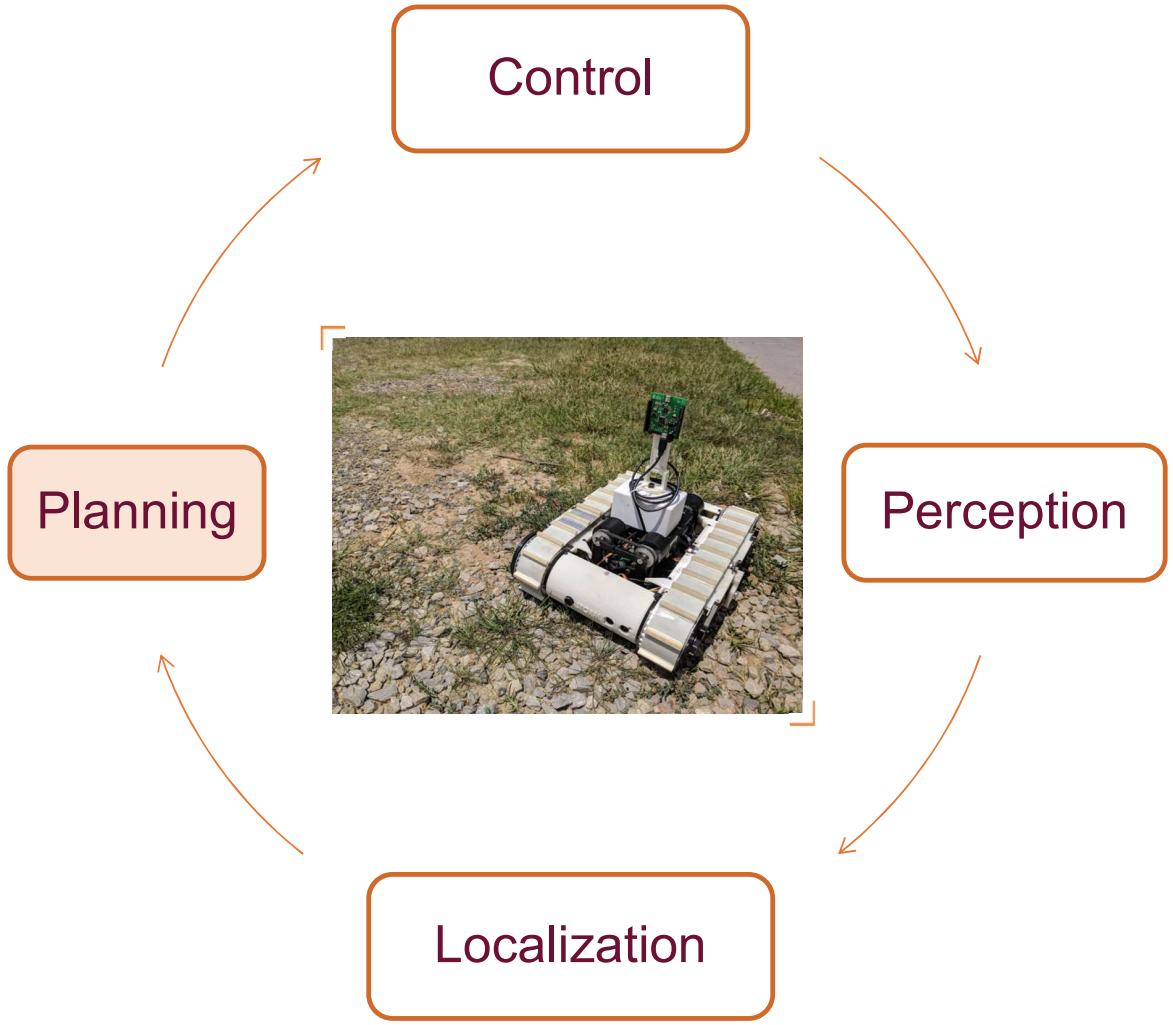
Offered in G slot → Wed: 5:00-5:50 PM, Thu: 10:00-10:50 AM, Fri: 9:00-9:50 AM

Classes will be conducted in ED108

INTRODUCTION

Capabilities needed for field robotic systems:

- Control: Locomotion - Mechanism, Kinematics, Dynamics, Actuator characteristics
- Perception: Sensor characteristics, uncertainty model, fusion
- Localization: Algorithms, Probability theory
- Planning: Artificial Intelligence algorithms

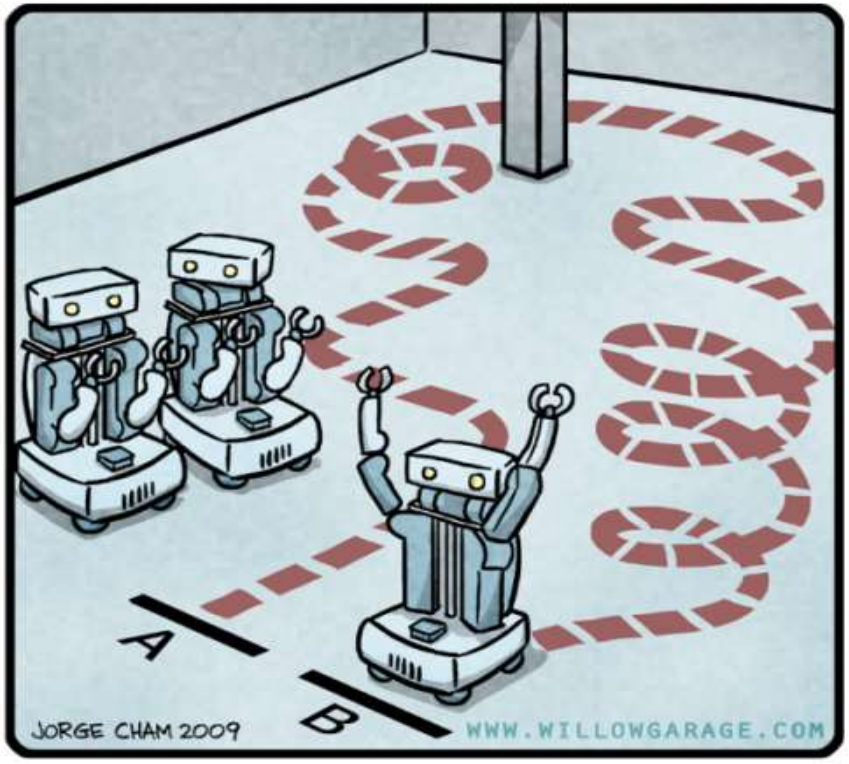


INTRODUCTION

What is motion planning?

- Answers the question of how a robot could go from point A (start) to point B (goal)
- Point A and point B could be:

  Actual locations in the world (Self-driving car)



"HIS PATH-PLANNING MAY BE SUB-OPTIMAL, BUT IT'S GOT FLAIR."

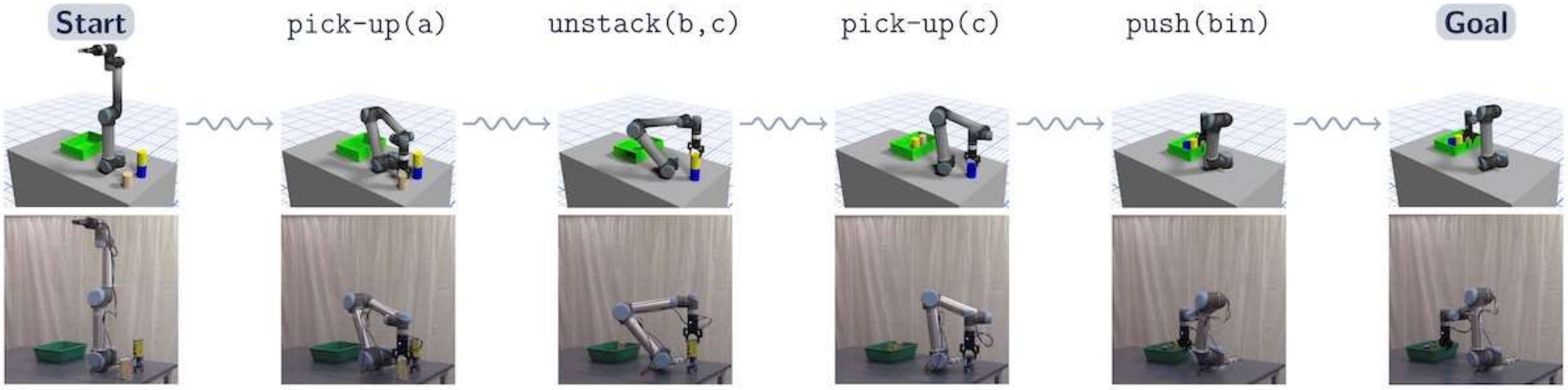
Credit http://wiki.ros.org/navigation

INTRODUCTION

What is motion planning?

- Answers the question of how a robot could go from point A (start) to point B (goal)
- Point A and point B could be:

Pose configurations of the robot (manipulator)



Credit https://ompl.kavrakilab.org/

SYLLABUS

We will start simple:

- Point robot that can move in any direction
- Known environment with stationary obstacles
- Perfect sensing
- Perfect control

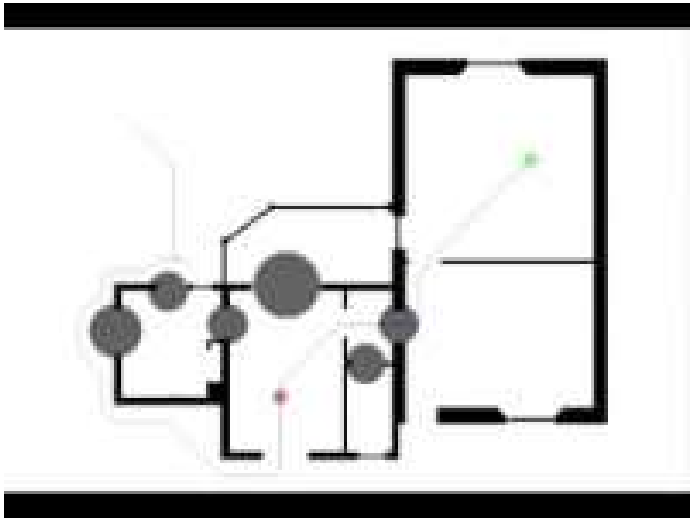
*Potential fields, Dynamic programming, Graph search, Depth-first, Breadth-first, and Dijkstra, A**

https://www.youtube.com/watch?v=7bsEN8mwUB8&t=1s

SYLLABUS

Move on to:

- Point robot that can move in any direction
- Unknown environments and/or moving obstacles
- Perfect sensing
- Perfect control



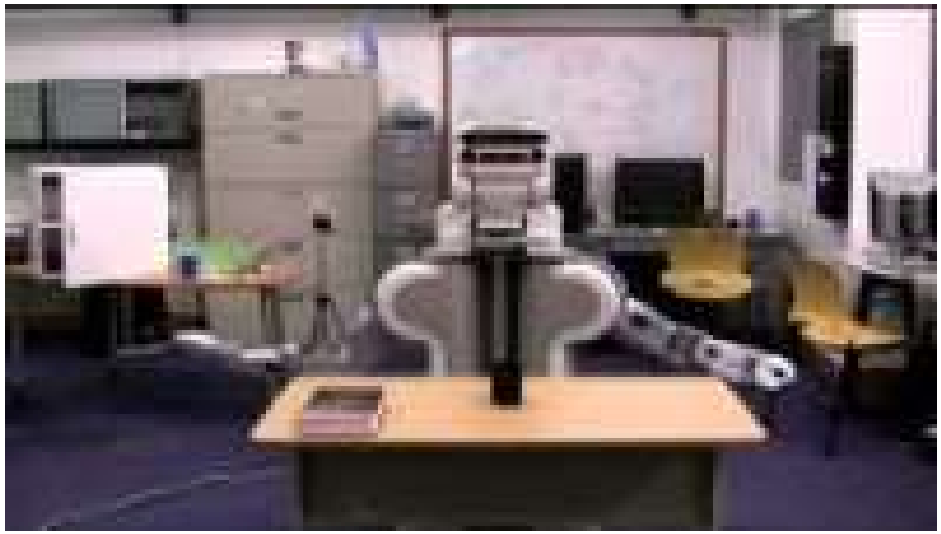
Weighted A, Anytime A*, D*, D* Lite*

https://www.youtube.com/watch?v=X5a149nSE9s

SYLLABUS

Move on to:

- Point robot that can move in any direction
- Complex, high dimensional environments
- Perfect sensing
- Perfect control



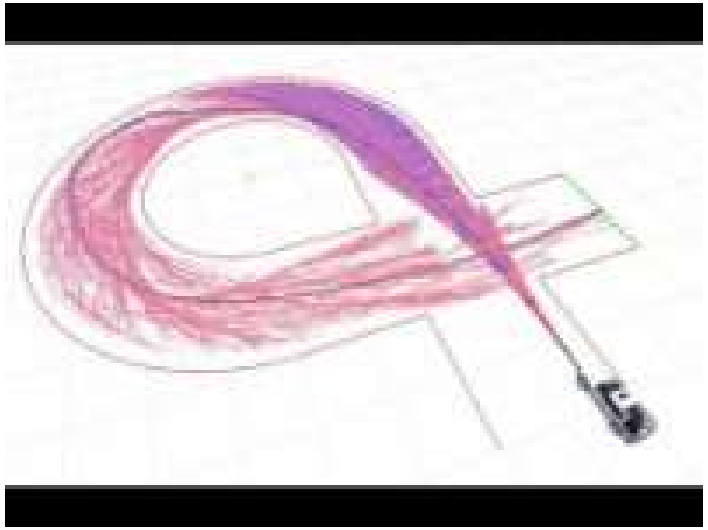
*Sampling-based algorithms, Visibility Road maps and randomized trees, how to build graphs, RRT and RRT**

https://www.youtube.com/watch?v=vW74bC-Ygb4&t=3s
https://www.youtube.com/watch?v=2WOBMswcCA8

SYLLABUS

Finally:

- Realistic robot models
- Complex, high dimensional environments
- Perfect sensing
- Perfect control



Reed-Shepps Car, Dubins Car, Differential drive robot + kinematic constraints, articulated arms

https://www.youtube.com/watch?v=p3nZHnOWhrg

COURSE OBJECTIVE

The objective of this course is to introduce motion planning algorithms and their application within robotics

By the end of the course, it is expected that the students will be able to:

- Understand and appreciate different kind of motion planning algorithms
- Formulate real-world applications as motion planning problems
- Compare different planning algorithms to select one that suits the application at hand
- Adapt and implement a motion planning algorithm for the real-world application accounting for constraints such as limited processing time and computing resources

COURSE DETAILS

Reference books:

1. Steven M. LaValle, Planning Algorithms, Kluwer Academic Publishers
2. Jean-Claude Latombe, Robot Motion Planning, Kluwer Academic Publishers
3. Principles of Robot Motion Theory, Algorithms, and Implementation Howie Choset, Kevin Lynch, Seth Hutchinson, George Kantor, Wolfram Burgard, Lydia Kavraki, and Sebastian Thrun, The MIT Press

All the above books are available online or with IIT Madras Central Library

COURSE DETAILS

Prerequisites:

- Comfortable with programming in Python or C++ (data structures, tree, linked list, etc.)
- Basics of probability and Linear Algebra (typical distributions, pdf, mean and covariance of
- random variables)
- Please note that you will be required to implement many of the algorithms discussed in class
- There will be NO coding support (only conceptual help from the TA)

COURSE DETAILS

Grading:

4 assignments: 2.5% each → Total of 10%

Project: Proposal presentation (5%), Mid-term presentation(5%), Final presentation(10%), Report(10%) → Total of 30%

End Semester Exam: 30%

Class participation: 5 %

2 Quizzes: 10% each → Total of 20%

Paper presentation: 5%

COURSE DETAILS

Project:

- Can be done in groups of 2 or 3 students
- Will involve apply planning concepts to a real-world problem
- You can choose from a list of problem statements (will be provided to you soon)
- Or come up with your own problem statement
- Can be part of your research work or other course project

COURSE DETAILS

Following materials will be made available through Moodle:

Lecture PPT, additional notes, assignments…

Submission of quiz/assignments/reports etc. only through Moodle

Check Moodle regularly and ensure you are getting the announcements and other notifications related to the course

Inform in-advance if you need extensions for quizzes and assignments

WELCOME

Let’s get started!