

16-311 Introduction to Robotics

Lab 6 – Sensor-Based Planning

Felix Duvall, Nick Heckman

So far...

- You have a robot (Lab 3)
- It moves at your command (Lab 4)
- You have a planner (Lab 5)
- BUT... It is currently blind to the world

Let there be light!

- Your kit comes with a nifty sensor:



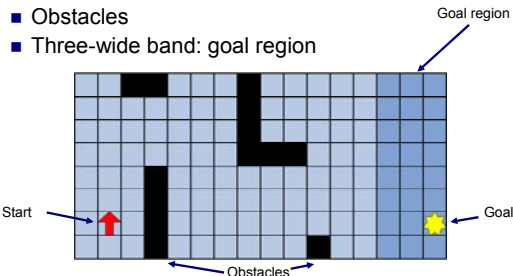
- Libraries, schematics and example code available on web site

The Challenge

- Get from start to a goal region safely
 - Sense obstacles
 - Avoid obstacles
- Touch a light bulb in the goal region and stop

The World

- Regular Grid: 8x16
- Obstacles
- Three-wide band: goal region



Start and Goal States

- Start
 - Given to you at demo time $[x, y, \theta]$
 - NOTE: As with previous labs, you **must** be able to input start state on the robot
 - NOTE: We pick your orientation
- Goal
 - Light bulb
 - Located at the end of the goal region
 - NOTE: You **cannot** program or input its exact location

Obstacles

- Grid-aligned
- Arbitrary position (outside of goal region)
- Arbitrary size (1,2,3,4)
- Obstacles can be combined (convex and concave)

- Same padding constraints apply

Timeline

- Two weeks for this lab

- Wed 2/21 – Assign Lab 6
- Mon 2/27 – Fri 3/2: Checkpoint during TA lab hours
- Tues 3/6 – Demo Lab 6

Checkpoint

- Occurs during lab hours next week
- Forces you to start early
- **30 points** of your grade
 - Robot built: **5 points**
 - Robot moves: **5 points**
 - Robot uses sensor information: **(20 points)**
 - Light sensing: 5 points
 - Display range data : 5 points
 - Detect walls correctly: 10 points

Demo Day

- Three tries *or* 10 minutes
 - Runs in progress will be allowed to complete (TA discretion)
- Runs ends if:
 - Robot hits obstacle
 - Robot runs off world
 - You want it to
- Arrive early
- Charge batteries

Grading

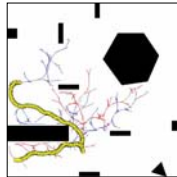
- **70 points**
 - Robot moves **5 points**
 - Robot detects obstacles **5 points**
 - Robot reacts to obstacles **10 points**
 - Planner updates configuration space **10 points**
 - Robot clears the maze **20 points**
 - Robot drives towards goal **10 points**
 - Robot stops on contact **10 points**
- Bonus
 - Fastest team in class **10 points**

Tips

- Start early
 - Start early
 - Start early
 - Start early
- Rangefinder
 - Know the sensor model
 - Sensor returns noisy measurements
 - Think about sensor position on robot
- Moving the entire robot vs. articulating the sensor
- Test planner independently

Big Picture

- Last of the motion planning labs:



Questions?

- Felix: felixd@cmu
- Nick: nth@andrew