

Homework 3: *Using Laser for Feature Extraction*

Assigned: Tuesday, Sept. 20, 2011

Due: Tuesday, Oct. 11 at 13:00:00

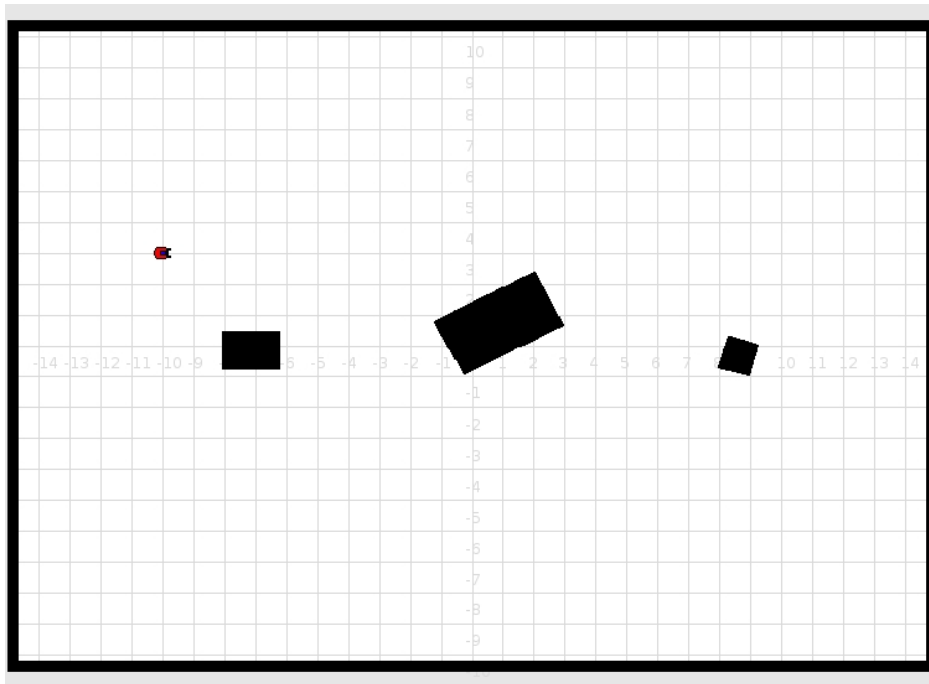
(any homework turned in after 13:00:00 on Oct. 11 will be considered late, and will receive a grade of '0')

Notice that there are 2 versions of this assignment – one for graduate students, and a second for undergraduate students.

Files for this homework can be found at <http://web.eecs.utk.edu/~parker/Courses/CS494-529-fall11/Homeworks/HW3.tar>

Graduate Student Version:

In this part of the homework, you will make use of a laser range scanner on a mobile robot to determine the size of 3 boxes in the robot's environment. The assumption is that the robot starts at the left side of a room at pose $(-10, 3, 0)$, and 3 boxes of different sizes and orientations are lined up along the x axis, as shown here:



You don't know in advance the exact positions of the boxes, but you do know that some part of each box touches the x axis (i.e., where $y = 0$). And, you also know that the x value of the starting position of your robot is to the left of the minimum x value of the first box (from the left). (You can make use of the GPS localization on the robot to determine where your robot is.)

Your approach also has to deal with noisy laser data. We are providing you with a function (in `lasernoise.cpp`) that adds noise to the laser scan according to the noise model typical for laser

range scanners. You might want to begin by getting your approach to work without noise first, then adding in the noise as the last step.

You are being provided with .cfg and .world files for this problem, called HW3.cfg and HW3.world, as well as the above bitmap image. These files also include lasernoise.cpp, which adds on noise to the laser range scanner. These are on the class website, on the “Homework Assignments” page. *Be sure to use the correct environment – i.e., the one with 3 boxes as above; do this by uncommenting/commenting the proper bitmap in the .world file.*

Your job is to write robot code that moves the robot around each box and outputs the length of each side of the found boxes. Note that even though these boxes will be rectangular, you should go around all 4 sides of each box to determine its size, based on the robot’s calculations using the laser. It doesn’t matter which side you start with. Thus, the overall output should be something like:

```
Found Box 1:
    Side 1 = 2.76m
    Side 2 = 1.35m
    Side 3 = 2.68m
    Side 4 = 1.28m

Found Box 2:
    Side 1 = 2.13m
    Side 2 = 3.82m
    Side 3 = 2.27m
    Side 4 = 3.90m

(etc. for Box 3)
```

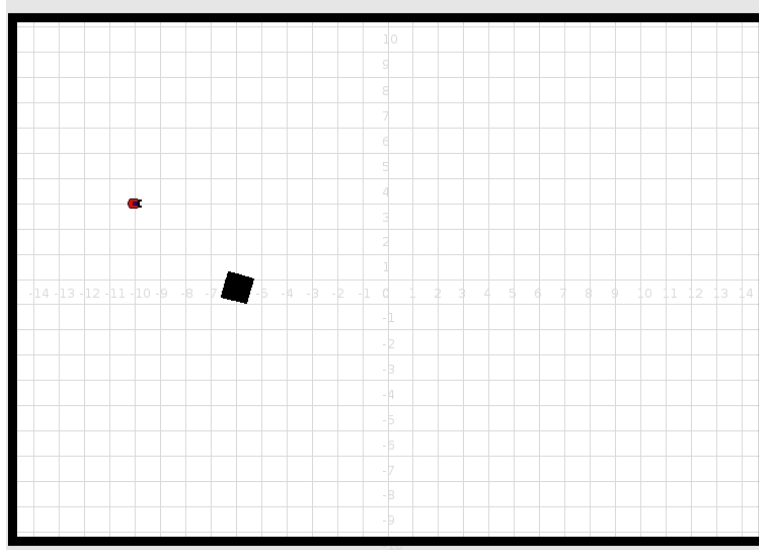
The focus of this exercise is in using the laser scanner data to fit a line to each side of the box to estimate its size. This is a feature extraction problem, as described in Section 4.7 in the handout reading

What to submit:

- A screenshot of the robot trace as it moves through the environment. (If you need to submit multiple screenshots because of the fading trace, please do that.)
- A listing of your robot code output.

Undergraduate Student Version:

Your assignment is similar to the graduate students' version, except you only have to deal with finding the size of 1 box. Here, the assumption is that the robot starts at the left side of a room at pose $(-10, 3, 0)$, and 1 box of some size and orientation is on the x axis, as shown here:



You don't know in advance the exact position of box, but you do know that some part of the box touches the x axis (i.e., where $y = 0$). And, you also know that the x value of the starting position of your robot is to the left of the minimum x value of the box. (You can make use of the GPS localization on the robot to determine where your robot is.)

Your approach also has to deal with noisy laser data. We are providing you with a function (in `lasernoise.cpp`) that adds noise to the laser scan according to the noise model typical for laser range scanners. You might want to begin by getting your approach to work without noise first, then adding in the noise as the last step.

You are being provided with `.cfg` and `.world` files for this problem, called `HW3.cfg` and `HW3.world`, as well as the above bitmap file. These are on the class website, on the "Homework Assignments" page. *Be sure to use the correct environment – i.e., the one with 1 box as above; do this by uncommenting/commenting the proper bitmap in the `.world` file.*

Your job is to write robot code that finds the box, and outputs the length of each side of the found box. Note that even though this box will be rectangular, you should go around all 4 sides of the box to determine the length of each side, based on the robot's calculations using the laser. It doesn't matter which side you start with. Thus, the overall output should be something like:

```
Found Box:
  Side 1 = 2.76m
  Side 2 = 1.35m
  Side 3 = 2.68m
  Side 4 = 1.28m
```

The focus of this exercise is in using the laser scanner data to fit a line to each side of the box to estimate its shape. This is a feature extraction problem, as described in Section 4.7 in our text.

What to submit for Part 3:

- A screenshot of the robot trace as it moves through the environment. (If you need to submit multiple screenshots because of the fading trace, please do that.)
- A listing of your robot code output.

SUBMITTING YOUR HOMEWORK (for everyone):

Place all your files in a single directory. These files should include:

- Your written screenshots and robot output as requested above, in a single pdf file called “yourlastname-HW3.pdf”
- Your configuration file, called “HW3.cfg”
- Your world file, called “HW3.world”
- Your makefile, called “makefile” or “Makefile”
- Your robot control code, called “yourlastname-HW3.cc” .
- A README file giving the command line arguments to run your code (it may simply be “./yourlastname-HW3”, but if you require command line arguments, please specify them here).

Remove all other unnecessary files. Package up everything into a compressed tarball and submit via BlackBoard by the deadline.