The Gauntlet

Quantitative Engineering Analysis

1 Overview

You have mastered the Bridge of Doom™ and tamed Mount Doom™. Now you face the most challenging challenge you've ever been challenged with. In this final challenge, you will help your robot to dodge through obstacles on your way to the ultimate prize – knowledge.

Throughout this semester, you have applied many quantitative engineering analysis tools (*hey, that's the name of the class!*). For this challenge, you'll use a powerful new sensor (the laser scanner), explore some new algorithms for optimization, and use the mathematics of artificial potential functions.

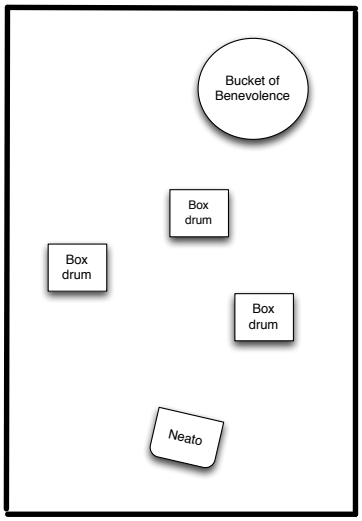

Figure 1: A top-down view of The Gauntlet™. You should write a program to guide the Neato past the obstacles (the box drums) to the goal (the Bucket of Benevolence™).

1.1 Learning Goals

By the end of this challenge, you should be comfortable with the following:

1. Fitting geometrical models to laser scan data.
2. Outlier resistant techniques for optimization.
3. Potential functions and vector fields.
4. Basic obstacle avoidance and path planning.
5. Working with multiple coordinate systems.

2 The Challenge

Your goal is to write a program to pilot your robot through a series of obstacles (walls and box drums). You will detect these obstacles using your robot's onboard laser scanner, which can detect obstacles within a 3m range (see Figure 1).

This final QEA-I challenge has a hierarchy of missions, which get progressively more difficult. For all missions, the goal is to gently tap the Bucket of Benevolence (BoB). Here are the conditions for the missions:

1. You are given the coordinates of the BoB. The only obstacles are the walls.
2. You are given the coordinates of the BoB. You are given a map of the obstacle locations (walls and box drums). The laser scan

can be used to improve the strategy or the path could be entirely pre-planned.

3. You are given the coordinates of the BoB. You must use the LIDAR to detect and avoid obstacles.

4. You are given the radius of the BoB, but not the coordinates. You must use the LIDAR to detect and avoid obstacles and identify and locate the BoB. To identify the BoB, you will need to differentiate the distinctive, circular shape of the goal from the linear shape of the obstacles (see Figure 1).

To achieve whichever mission(s) you choose to accept, you will apply what you (will) have learned about potential functions and vector fields. You may also choose to extend any of the above missions by applying or creating another goal-seeking/obstacle-avoiding algorithm.

3 *Completing the Challenge*

Prepare a writeup of your work on this challenge. Your writeup should contain the following components:

1. The strategy you used to solve the challenge. Where appropriate, connect this to the work that you did building up to this challenge.

2. Some experimental data that shows, quantitatively, how well your system works. Specifically, we'd like you to record the time it takes for your robot to get to the BoB (for whichever mission you choose). It's up to you exactly how you design this experiment (e.g., how you configure the obstacles in The Gauntlet™, how many trials to perform, etc.), however, whatever you choose must be presented clearly in your writeup.

3. A description of your general process. What strategies did you try? What worked? What didn't?

4. A link to a youtube video of your robot in action.

In addition to the writeup, you should also turn in your code (a link to a Github repo is fine, or attach it to your submission on Canvas).