UNSW COMP3431: Robot Architectures S2 2011

Assignment #1

Localisation

Due: Start of Lab, Week 12 (noon, Friday 14th October)

1 Overview

This goal of this assignment is to give you broad familiarity with localisation in robots. In particular, in this assignment you will write behaviours to move to a series of locations on the field.

Students will perform this assignment in small groups of up to 4. You are requested to work closely together on the project, developing the code together (rather than using the "divide and conquer" technique of splitting the project into parts, developing the parts separately, and then recombining). Please work in different groups to the groups from Assignment 1. If you have a problem forming groups, please talk to the lecturer in charge as soon as possible.

1.1 Deliverables

This assignment requires you to develop behaviours for a pioneer robot. The compiled code should have been well tested on the robot before the class starts.

During the lab each team will run their code on the robot. The solutions will be compared and graded in the lab.

You will also submit both your source code, and a report in an easily readable format (*e.g.* plain text, html, PDF) describing your approach.

These documents should be emailed to the lecturer in charge.

2 Localise (10 marks - graded in lab)

This section is loosely based on the 'localisation challenge' from the international robocup competition (see `http://www.tzi.de/spl/pub/Website/Downloads/Challenges2005.pdf`).

Before the challenge the lecturer in charge shall choose appropriate landmarks, five points on the RoboCup field and one restart point (and angle). The selected points will be placed on the robot in a file: `points.cfg`. The format of the file has one target point per line, the x coordinate followed by the y coordinate.

The global field coordinates are in centimetres, with the origin in the centre of the field. The x axis points down the long axis of the robocup field in the lab with the

Beacon	x	y
Small	-100	200
Medium	-100	-200
Large	300	0

Figure 1: Locations of beacons on the field.

```
-210 90
220 -150
130 120
-120 -80
270 0
```

Figure 2: A sample list of coordinates

positive direction being towards the back (orange) wall of the lab. When facing the positive x axis, the positive y axis points across the field to the left.

The local robot coordinates are measured from the point on the ground between the drive wheels.

The beacons will be placed on the field at the locations in Figure 1.

Points are guaranteed to be at least 50cm from the nearest obstacle, and at least 100cm from any other point.

The robot performing the challenge must start paused. The referee will move the robot to a point on the field (unknown, but the same for all teams) and then activate the robot by touching its head sensor. The referee will then leave the field area.

Upon activation, the robot shall start moving to one of the target points. When it thinks that it is close to the target point, the robot shall pause itself and indicate to the referee that it believes it is near a target point (perhaps by beeping). At this point the referee will pause the timer, place a small marker underneath origin of the robot. Then the robot will be re-activated and the timer restarted.

The run ends when the robot has had two minutes, or when it has stopped five times. At the end of the second stage, all robot position markers more than 50cm from any field point are disregarded, and if there are multiple markers within 50cm of a single point then only the closest is kept. Teams are then awarded $150 - d$ points for each visited marker, where d is the distance from the marker to the point in centimetres. They are then awarded $5 \times (120 - t)$ points, where t is the total time used in the second stage measured in seconds.

Teams will be ranked as follows: First, they will be ranked by the number of markers they reach (within 50cm). When two teams reach the same number of markers, the score determines their rank.

Another way of looking at the scoring is as follows:

- You start with 600 points.

- You lose 5 points per second.
- You get 100 points for reaching a marker (within 50cm).
- At 5 points per second, this means you need to reach that 50cm circle within 20 seconds to make it worth your time.
- For each 1cm improvement in accuracy you get another point. At 5 points per second, this means you need to increase your accuracy at 5cm/s to make it worth your time.

2.1 Use of others' software

You may use components of the Robot Operating System (ROS). You should write your own Bayesian Filter component (possibly an extended Kalman Filter), and your own robot control component (which maps the output of your Bayesian Filter component into 'twist' messages for the ROS p2os component).

3 Report (5 marks)

Describe the approach used in the previous section. Describe the strengths and weaknesses of that approach.