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CDA 4621 Control of Mobile Robots

Lab 2

**Task 1 Plots**

Figure 1: Plot showing the values reported by the front, left, and right distance sensors for a starting robot orientation of 0 rad (facing directly forward) and kp = 1. Note that the left and right sensors reported almost identical values.

Figure 2

Figure 3

Figure 4

Figure 5

Figure 6

**Task 2 Plot**

Figure 7: Plot showing

**Mathematical Computations**

Task 1

This task required the robot to utilize PID control to move towards the goal while keeping its distance from the side walls. The robot starts at a distance of 50 inches from the end wall and must move forward 40 inches, stopping exactly 10 inches from the end wall. This motion must be completed in 30 seconds. To complete the motion within this time, the robot measures its distance from the goal (using the front distance sensor), and it keeps track of how much time has elapsed since the simulation began. Dividing the remaining distance by the remaining time yields the desired linear velocity V.

PID control is used to keep the robot centered in its path. Let y(t) be the distance from each side wall as measured by the distance sensors. Let r(t) = 3.624 in., the optimal distance from each wall. When both side distance sensors report this value, the robot is directly in between the walls. The error e(t) is given by the equation below:

(1)

The error is positive when the robot is too close to the wall, and it is negative when the robot is too far from the wall.

The motor velocity control function is as follows:

(2)

The constant Kp was determined through experimentation. After testing different starting orientations (in the range of -30 to 30 degrees, inclusive), using 2.5 for the Kp value yielded the best results. This value caused the robot to stabilize its motion and center itself in the corridor fastest, even when starting at an orientation of 30 degrees.

After determining the error for each motor, the two errors are compared to determine which is larger. If the absolute value of the left sensor’s error is larger, the robot is closer to the wall to its left. In this case, the robot’s left motor should be sped up to move it away from the left wall. The new velocity will be the sum of V and the left motor velocity control value. The right motor’s velocity is determined by solving the following equation for vr:

(3)

A similar procedure is used when the right sensor’s error is larger.

Task 2

**Conclusions**