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Group 53 - Wall-Follower

Lab 1 Report - Intro to Embedded Systems

Data Analysis

The bang-bang controller mostly kept the robot at a distance bandCentre. Although it was not always precisely bandCentre away, its average distance away was bandCentre. This is due to it oscillating from one side of the band width to the other. Since, as soon as it gets outside of the band, it will correct to go inside the band (but likely overshoot to the other side). Once on this side, it will again try to go back to the first side (hence the oscillation). For PController, this oscillation was smaller, since it’s adjustment speed was much slower when it was close to the band center. A slower adjustment speed meant that it wouldn’t overshoot the band center (as much).

Observations and Conclusions

On occasion the ultrasonic sensor would display a maximum measurement in-between normal measurements. This could be due to the fact that the sensor was angled at 45 degrees and not all signals were pinged back to the ultrasonic sensor (false negative). This error is filterable. It was filtered by ignoring maximum measurements, unless they were read FILTER\_OUT times in a row (usually FILTER\_OUT = 10). This resulted in these false negatives being ignored by the robot.

There were not any consistent false positives. Although there were other sources of ultrasonic signals (other teams’ robots), they did not appear to affect the robot.

Although it is not an error the ultrasonic sensor would take 2 to 3 seconds longer to start up compared to the motors. This can be corrected by making the motors stay at idle until the sensor activates. This should be implemented into the final project.

Further Improvements

There were many improvements that were made and could be made in the future.

One improvement is to add a condition where if the robot gets too close to a wall, reverse and rotate (rather than trying to speed up and turn faster). This could be added in either PController or bang-bang.

Another improvement is to add another ultrasonic sensor. Rather than having one sensor at 45 degrees forward from the wall, there could be one right at the wall, and one 90 degrees from the wall. The first would maintain a distance from the wall, and the second could tell if there was a wall/corner coming up (so that we could avoid it). The robot would become better at following the wall the more data it had about its surrounding.

Another improvement is the addition of a filter so that the robot can ignore both false negatives and gaps. If the robot reads a max-distance-value, we can choose to ignore it, unless we read it X times in a row. This means that the robot will not react to sudden max values followed by normal values (ignoring false negatives).