EGN 4060C Lab 2: Robot Movement

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The lab consists of four parts:

1. Drive the robot in a square and measure the accumulated distance error
2. Program the robot to drive in an expanding square spiral
3. Driving the robot in a curved trajectory
4. Adapt the expanding spiral behavior to handle bumper events

Two lab sessions have been allocated for you to complete this lab.

1 Part 1: Driving in a square and measuring odometry errors

- Clockwise square: Write a program to drive the robot in a clockwise square by repeating the following sequence of commands 4 times:
  - Drive forward 100cm
  - Turn 90 degrees clockwise
- Measure odometry errors: Start the robot in a known position and orientation and execute the clockwise square program. At the end of the motion, measure the positional displacement. Repeat this five times and calculate the mean and standard deviation of each measurement.
- Repeat this procedure for counter-clockwise squares: Modify your program to drive the robot in a counter-clockwise squares and repeat the measurements.

You will need to report the measurements you take in your lab report.

2 Driving the robot in an expanding square spiral

- Write a drive-and-turn function Write a function that, given a number X, drives the robot forward by X cm, then turns 90 degrees clockwise.
- Drive-and-turn a distance specified by GUI
  - Figure out how to read a number (X) from the text field of the GUI
  - Execute your drive-and-turn function to drive-and-turn X cm
- Write a program to drive in a square spiral [2 points]
  - Read an X from GUI; this is the number of segments in the spiral
  - Write a program that does a sequence of X drive-and-turn segments, with each segment increasing in distance by 10 cm (starting with 10 cm). In other words, drive 10 cm, turn 90 degrees, drive 20 cm, turn 90 degrees, drive 30 cm, turn 90 degrees, until X segments have been driven. The robot should drive in an expanding spiral.
  - Demonstrate your spiral program to the TA.

3 Smooth Curving

Use the `moveMotors` function to make the robot follow a curved route. When you give different speeds to wheels the robot will go forward in a rounded trajectory. [1 point]

- In the while loop, insert a delay function that will make the loop wait every 200ms.
- Call the `moveMotors` function by giving different speeds to the left and the right wheels (ie: 250, 150)
- Keep track of time that passed in the while loop, and when it reaches 4 seconds, switch the wheel speeds to curve the other way.
- Demonstrate your program to the TA.

4 Interrupted Spiral

The goal is to modify the spiral program to respond to bumper press events.

- Modify the drive-and-turn function to respond to bumper presses. When the robot senses a bumper press during the execution of a drive-and-turn segment, it should back up 10 cm, turn 90 degrees clockwise before the function returns. This aborts the current segment but not the overall program. Treat the aborted segment as complete and confirm that your spiral program still works.
- Spiral rewind [2 points] Get the robot to execute the following behavior:
  - Drive in an expanding clockwise spiral (known as an "expansion behavior")
  - If any bumper is pressed, the robot switches to a "contraction behavior". It immediately retreats 10 cm and turns 180 degrees.
  - The robot's goal is now to spiral back towards its start goal. This involves driving segments of decreasing length followed by 90 degree counter-clockwise turns.
  - If a bumper is pressed during the contraction behavior, the robot retreats 10 cm, turns 180 degrees and goes back to expansion.
  - The robot stops either when it completes the desired number of segments in an expanding spiral or when it returns to the start state at the end of a contraction.
- Demonstrate the interrupted spiral to the TA