Assignment 3: Motion
CS 393R: Autonomous Robotics
9/18/2018
Assignment due: 11:59:59 PM Wednesday, October 3, 2018

Your task is to use PID control and motion sequences to approach the ball, align with the goal, and score as many times as you can. This assignment will build off of the previous one, making heavy use of your object detection code to find the ball, the beacons, and the goal.

First, you will write a PID controller to allow your robot to smoothly approach the ball and align to face the goal. Use PID to control the robot's path by adjusting and correcting the x, y, and Θ components of your robot's walk velocity. Try different variants of the PID control (P, PI, and PD) to see which works best. Remember to leave plenty of time for tuning your controllers.

Once your robot is at the ball and facing the goal you should kick the ball as many times as necessary to score. For this portion, you will design a kick as a sequence of keyframes; for each keyframe you will specify 1) the configuration of joint angles for each joint on the robot, and 2) the amount of transition time from the previous keyframe. Your kick should be stable and consistent, and should move the ball as far as possible.

Note that even a well-tuned kick can cause the robot to fall from time to time. **Whenever your robot is kicking, you or your partner must be right behind it to stabilize it in case it starts to fall.**

The ball may be far enough from the goal that multiple kicks are needed to score, so your robot should keep chasing the ball and kicking it towards the goal until it scores. It is acceptable to dribble the ball to get into a better position, but you should not dribble the ball into the goal - this does not count as a kick!

After your robot scores, the ball will be moved approximately 2 meters away from the goal, and your robot can try to score again. This process will repeat as necessary for the entire 10-minute evaluation.

Checklist:

[_____] (2 points) Design a standing kick for the robot using the Motion window of the tool.

[_____] (2 points) Show that the robot can execute the kick and remain standing without assistance.

[_____] (2 points) Show that the kick moves the ball at least .5 meters forward (1 point) or 1 meter forward (2 points).

[_____] (1 point) Identify and walk towards the ball using PID control.

[_____] (1 point) Show that the robot accelerates to maximum forward velocity when the ball is at least 1.5 meters away.

[_____] (1 point) Show that the robot smoothly slows down as it nears the ball.

[_____] (1 point) Show that the robot moves slowly enough near the ball to avoid oscillating or moving the ball inadvertently.

[_____] (1 point) Align the robot so that it is behind the ball and facing the goal without touching the ball.

[_____] (1 points) Score a goal with any combination of dribbling and/or kicking, as long as the ball is not dribbled over the goal line - the final shot must be a kick.

[_____] (2 points) Clarity and quality of your memo. Email it (along with a compressed folder of your code) to Peter and Josiah by the due date.

Extra Credit:

[_____] (X points) One point for each additional goal.

Initials: _____   _____ _____ _____
                              TA   Teammates