Assignment 2: Control: Walk and Kick
CS 393R: Autonomous Robotics

Assignment due: Thursday, September 22, 2011

Your task: Score! Walk up and kick a ball using PID control.

The first task is to program your Aibo to walk towards a ball (up to 8-10 body lengths away) using PID control. Note that the ball can be anywhere with respect to the robot's starting position, so you may need to search for it.

- Use PID to control the whole robot by giving commands to one of the walking engines. You should not be controlling individual joints with PID, nor should you be developing your own walk engine.
- You may want to use the angle of the direction toward the ball (in the body frame of reference) as the error signal. If the head moves around, this could be difficult to determine. But it is easy to bring the head facing forward in its default position
- Try various variants of the PID control (P, PI, and PD) to see which works best.
- Leave plenty of time to experiment with tuning!

Second, on getting close enough to the ball, locate the goal, and position the robot so that it can kick the ball toward the goal. Note that the goal can be anywhere with respect to the robot's starting position, so you may need to search for it.

Third, design your own kick. Take a look at the Tekkotsu tutorial on postures and motion sequences: http://www.cs.cmu.edu/~dst/Tekkotsu/Tutorial/postures.shtml. You can make a number of keyframes using the posture editor, and then put these key frames together in a motion sequence to build a kick.

Fourth, kick the ball toward the goal (with any kick). Ideally, score.

Note that the ball may be far enough from the goal that multiple kicks are needed to score - your robot should keep chasing the ball and kicking it towards the goal until it scores without any human interaction. You should follow the RoboCup rules, where you can't hold the ball under your chin for more than 3 seconds at a time (ie, you can grab it and walk/turn for 3 seconds, but then you must kick or release and walk away for atleast 3 seconds). It is acceptable to dribble the ball to get into better position (following the above rule), but you should not dribble the ball into the goal - this does not count as a kick!

Keep in mind the upcoming penalty shot competition (see assignment 3 for more details) when designing your approaching and kicking strategies.

Write a short but professional memo (one memo from each team, co-authored by all team members), concisely but clearly describing what you did, what problems you encountered, how you overcame them, and how successful you were in the end. Make sure to compare your PID controller against what you did for Assignment 1. Also be sure to briefly describe the contributions that each team member made to the final outcome.

Checklist: (grades will be calculated out of 12 pts, so there are 2 pts of extra credit available)

[_____] (1 point) PID formulation (specify error signal and how it is obtained)

[_____] (1 point) Find the ball

[_____] (1 point) Walk successfully towards ball using PID control.

[_____] (1 point) Stop/slow down when close to the ball.

[_____] (1 point) Find the goal

[_____] (1 point) Position robot so that the ball and goal line up

[_____] (2 points) Design your own kick

[_____] (1 point) Kick ball towards goal.

[_____] (0-2 points) Kicking success: (four tries, 0.5 points for each goal scored)

[_____] (2 points) Clarity and quality of your memo. Email it (along with a compressed folder of your behaviors and motion files) to Peter and Katie by class on Sept 22.

More Extra Credit:

[_____] (1 point) If the robot detects that the ball is at a **very** skewed angle with respect to the goal, then kick the ball into a better position and score.