RoboCup Soccer: Approaching the Ball

Josh Imhoff, 2015

I am a member of the Northern Bites RoboCup team at Bowdoin College. RoboCup is an international robotics competition where teams of autonomous robots compete in games of soccer. We compete in the Standard Platform League. We program toddler-sized humanoid robots (whose hardware we cannot modify in any way) called Nao’s to play soccer. This summer I worked on approaching the ball to setup for kicks efficiently and accurately.

Approaching the ball is one of the most important problems in RoboCup soccer. Speed is important, as the longer it takes to setup for a kick the more likely it is that your opponents will stop you from kicking. Accuracy also matters; nothing is more embarrassing then walking through the ball or whiffing when trying to kick. On top of that, many RoboCup teams (including the Northern Bites) use a keyframe approach to kicking. This means that kicks do not adjust to the ball’s position because kicks are modeled as static movements; instead we have to approach the ball in such a way that we are perfectly setup for the kick we plan on executing (so that we are in the “sweet-spot” of the kick).

This summer, I spent most of time with B-Human’s (2010, 2011, and 2013 RoboCup SPL champions) walking engine. We have used B-Human’s walking engine for the last two years. After reading through much of the walking engine code, I realized that three major improvements could be made to approach ball:

1. BHWalkingEngine allows a robot to approach the ball by setting a speed vector in cm/sec (what we used to do to approach the ball) and by setting a destination vector in cm away from the robot (what we now do to approach the ball). By approaching the ball via destination walking, BHWalkingEngine is able to clip steps to the destination, meaning we will never step past the location of the ball on purpose. Because precision matters so much in approaching the ball, pedantic mode is also on, so that we won't increase or decrease step size very much to balance the robot when trying to setup for a kick.
2. In the old approach ball, we would not stop setting up for a kick until we were at the perfect distance from the ball – not too far and not too close. We now only require that we are close enough to the ball to kick it; we do not worry about being “too close.”
3. We now have the option of doing a special kind of kick called a motion kick. This is a feature of BHWalkingEngine that was not enabled when we ported the walking engine over two years ago. Motion kicking allows our robots to do simple kicks that adjust to the ball’s actual location while walking. We therefore do not need to approach the ball as precisely to successfully kick it with this method. Kicking is also much faster.

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