Simulating Behavior on a Mobile Robot

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In the context of RoboCup, a robot’s behaviors system takes information about the state of the world around it, for example, visual information from the robot’s cameras, where the robot thinks it is on the field, sensor data, and data about the other robots in play, and outputs the next action the robot will take, for example, walk to the ball, kick the ball, position for a pass, etc. Developing and testing a behaviors system can be difficult because the input data can be unreliable and recreating specific complicated game situations can be time consuming and/or difficult. In order to solve these issues and promote greater progress in the behaviors system I sought to create a simulator to run the behaviors code.

The simulator displays the robots and ball as circles on the field. The players and the ball can be dragged to any place on the field so that any situation can be easily created. Each player is given perfect information regarding every detail about the game so that bad input data cannot be blamed for bad behavior. Using this simulator I spent the rest of the summer developing and testing new behaviors.

I first used the simulator to work on a path-planning algorithm. Before kicking the ball a robot needs to be facing the place it wants to kick the ball. Instead of walking to the ball and then facing the kick direction, it is faster to walk to the ball in such a way that the robot is already lined up when it gets to the ball. Using the simulator I was able to implement what is called a potential field path-planning algorithm. Essentially the potential field creates a smooth curve from any point in space toward the kick position. The robot simply walks the vector produced at its point in space relative to the ball. Because the robots were often injured and so few of them walked well before they were repaired at competition, it would have been very hard to test this code without a simulator.

The next large project the simulator helped develop was a new positioning system. I designed a system in which the defenders were coordinated so that if the ball was on the left side of the field, the left defender would position near the ball while the right defender would protect the goal and vice versa. The mid-field player always follows the ball and the striker player positions between the ball and the goal waiting to score. Running 4 robots on the field to test this would be a major undertaking for one person to do so the simulator simplified testing greatly.

In addition to these two large developments, I was able to make many smaller changes as well as debug the existing code at a much faster rate than was previously capable.

The Northern Bites source code can be found athttps://github.com/northern-bites/nbites

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