Coaching Interface for Robot Positioning

RoboCup 2013 SPL Open Challenge Entry

The UPennalizers, University of Pennsylvania

Motivation:

The ultimate goal of RoboCup SPL League is to develop robot soccer techniques to the same level as human soccer. As the skill level of single player and team strategy are the two most important success factors in real soccer games, the behavior of single robot and the team coordination between multiple units play a crucial role in RoboCup games. One difficulty in developing a better behavior model lies in the complexity of the game environment: the situation on the field is changing frequently and cannot be predicted, so it is hard to pattern match every possible situation and decide robot movements. To solve this problem, we propose a coaching interface approach: instead of arbitrarily setting the role and position of a robot on the field, developers can now be soccer coaches. They can manually control the robots to play a game, during which the robot can learn how to play through machine learning. For the purpose of Open Challenge, we narrow the problem to two tasks: one is to teach a single robot to take the most appropriate path to approach a ball (single robot behavior); the other is to teach a team of robots to position themselves at the most effective place on field (team cooperation).

Methodology:

To implement the coaching interface, we use joysticks to remotely control the Naos. During the learning process, when a robot is moving on the field under human control, it will record related data including: its moving trajectory, the relative position of the ball and goal posts, etc. Then a standard supervised learning approach will be applied to the training set and generate a Gaussian mixture model for robot moving trajectory. This model will be applied to the robot and generate best ball approaching strategy during games.

For the team cooperating task, we initially have all robots playing attackers, a role that is always trying to chase the ball and shoot a goal. Robots at this stage are more like children first learning playing soccer and do not have any sense of team yet. During the training process, we remotely control some robots to stop ball chasing and move to supporter or defender positions. Robots will record ball relative positions and teammates positions during the training and all training sets will be combined to learn a decision tree for best team strategies. The learning result will then be applied to all robots and they will be able to get positioning decisions based on their current position and ball information.

Demonstration Plan and Expectations:

In the presentation we will compare the robot behaviors before and after the learning for both tasks. For each of the task, we will first run robots without any learning. Afterwards we will show the learning process. Since it takes time to finish supervised learning on scene, we are planning to videotape the process and fast play it in the presentation. Finally we will run robots with learning results loaded, where some obvious differences are expected. For the single robot task, before the learning, the robot will directly go to the ball, orbit around it and kick it to the goal. After the learning, it should be able to take a curved approaching path that is faster. For the cooperation task, before the learning, all robots on field will chase the ball at the same time. After the learning, we expect to see only one robot follow the ball while the others are trying to take a supporting/defending position so that the whole team can make better use of the open space on the field.