Offensive Positioning Based on Maximum Weighted Bipartite Matching and Voronoi Diagram

AUT Parsian Article for RoboCup2014 2D Soccer Simulation Free Challenge

Positioning:
- Finding the best target position for agents who do not possess the ball regarding the field situation and team strategy.
- Great importance in a soccer match, either in defensive situation or in offensive situation.

Offensive Positioning:
- The case when one agent of us owns the ball, all the other agents of us should modify their position in field in order to increase the chance of receiving pass from the ball owner and increase the scoring chance.

2D Soccer Simulation:
- A multi-agent system that our agents do not have the limitations of real robots in their movement
- The maximum acceleration and speed of movement of agents, and the similar energy factor of humans are simulated by the stamina factor and other parameters in this simulated environment.

➢ Therefore, considering the stamina and smooth movement in positioning is a crucial task.
➢ In general the solutions to agents' positioning problem within the simulation leagues are more elaborated and computationally complex in comparison to solutions within hardware leagues due to the more reliable world model and less motion and low level control considerations within the simulation leagues.

Delaunay Triangulation Based Positioning:
- In 2008 Hidehisa Akiyama and Itsuki Noda used Delaunay Triangulation of the field depending on the ball position to determine the agents' positions.
- A representative set of potential ball positions are the vertices of these triangles and in each potential ball position we can set the positions of all of our agents.
- During the match the positions of the agents are determined by an interpolation method between the vertices of the triangle in which the current position of the ball lies.
- This method has shown a great performance and was adopted by most of the teams participating in Soccer Simulation League of Robocup Competitions in recent years.
- One of the benefits of this method is its simplicity in implementation and initialization by the developer, since it can be done by a visual software namely fedit provided by Hidehisa Akiyama and all the considerations of smooth movement of players between positions can be handled by the human intuition operation in a visual manner.
- But this method has a major defect that it does not consider the opponent agents and is static with respect to opponent players.
- Due to recent defensive skill advancements and strong marking skill of Soccer Simulation Teams, receiving passes in the opponent's penalty area and making scoring chances requires a dynamic positioning regarding the opponent's agents to escape their marking skills.

Voronoi Based Positioning:
- Offensive positioning by applying Voronoi Diagram of opponent's agents and Maximum Weighted Bipartite Matching.
- Considers the vertices of the defending team agents' Voronoi Diagram as potential positioning points for attacking team agents, since they have a good and safe distance from all the defending players and positioning in these points increase the chance of receiving passes by teammate agents.
- Then makes a bipartite graph, assuming these points on one side and attacking team agents on the other side, so our problem reduces to an assignment problem to determine which agent should choose which vertex to take position on.
- Besides, Soccer Simulation environment is a multi-agent system in which we have an increased chance of decision conflicts when each agent applies the algorithm and reaches to a conclusion individually, due to the limitations and uncertainties in each agent's information of the field situation gathered by its sensors.
- For this reason in the implementation of this algorithm one agent which has the best and most confident information of the field applies the algorithm and informs the other teammate agents of the result by the "say ability".