

# Multi-Agent Collaboration with Semi-Static Formation

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## Abstract

The Robocup initiative was started in an attempt to foster AI research by providing problems where a wide range of technologies can be implemented integrated and utilized to provide solutions.

Our first approach to the first Pacific Rim Series of the ROBOCUP AI research is one, which utilize multi-agent collaboration. Using Strategically positioning, specialist roles, individual player responsibilities and a barrage of interesting research result based on both real soccer and server soccer we have developed our client's behavior in hope of excelling in this dynamic environment.

## 1. Introduction

For the actual simulation league competition, all participants are required to complete through the soccer server using their client programs. There have in fact been many successful client implementations, namely the *Robot Learning Based on LfE Method* by Asada *et al*, *Generic Programming* by Luke *et al*, *Decision Tree* by Stone *et al*, etc. We decide to focus on the work of Matsubara which implements *Multi-Agent Collaboration* which is similar to the teamwork structure often found in successful real life soccer teams.

The following sections below describe the behavior of our primary agent framework.

## 2. Team Structure

The team consist of 11 agents formed up in the *Semi Static* 4-3-3 formations (4 defends, 3 mid fielders, 3 strikers). These will later be broken up further into more specialized roles and functionality for every individual player just like real soccer <further explained in the roles and responsibility section>.

Our terminology of *Semi-Static Formation* means that the mid fielders are not confined to the mid field as their area of play but will instead continuously capture the ball data and react to it by changing their position in the playing field.

Also like actual soccer, players have an initial start up position i.e. position before kick off. This has been thoroughly experimented via trial and error to give an initial start position that will allow the players the fastest access to their pre-assigned strategic default position once kick off has been initiated.

The strategically position assigned to each individual is then later combined with on field communications to result in the offensive and defensive playing tactics.

### **3. Roles & Responsibility**

Each agent has been assigned to a certain role in the field and is totally indispensable if the team is to reach its maximum playing capacity. Every individual role is broken down and explained below:

<u>General Role</u>	<u>Specialist Role</u>	<u>Responsibility</u>
Goalkeeper	-	To prevent goals from being scored by placing himself between goal and ball.
Defender	Sweeper	The job of the defender is to prevent any opposition from attempting any attack on our goal. The Specialist defined herein or the <i>Sweeper</i> has the job of acting as the secondary goalie as well as to judge incoming offense. If the sweeper rules that the incoming offensive is too dangerous then it will attempt to clear the ball away by kicking it out of the playing field. Else it will only act as a normal defender positioned extremely close to the goalie to help out with the goal keeping. Defenders are also responsible for homeside <i>kick-ins</i> .
Mid Fielders	-	The primary goal of the mid-fielder is to feed balls to the attackers as well as provide support to the defense in times of need. The mid-field is also responsible for <i>kick-ins</i> on the opponent side. Lastly, mid-fielders are also supposed to react to the changes to the current ball position and change tactics. This is to either overbear the opponent defense or to provide support for defense on the homeside.
Attacker	<i>playmaker</i>	The goal of the attackers is to score goals. They will also hard press opponent defense for ball possession. The <i>play-maker</i> will be the deciding factor as to how each offense can be implemented as he will be controlling the ball most of the time.

## **4. Behavior**

### **General**

Using Strategic Positioning we have placed our players at certain nodes or position in the playing field then we have assigned every player with a certain zone that they are *in-charge* of. We have found that this tactic helps to conserve stamina greatly.

Players are also programmed with a anxiousness factor. This is reflected when the time counter reaches close to maximum and the team is still lagging in goals. Under the following condition the team will go all out in an attempt to equalize or win in goal scores.

The team will also broadcast whatever it sees continuously to its team mates. This is to ensure that all the players will know the position of the ball so that they can face it continuously. The broadcasting will also help to allow efficient passes which is essential for carrying out all essential strategy.

### **Attacker**

We have on the playing field defined certain shoot zones. This shoot zone have been specially allocated to concentrate all offensive on the sides as experiments have shown that attacks based on the left and right flanks have higher probability of success.

The attackers have also been program with this instinct of chasing after all balls inside the penalty area. Again this will greatly increase the odds of scoring.

The play maker is made with the ability to dribble the ball and make efficient passes to the other attackers to help them to score goals. He will also be the one to initiate the strategies and various tactics for offensive play,

### **Defender**

The sweeper uses current ball data <either those he observed himself on the field or those that others communicates to him> to decide if the incoming ball poses a great threat to the goal or not. His directives are simple. Go all out to clear the ball away even if it means kicking it out of the field if the ball poses a threat. This is especially useful for stopping attacks targeted at the hard to save angled attacks.

The defense will also use offside trapping, although it is a very ungentlemanly mode of play but then by shifting the defenders upwards we can stop all opponent ball passes. Due to its ungentlemanly nature it will only be used as a last resort defense plan.

### **Mid-field**

The midfields are programmed to ensure that the opponents will not deliver the ball over to our side to threaten our defense. Mid-fielders are also assigned the role of backing up the attackers during offense and defenders during a time when the goal is threatened.

This tactic is implemented using a semi-static formation where the player will receive, analysis the current ball position and change their positioning in the field to suit the needs of different playing methods.

## **5. Conclusion and Future**

In the above paper we have presented our ideas at implementing the multi Agent collaboration based on strategically position and individual roles and responsibility. Everything has been modeled as closely as possible to an actual soccer team and the whole team is now similar to an colony of ants where everyone is indispensable and has to work together for maximum efficiency. Everything presented herein is accurate up to the time of press. In the future we hope that we can further on the communications between the agents to maybe even to the extend of "stealing" information from opponents and from this information deprive their tactics. Finally, we hope that we can fully implement the formation scheme to one that is totally dynamic!

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