SFUnleashed Team Description

Purpose: Simulated soccer competition pre-registration

Team Name: SFUnleashed

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We are representing the newly established School of Interactive Arts & Technology at Simon Fraser University, Surrey, BC Canada.

The SFUnleashed team builds on the extensive research done by the project participants since the summer 2001 and the more than 20-year experience of the project leader in defense systems simulation and spatial/temporal signal processing. In this version, we reused some low-level solutions from the publicly available UvA-2001 team [1] and have made several significant enhancements to it. We also have acquired and improved some ideas from other high-performance teams, such as CMUnited'99 [2] and FC Portugal 2000 [3].

While creating SFUnleashed'03, we pursued two objectives:

1. processing coordinate information with higher precision, and
2. improving the agent/player behavior model.

The first direction of our research has resulted in the better accuracy of agent self-orientation and moving object parameter estimation algorithms. This resulted in a statistically significant score difference gain while the prototype simplified UvA team was playing against itself. Full description of the research results is given in the paper submitted to the RoboCup 2004 Symposium – "Optimizing Precision of Self-Localization in Simulated Soccer Agents" by Vadim Kyrylov, David Brokenshire, and Eddie Hou

Since the second direction is challenging by the growing complexity, we have contained it in a systematic way, by using a multi-level agent behavior model architecture. Each of total five levels of abstraction in this model is responsible for sets of tasks involving different number of players and having different time horizons:

3. atomic action control level (1 simulation cycle),
4. individual player tactics control level (several cycles),
5. group tactics control level (about a dozen cycles),
6. dynamic whole-team effort management level (several dozen cycles), and

7. static whole-team effort management level (about 1000 cycles).

Each level is characterized by its own set of actions, situation assessment criteria, and a decision making procedure for rational action selection. Higher-level actions are regarded by the immediate lower level as objectives and/or constraints for decision making. Level 0 actions are the elementary commands passed by the player/agent to the Soccer Server.

By default, each level execution calls are invoked with regular time intervals, ranging from one simulation cycle on the Level 0 to hundreds cycles on Level 4. Each level assesses the situation, selects the most appropriate action(s), and passes the execution results to the immediate lower level. The latter uses these results as the goals for new action selection or continuing the action started earlier. The situation assessment activity includes making decisions about the feasibility of goals set by the immediate higher level. If current goal cannot be reached, an execution request is sent to the higher level for re-assessing the situation and the goal update.

This control architecture allows to execute higher-level tasks only when it is really necessary, which significantly reduces the design and implementation complexity. Compared to the approach used by most known simulated soccer teams [1,2,3], who were trying to put everything into single simulation cycle, our method is more computationally efficient. Higher-level task execution on the "need to run" basis only, rather than in each cycle, also contributes to the agent behavior control process stability. In particular, this reduces the likelihood of abrupt changes in the agent, group, and team intentions caused by random factors.

The most recent research is about using the ideas of reflection and active positioning. Reflection means that an agent can predict short time behavior of teammates and opponents using rules, based on its own decision-making mechanism. The level of the reflection is the subject for the research. Active positioning is a new feature of the team. The positioning in previous version of the team was rule-based and depended on ball location and agent's home position only. Now, some elements of decision-making mechanism for positioning are presented.

The team participated in two RoboCup events in the year of 2003. In American Open 2003, the first official competition for the team, rather good level of game quality was shown. SFUnleashed'03 won several games (6^{th} place in the competition). In WorldCup 2003 in Padua the team appeared in the second round and won the 3^{rd} place there. In both events the team showed itself as the best team in America.

Recent experiments run on some published top-tier RoboCup-2003 teams have indicated that our approach is indeed promising. We hope to fine tune SFUnleashed team performance before the RoboCup 2004 in Lisbon.

[1] R. de Boer & J. Kok, (2002) The Incremental Development of a Synthetic Multi-Agent System: The UvA Trilearn 2001 Robotic Soccer Simulation Team. M.S. Thesis. Faculty of Science, University of Amsterdam, 199 pp.

[2] Stone, Peter (2000) Layered Learning In Multiagent Systems : A Winning Approach To Robotic Soccer. MIT Press.

[3] RoboCup 2001: Robot Soccer World Cup V. Andreas Birk … (ed.) – Berlin et al. Springer, 2002.