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RoboCup: The Robot World Cup Initiative

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The Robot World Cup Initiative (RoboCup) is an attempt to foster AI and intelligent robotics research by providing a standard problem where wide range of technologies especially concerning multi-agent research can be integrated and examined. The first **RoboCup** competition is to be held at IJCAI-97, Nagoya. In order for a robot team to actually perform a soccer game, various technologies must be incorporated including: design principles of autonomous agents, multi-agent collaboration, strategy acquisition, real-time reasoning, robotics, and sensor-fusion. Unlike AAAI robot competition, which is tuned for a single heavy-duty slow-moving robot, RoboCup is a task for a team of multiple fast-moving robots under a dynamic environment. Although RoboCup's final target is a world cup with real robots, RoboCup offers a software platform for research on the software aspects of RoboCup. This paper describes technical challenges involved in RoboCup, rules, and simulation environment.

RoboCup as a Standard AI Problem

We propose a Robot World Cup (RoboCup), as a new standard problem for AI and robotics research. This is a proposal to use a soccer game as a platform for a wide range of AI and robotics research, such as design principles of autonomous agents, multi-agent collaboration, strategy acquisition, real-time reasoning, and sensor-fusion. Every year, AAAI hosts the robot competition for a single autonomous robot. Although the task of the AAAI competition changes every year, it is designed for a slow-moving and heavy-duty single robot. The goal of the RoboCup is the opposite. RoboCup aims at providing a standard task for research on fast-moving multiple robots, which collaborate to solve dynamic problems. Although RoboCup's final target is a world cup with real robots, RoboCup offers a software platform for research on the software aspects of RoboCup. In addition, we intend to create an award for an expert robot, which demonstrates a high-level of competence for a specific task, such as shooting, intercepting, etc. Thus, RoboCup consists of three competition: the real robot competition, the software robot competition, and the special skills competition.

Standard AI problems have been the basic driving force for AI research. Research on computer chess, which is the most typical example of a standard problem, lead to the discovery of various powerful search algorithms. Other problems including, the Yale Shooting Problem and the Monkey-Banana, contributed to AI research by illustrating the essential difficulties involved in everyday reasoning. Criticisms against using such problems often focus on the fact that these are abstract tasks, which ignore essential difficulties of real world problem solving. Proponents of such criticism argue that the real world problem must be the target of serious research. While there is truth in such a claim, solving real world problems inherently involves domain-specific constraints and often social and economic constraints, which are not necessary common in other domains. In addition, research on usable real world systems are beyond the manpower and funding of many research groups. This hampers comparative studies of techniques for real world tasks.

The RoboCup is designed to meet the need of handling real world complexities, though in a limited world, while maintaining an affordable problems size and research cost. RoboCup offers an integrated research task covering the broad areas of AI (significantly, multi-agent domain) and robotics. Such areas include: real-time sensor fusion, reactive behavior, strategy acquisition, learning, real-time planning, multi-agent cooperation and coordination schemes, context recognition, vision, strategic decision-making, motor control, intelligent robot control, and many more.

We are currently inviting participation to this initiative, in order to define rules of play, develop a common research environment, and to host competitions and workshops. Those who are interested in RoboCup, please send e-mail to RoboCup@csl.sony.co.jp. Or write to: Robot World Cup Initiative (RoboCup), c/o Hiroaki Kitano, Sony Computer Science Laboratory, 3-14-13 Higashi-Gotanda, Shinagawa, Tokyo 141 Japan.

Finally, the first **RoboCup** competition is to be held at IJCAI-97. Beforehand, a preliminary competition is to be held at International Conference on Intelligent Robots and Systems (IROS96) in Japan in November 1996. Therefore, we hope to be able to present some significant results from the pre-competition at the occasion of ICMAS'96, which will probably stimulate many multi-agent researchers.