

Executive Summary of the Dagstuhl Seminar 06251

Uwe Schwiegelshohn, Walter Nistico, and Matthias Hebbel

Robotics Research Institute
Universität Dortmund
Otto-Hahn-Str.8, 44221 Dortmund

The Dagstuhl Seminar on Multi-Robot Systems (06251) was held in June 20-23, 2006. It had the goal to bring researchers together from different areas of robotics to discuss current research topics on autonomous and interacting robots. The technical focus was on perception, behaviors, learning, and action. The seminar took directly place after the RoboCup robot soccer competitions and the subsequent symposium in Bremen. Thus researchers from many different countries were able to join the seminar and address issues without taking into account upcoming competitions or events.

The seminar consisted of brief presentations by many participants and extensive discussions on three issues of general interest:

- A comparison between formal and empirical methods in robotics
- Multi-robot systems with teams of homogeneous robots versus teams of heterogeneous robots
- The benefits of standard versus customizable hardware platforms in robot soccer

Reflecting the many different research issues in multi-robot systems, the talks presented a large number of different topics. A strong emphasis was on various modeling aspects while other presentations covered subjects from the analysis of human soccer games to the design of robot platforms that are well suited for robot soccer.

All discussions were very vivid. Some of presented results in the area of behavior specification for multi-agent systems led to first discussion about advantages and disadvantages of formal and empirical methods in the field of robotics. In general, it has been agreed that in new research areas, it is easier to start with empirical approaches and validate the results achieved through experiments and statistics. However, for certain systems, an empirical validation of the system and determination of its reliability are not possible either due to high costs (complex autonomous vehicles) or the consequences of a failure (autonomously guided nuclear power plants). In those cases, formal methods can help to find upper and lower bounds or even optimal solutions in some situations. However, this kind of analysis is often time consuming and in many cases the theoretical optimality of a method can not be proved for a long time, if at all.

As multi-robot systems consist of several individual robots, it must be decided whether those robots must all be identical or whether they may differ from each other. Conceptually, heterogeneous systems have advantages if there is shortage of resources such that each individual cannot be equipped with all possible features. However during the discussion, nobody was able to present an application for multi-robot systems where heterogeneous robot teams are clearly advantageous provided the cost factor is neglected. Moreover, the design and maintenance of homogeneous systems generally appears to be easier and cheaper. Only if a complex task can be decomposed in a strictly sequential series of smaller jobs, specialized heterogeneous robots can be more effective, like for example in the assembly line of a factory.

Due to the end of production for the popular “Aibo” robot, that presently is the only standard hardware platform in RoboCup, a discussion emerged about the benefits of standard versus customizable hardware platforms in robot soccer. This was specifically targeted on humanoid robot soccer and the potential successor of the “Aibo” that has been presented at this seminar for the first time. In the discussion, it turned out that it is still too early for the humanoid league to propose a standard platform as too much research is necessary to improve the hardware of the robots and determine a suitable platform. In general, a custom hardware design gives the advantage of

creating a robot specifically for the desired task and therefore to overcome the limitations of commercially available solutions. On the other hand, standard platforms are usually cheaper and put a greater emphasis on software development. Thus they allow a better comparison between different algorithmic approaches.

In general, all participants agreed that the seminar was very fruitful and would like to thank the staff for their extensive support.