

Multi-Robot Teaming Challenge Contribution Proposal (IJCAI 2009)

SMRT 2009

The SpaceMaster Robotics Team (SMRT), consists of students Jürgen Leitner and David Leal, both master degree students in the 'Joint European Master in Space Science and Technology' (www.spacemaster.eu), and currently doing their master's thesis on Multi-Robot Cooperation for the Helsinki University of Technology and the Luleå University of Technology (the program is a double degree). Jürgen Leitner is currently doing a part of his thesis work in the University of Tokyo, Japan, as an exchange student.

We would like to contribute to this year's IJCAI 2009 Robotics Exhibition and Workshop Multi-Robot Challenge by presenting our master's thesis in this event, which will consist of one simulation and one real robot implementation, both in multi-robot systems.

Project Descriptions:

Reconfigurable Multi Robot Society based on Lego Mindstorms Robots

This project is an implementation of a reconfigurable multi robot society, which will consist of four to six independent, *homogeneous, mobile [1]* units that will be able to reconfigure themselves to reach a goal outside the reach of a single unit. This Society will be a *decentralized, deterministic[1]* system, as all the units will be capable of communicating to each other and selecting from among themselves a unit that will lead or coordinate all the other units in the region to achieve this reconfiguration and goal at hand.

The demonstration will consist of a group of units that will be heading towards a general direction and will bump into a big step, a step that none of the units would be able climb on their own. The units will then merge and transform into a unit that will

take all of them to the higher ground, enabling them to continue their on their way to their destination.

The implementation will be made with Lego Mindstorms NXT units to be able to produce a fast, low-cost prototype of the system, as the team already possesses a number of NXT systems available.

Multi-Robot Cooperation

This project consists of research of algorithms for multiple robots doing area coverage. The aim is to develop some machine learning approaches to dynamic changes during the mission (e.g. changes of formation that might be needed due to e.g. failure of one robot).

The solution should be able to be used with rovers (for planetary exploration) and satellites.

A simulation and maybe implementation (depending on robot availability) of a marsupial [2] robot system with area coverage is currently being evaluated.

In this moment both systems are under design and are scheduled to be completed around this summer (around June 2009), as they will be Master's thesis of the participant and deadline must be met, So by the time IJCAI 2009 takes place, both systems will be finished.

[1] Yim M., Shen W-M, Salemi B., Rus D., Moll M., Lipson H., Klavins E., Chirikjian G. S., (2007) "[Modular Self-reconfigurable robotic systems](#)", IEEE Robotics and Automation Magazine, Vol. 14 No. 1, pp. 43-52.

[2] Cao, Y. U., Fukunaga, A. S., and Kahng, A. B. Cooperative mobile robotics: Antecedents and directions. *Autonomous Robots* 4 (1997), 226-234.