Jürgen Leitner

currently at:
Sakura House Uguisudani B, 404,
2-17-1 Negishi Taito-ku 110-0003
Tokyo, Japan

Helsinki University of Technology
Department of Automation and
Systems Technology

jleitner@cc.hut.fi

Project Description

Prepared for: Luleå Tekniska Universitet Application Form, Master Thesis Project
Prepared by: Jürgen Leitner

Multi-Robot Formations for Area Coverage in Space Applications

My Research will be in the field of swarm robotics where I will try to investigate algorithms for area coverage problems. The solution should be general enough to cover satellite (for the University of Tokyo) as well as rover (TKK) applications. Use could be manifold (depending on the definition of "coverage"), e.g. cameras in satellites, radio networks for multi rover environments.

I will start with developing strategies strategies to cover a given area by a given number of coverage zones, which might vary over time or can vary its reach depending on e.g. altitude or antenna power. At the beginning the goal will be to cover a convex area with simple shapes (most likely circles), later on, depending on progress, difficulty, time and use, more difficult shapes and non convex areas (e.g. obstacles in the line of sight) will be added. Also of interest is a measurement of how optimal the coverage is and optimize the positioning (e.g. various ways to do this should be investigated including genetic algorithms), this could be in terms of overlap or fluctuation (e.g. changing coverage areas of each unit) or limited resources (e.g. rover energy/movement, satellite fuel). Another possibility for extension is a time varying target area, which would represent e.g. a continues ground scan by the satellites with changing scan widths.

Implementation of the algorithm will also be part and might take some time especially with coordinating all the needed (software) packages as well as tools used at TKK and the University of Tokyo.

During my 3-month research stay in Japan I plan to do the following:

✳ Literature Review

✳ Define the boundary conditions more closely

✳ get information on: Multi satellite formation flying

✳ Investigate Multi-Robot/Satellite simulation possibilities *(GIM simulator, ISSL simulator, and maybe look at completely different ones)*

✳ look into Multi-Agent Frameworks (especially the ones used at TKK)