Obligatory assignment 2 in TEK5010 Multiagent systems 2020

Report delivery date November 10 by e-mail to hjmoen@its.uio.no.

The report should contain answers to all the questions, include discussions on simulation results in the form of graphs, tables or figures, and an appendix with the simulation program code. The report should be delivered as a pdf file. You can use any programming language of your choosing for this oblig.

Search and task allocation in multiagent systems: Game theory

Background

In the obligatory assignments in this course we are going to explore Search and Task Allocation (STA) problems in multiagent systems (MAS). STA problems are considered a general class of problems in MAS and many real-world problems could be formulated as a STA problem. See Ijspeert et al. for an example of STA modelling in swarm robotics [1].

In the first oblig we are going to study STA in relation to reactive agents, i.e. swarm intelligence, and in the second oblig we are going to employ strategic agents, i.e. game theory, for solving the same STA problem. The goal is to analyze how these two MAS concepts differ and to understand when it is appropriate to employ the different algorithms under varying STA conditions. The main focus will be to analyze how the agents' ability to share information affects system performance in STA problems.

Definition of the search and task allocation problem

The *search area A* is a bounded square spanned by the two points (0, 0) and (1000, 1000).

The *tasks T* are randomly distributed over the search area. As soon as a task is completed a new task is spawned at a random position in the search area. The tasks have a task capacity *Tc* indicating how many agents that are required to solve a task, e.g. *Tc*=3 means that 3 agents are required to solve the task. The task is automatically completed if *Tc* agents are within the task radius *Tr*.

The *agents R* move randomly around the search area at a speed *Rv*. When an agent is inside the task radius *Tr* of a task, the agent will stop and wait for other agents to complete the task. The agent could also call for help by engaging in communication with nearby agents. The communication distance *Rd* determines the information sharing process between agents, e.g. *Rd*=250 means that any agent that is within distance of less than 250 from the agent will hear the communication signal. The information communicated and corresponding response will depend on the STA condition and choice of MAS algorithm employed.

Questions

a) In this oblig 2 a simple auction is to be implemented in the STA problem. Every time a new task is discovered an auction is to take place among the agents within communication range. The agent who discovered the task is the auctioneer and the bidders are the helping agents. The helping agents use the distance to the newly discovered task as their bid in the auction. The auctioneer will recruit helping agents based on their bid in order to have enough agents to solve the task (including the auctioneer). Could you implement such a simple auction and test it using parameters *T*=2, *Tr*=50, *Tc*=3, *R*=30 for communication distance *Rd*=0, 100, 200, 300, 400, 600, 1000 and 1400?

b) Compare your results to the results obtained in oblig 1 e) and f). Comment on your findings.

c) If a strategic agent cost twice as much as a reactive agent, could you plot a graph comparing the two system designs? Comment on your findings.

References

[1] Auke Jan Ijspeert, Alcherio Martinoli, Aude Billard and Luca Maria Gambardella, "Collaboration through the exploitation of local interactions in autonomous collective robotics: the stick pulling experiment", Autonomous Robots 11, 149–171, 2001. https://doi.org/10.1023/A:1011227210047 or http://people.idsia.ch/~luca/AR2001.pdf

[2] Jørgen Nordmoen, "Detecting a hidden radio frequency transmitter in noise based on amplitude using swarm intelligence", Msc, NTNU, 2014.