CAS master thesis proposals 2022:

Quorum sensing in multi-robot systems (long or short thesis)

Multi-robot system performance can be evaluated and benchmarked in generalized search and task allocation problems (STAP) [1]. In STAP robots search for tasks and recruit other robots to help solve and complete the discovered tasks. Multi-agent coordination algorithms, like swarm intelligence and game theory, are of special interest when assessing multi-robot system performance in STAP. Also, system dimensions like the ability of inter-robot communication, robot computing power and unit design cost can be simulated and tested using this benchmark problem. It would be interesting to research if there exist any swarm behaviour that could approximate the optimal game theoretic coordination algorithm in terms of system performance in STAP? A strong candidate would be to analyse quorum sensing mechanisms in this context, e.g. estimating swarm density using collision frequency or some signal aggregation. Consequently, this thesis would evaluate system performance when comparing quorum sensing mechanisms to the optimal auction algorithm in simulated multi-agent STAP. The simulated results could be validated in the ITS robot lab using up to 20 TurtleBots.

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[1] M. Minos-Stensrud, H. Jonas Fossum Moen and J. Dyre Bjerknes, "Information sharing in multi-agent search and task allocation problems," 2021 IEEE Symposium Series on Computational Intelligence (SSCI), 2021, pp. 1-7, doi: 10.1109/SSCI50451.2021.9660121.

Analysis of human avatars in multi-agent systems (long thesis)

Generalized multi-agent systems can be evaluated and benchmarked in stylized search and task allocation problems (STAP) [1]. In STAP agents search for tasks and recruit other agents to help solve and complete the discovered tasks. Multi-agent coordination algorithms, like swarm intelligence and game theory, are of special interest when assessing multi-agent system performance in STAP. However, these algorithms do not fully generalize all aspects of natural cooperative systems, especially in the case when agents are self-interested. In this thesis the master candidate would investigate how humans would guide and steer agents as avatars in STAP. By controlling for relevant system parameters, like inter-agent communication, agent computing power and unit design cost, novel coordination algorithms could possibly be discovered when analysing the avatar behaviours. The assignment requires the development of a suitable man-machine interface for human steering of agents in STAP, possibly using online recruitment of humans for analysis of massive swarms.

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