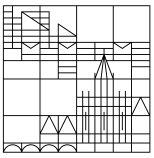
Task Sheet 6

Universität Konstanz



Anti-agents

Deadline 15.00, 13.06.2024

Lecture: *Collective Robotics and Scalability*, Summer Term 2024

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Objectives:

- ▷ boost a robot swarm aggregation behavior with so-called anti-agents
- ▷ measure performance in a swarm simulation

Task 6.1 Anti-agents in swarm aggregation

An interesting approach is that of 'anti-agents' by [1] and [2]. The idea is to have a heterogeneous swarm with a minority of robots that behave basically inversely to the majority of robots. They use it for object clustering and observe an improvement in performance once a certain percentage of anti-agents is added. The standard approach to object clustering is probabilistic with a probability P_{pick} to pick up an object and P_{drop} to drop it. An anti-agent is a robot that behaves differently than the majority of robots. 'Reverse anti-agents' invert the above probabilities to $1 - P_{\text{pick}}$ and $1 - P_{\text{drop}}$. Scheidler et al. [1] found a counterintuitive effect, namely that certain numbers of reverse anti-agents increase the observed clustering effect.

In this task you can choose from two options, either (a) or (b), but always (c):

a) Implement object clustering (aka 'wood chip clustering,' robots pick up objects and cluster them) and add anti-agents in the above sense. You can also introduce pick-up and drop probabilities that depend on densities of objects (pick-up more likely in sparse areas, drop more likely in dense areas). This would then needed to be inverted for the anti-agents as well.

b) Implement a swarm aggregation scenario (robots cluster, no objects) and add anti-agents that we define in the following way. Anti-agents move around and can order individual aggregated robots (via messaging) to leave a cluster. It seems useful to make that 'leave' command dependent on the cluster/neighborhood size.

c) Test different percentages of anti-agents (preferable low percentages) and measure the performance. You can define the performance, for example, as the biggest observed cluster after a defined time. You should do several repetitions for each setup to get statistically relevant measurements. Can you confirm the findings of [1] and [2]? It is actually tricky to reproduce their result. Try different parameter sets to find situations when anti-agents really help.

Bibliography

[1] Alexander Scheidler, Daniel Merkle, and Martin Middendorf. Swarm controlled emergence for ant clustering. *International Journal of Intelligent Computing and Cybernetics*, 6(1):62–82, 2013.

[2] Daniel Merkle, Martin Middendorf, and Alexander Scheidler. Swarm controlled emergence-designing an anti-clustering ant system. In *IEEE Swarm Intelligence Symposium*, pages 242–249. IEEE, 2007.