Swarm Intelligence
Adaptive Multi-Agent Robotics

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Abstract

This work examines the capabilities of scalable mobile-robotic swarms that employ cognitive intelligence and adaptable behavior. The study of swarm behavior examines a group of agents (i.e., robots) uniquely designed to work collectively towards a common goal that is too large or complex for a single agent. This study utilizes multi-sensor fusion of inertial, magnetic, photo-optic, proximity, and temperature measurement devices to sense and interact with the environment. The swarm members feature multiple physical architectures to exploit mechanical or sensory strengths for role development. Specifically, this work employs biologically inspired machine learning techniques to develop a collective artificial intelligence database.

The intelligence database controls the entirety of the swarm as a set of sub-groups and individuals. All swarm members are capable of autonomous navigation and localization. Swarm members are able to recognize and develop collective behavior among other members in proximity. Swarm sub-groups and individuals communicate with the intelligence database to obtain goal-oriented task and path planning commands. Feedback sent to the intelligence database allows for dynamic construction of a cloud-based map by multiple groups, simultaneously. The developed algorithms will be demonstrated by computationally constrained mobile robotic hardware and a stationary computer tasked with collaborative building mapping. These approaches can be used to develop swarms that may be utilized for information acquisition or monitoring, exploration, rescue, and other mobile robotic missions, in land, water, air, underground, space and foreign terrain.