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Commentary

Potential Applications of Swarm Robotics

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DESCRIPTION

Swarm robotics is the study of how to construct groups of robots that can operate independently of any external infrastructure or centralised control. The collective behaviour of the robots in a robot swarm is the outcome of local interactions between the robots and between the robots and the environment in which they act. Swarm intelligence principles guide the construction of robot swarms. These principles encourage the development of fault-tolerant, scalable, and flexible systems. When different activities must be performed concurrently, when high redundancy and the absence of a single point of failure are desired, and when it is technically impossible to set up the infrastructure required controlling the robots in a centralised manner, swarm robotics appears to be a promising approach. Swarm robotics could be useful for activities such as demining, search and rescue, planetary or underwater exploration, and monitoring.

Swarm robotics derives from swarm intelligence and might be defined as "embodied swarm intelligence." The primary goal of swarm robotics research at first was to examine and validate biological findings. Swarm robotics' focus has shifted in recent years: from a bio-inspired discipline of robotics, swarm robotics is gradually becoming an engineering field focused on the development of tools and methods to tackle real-world issues.

A robot swarm is a self-organizing multi-robot system with a high degree of redundancy. Robots have limited sensing and communication capabilities, and thus do not have access to global information. The interactions of each individual robot with its peers and with the environment result in the aggregate behaviour of the robot swarm. A robot swarm is often made up of homogeneous robots, while there are occasional examples of heterogeneous robot swarms.

POTENTIAL APPLICATIONS OF SWARM ROBOTICS

Swarm robotics systems' features make them desirable in a variety of possible application sectors. The use of robots to perform dangerous tasks is plainly enticing because it reduces risk for humans. Because these activities are dangerous, there is a substantial chance of robot loss. As a result of the need for a fault-tolerant methodology, risky jobs are an appropriate application domain for robot swarms. Demining, search and rescue, and cleaning up chemical spills are examples of dangerous duties that could be handled by robot swarms.

Potential applications for robot swarms include those where estimating the resources required to complete a task is challenging, if not impossible. Allocating resources to manage an oil spill, for example, can be problematic because it is sometimes difficult to quantify the oil output and predict its temporal evolution. In these instances, a scalable and adaptable solution is required. A robot swarm could be an enticing solution: robots can be added or removed as needed to supply the right number of resources and match the unique task requirements. Search and rescue, tracking, and cleaning are examples of tasks that may necessitate an unknown number of resources.

Another potential application domain for swarm robotics is tasks that must be completed in huge or unstructured locations with no existing infrastructure to govern the robots, such as a communication network or global localization system. Robot swarms could be used for such applications since they can operate autonomously without the requirement for infrastructure or external coordination. Underwater or extra-terrestrial planetary exploration, surveillance, demining, and search and rescue are examples of tasks in unstructured and massive environments.

Some settings may undergo rapid change over time. For example, in the aftermath of an earthquake, buildings may collapse, altering the landscape and introducing new threats. In these instances, adaptable systems that can respond swiftly to events are required. Swarm robots could be utilised to create adaptable systems that can quickly adapt to changing operational conditions. Patrolling, disaster recovery, and search and rescue are examples of tasks in changing contexts.

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