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Perspective

Properties of a Swarm Intelligence System

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DESCRIPTION

The study of natural and artificial systems composed of numerous individuals that coordinate through decentralised control and self-organization is known as swarm intelligence. The discipline focuses on collective behaviours that emerge from individuals' local interactions with one another and with their surroundings. Swarm intelligence has investigated systems such as ant and termite colonies, schools of fish, flocks of birds, and herds of land animals. Some human products, such as multi-robot systems and computer programmes created to solve optimization and data analysis challenges, also come into the domain of swarm intelligence.

Swarm Intelligence (SI) is the collective behaviour of natural or artificial decentralised, self-organized systems. The notion is used in artificial intelligence research. Gerardo Beni and Jing Wang coined the phrase in 1989, in the context of cellular robotic systems.

SI systems are often composed of a population of simple agents or boids that interact locally with one another and with their surroundings. Ant colonies, bee colonies, bird flocking, hawk hunting, animal herding, bacterial growth, fish schooling, and microbial intelligence are all examples of swarm intelligence in natural systems.

Swarm robotics refers to the application of swarm principles to robots, whereas swarm intelligence refers to a broader collection of algorithms. Swarm prediction has been applied to forecasting difficulties. In synthetic collective intelligence, methodologies similar to those described for swarm robots are being studied for genetically engineered organisms.

PROPERTIES OF A SWARM INTELLIGENCE SYSTEM

The following are the characteristics of a typical swarm intelligence system:

- It is made up of numerous individuals.
- The people are relatively homogeneous (that is, they are either all identical or belong to a few typologies.
- Interactions among individuals are based on simple behavioural rules that utilise only local information that the individuals communicate directly or *via* the environment.
- The overall behaviour of the system is determined by the interactions of people with one another and with their surroundings; thus, collective behaviour self-organizes.
- Scalability indicates that a system can keep its function while growing in size without having to rethink how its components interact. Because interactions in a swarm intelligence system involve only surrounding individuals, the number of interactions does not tend to rise with the overall number of persons in the swarm: the swarm dimension has only a minor influence on each individual's behaviour. Scalability is interesting in artificial systems because a scalable system can boost its performance by simply increasing its size without requiring any reprogramming.
- Swarm intelligence systems allow for parallel action because individuals in the swarm can undertake different actions in different regions at the same time. Parallel action is useful in artificial systems because it can help to make the system more flexible, that is, capable of self-organizing in teams that take care of different aspects of a difficult task at the same time.
- Because of the decentralised, self-organized nature of their control structures, swarm intelligence systems have inherent fault tolerance. Because the system is made up of many interchangeable individuals, and none of them is in charge of controlling the overall system behaviour, a failed individual can be quickly fired and replaced by another fully working individual.

CONCLUSION

A number of swarm characteristics found in natural systems have inspired novel approaches to problem solving employing swarms of robots. This is referred to as swarm robotics. Swarm robotics, in other words, is the application of swarm intelligence principles to the control of swarms of robots. Swarm robotics systems, like swarm intelligence systems in general, can be

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scientific or engineering in nature. As an example of an artificial/scientific system, clustering in a swarm of robots was discussed above. A collective transport of an item too large for a single robot is an example of artificial/engineering swarm intelligence system, behaviour also frequently observed in ant colonies.