StudyGuide Baden-Württemberg

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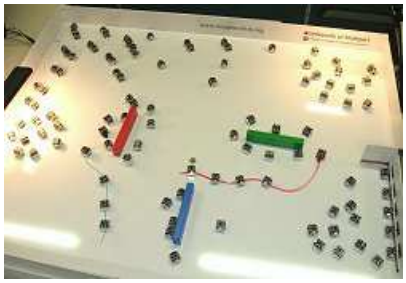
Universität Stuttgart has the largest swarm of robots in the world



The miniature robotic swarm
Institute of Parallel and Distributed Systems Universität Stuttgart

Microrobots are becoming increasingly compact and, at the same time can achieve ever-better performance. When they are present as a group, the barely three-centimetre mites are able to search a user interface for defects or even clean the dirt on it. The world's largest cluster is composed of 300 microrobots which have been developed and produced at the Institute of Parallel and Distributed Systems at the Universität Stuttgart. The scientists are in the process of examining how these "digital bees" can be organised and how a so-called swarm intelligence can be created.

Robot swarms of this size can be differentiated from smaller robot groups because of their coordination and perception principles as well as their activities. The research allows an understanding of how these restricted agents are in a position to demonstrate common complex behaviour and carry out a decision-making process. Such decision are, however, not based on the robot's individual characteristics but their collective ones, thus this examination forms the central point of the research activities.

Ants and bees are used as role models here. Their group behaviour is analysed and modelled by scientists. In such groups, only the mass of individuals is in a position to fulfil the assigned tasks and therefore make collective decisions. This occurs through self-organisation and through the agreement of each behavioural rule. Something that is so obvious in nature appears to be a great challenge for the "digital bees". Various mechanisms need to be developed for the microrobots such as perception, coordination and communication. These mechanisms, of course, are particularly limited due to the tiny size and weight but is vitally important as the robots have to act in their local environment.

These examinations are promising for research fields such as nano- and biotechnology. For example, microbiological systems consist of millions of agents, in this case, bacteria or molecules which can influence each other. If one understands the hidden principles of these influences, medicine will be greatly helped and highly complex processes such as inspection and repairing of human organs can be envisaged.

The examinations are part of the project Collective Microrobotics which is being conducted by scientists from the Universität Stuttgart and the Universität Karlsruhe (TH). Their aim is to analyse the principles and mechanisms of the micro world and thus develop hard and software architecture, processes, methods and algorithms for collective technical systems in order to achieve self-organisation processes.

As the basis for large artificial swarms (from 100 microrobots), the research team have developed the test platform "Jasmine" at the Universität Stuttgart. In order to perceive their environment and

navigate themselves autonomously, they are equipped with an infrared-based sensor system. This means that they can recognise and avoid obstacles and measure distances. The motivation of microrobots can be compared to a real swarm of bees: once the batteries are empty, they feel "hungry" and all look for "food sources" or the nearest charging station. If the robot fails to find food, it is energetically dead.

http://www.ipvs.uni-stuttgart.de/start/en

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