

# Swarm Robotics



## Overview

- **Description:** Similar to swarms of certain animals, which exhibit a collective behaviour when aggregated together, groups of robots can interact by following simple rules implemented in each individual system instead of carrying out instructions of a central planning unit. Such robot swarms are not necessarily dependent on communication between the swarm members and do not need any command structure, in contrast to cooperative multi-robot systems. However, in common language often the term “swarm” is used with respect to robotics neglecting this differentiation, but referring to arbitrary groups of robots, irrespective of the type of their interaction.
- **State of research:** Robotic swarming technology is mostly a matter of basic research in laboratories of universities. Interest in robotic swarms is however rising with some recent research projects and prototypes addressing this field.
- **Capabilities:** Robotic swarms are of advantage for application in confined spaces or wide-ranging tasks, where a single monolithic and expensive system would be too big or need too much time to scan the complete mission area. Important technical features are their scalability, flexibility and inherent redundancy. Swarm robot systems are comparatively small, light, easy to transport and inexpensive.
- **Limits:** Due to their smaller dimension swarming systems are limited with respect to their endurance resp. range and their payload capacity. They normally are more susceptible to harsh environmental conditions like obstacles, wind or rain.

## Further Information

- **Key player:** GRASP Lab University Pennsylvania (USA), SEAS University Harvard (USA), EPFL Lausanne (Switzerland), University Stuttgart (Germany), Université Libre de Bruxelles (Belgium).
- **Readiness:** In principle still a matter of basic research in laboratories, however with first application-like demonstrations.
- **Users:** Productive usage of swarm robotics has not been realised so far.
- **Future outlook and forecast:** Due to the significant rise of small robotic or unmanned system platforms and the growing commercial interest in such platforms during the last years, the meaning of swarm technology for productive applications is increasing. First productive applications might be technically achievable until 2020, however judicial issues concerning introduction of swarm robots into public space have to be addressed.
- **Related Technologies:** swarm intelligence, optimisation, autonomous systems, sensor miniaturisation, communication.
- **Links:** [1] DOI 10.1007/s11721-012-0075-2; [2] DOI 10.1007/978-3-662-43505-2\_66; [3] DOI 10.1007/978-3-540-30552-1\_1

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