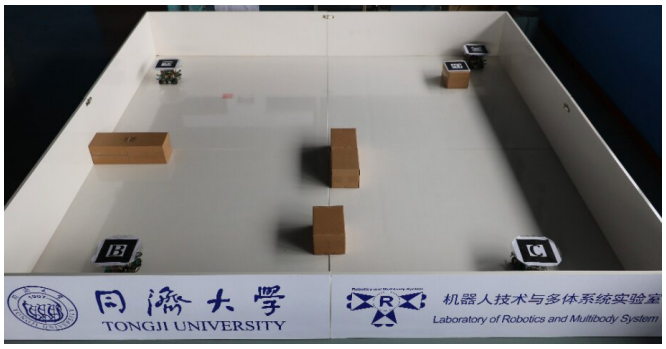
A scheme to enhance how swarm robots search for multiple targets

30 June 2020, by Ingrid Fadelli



Example of an experimental environment used in the study. Credit: Tang et al.

Over the past decade or so, researchers have been trying to develop techniques that could enable effective collaborative strategies among teams of robots. One of the tasks that teams of robots could complete better than individual robots is simultaneously searching for several targets or objects in their surrounding environment.

The ability of a team of robots to collectively seek and identify numerous targets at once could be useful for a wide range of applications. For instance, it could aid surveillance applications and help to better track individuals or vehicles.

Researchers at Tongji University and University of Stuttgart have recently devised a systematic framework for enabling more effective multiple target search in swarm robots. This framework, presented in a paper published in *IEEE Access*, is based on the use of a mechanical particle swarm optimization method and artificial potential fields.

"The innovative extension makes the bio-inspired particle swarm optimization first endowed with the robots' mechanical properties, which reduces the control expense and is already beyond the conventional application scope of this algorithm," the researchers wrote in their paper.

In their paper, the researchers first summarize the key characteristics of previously developed techniques for multiple target search, highlighting how well these techniques performed in evaluations. Subsequently, they present their own scheme based on mechanical particle swarm optimization and artificial potential fields.

The researchers' scheme takes real-world swarm robot applications that could benefit from multiple target search into consideration. To enable more efficient searches, it organizes the overall robot swarm into subgroups that search for targets based on differences (e.g., signal frequencies) between these targets.

When a sub-group moves toward a target that is not the one assigned to it, it receives a penalty. In addition to guiding a swarm's collective behavior to search for multiple targets more efficiently, the framework proposed by the researchers helps the robots to avoid obstacles in their surroundings or that are blocking their path.

"Robot groups that move toward non-aimed targets are applied with penalties, thus, a unimodal objective function for each robot group is built," the researchers explained in their paper. "Meanwhile the developed method contains the ability for obstacle avoidance based on a module-switching strategy that works according to their priorities."

The researchers at Tongji University and University of Stuttgart evaluated their scheme both in simulations and in experiments involving real mobile robots that they developed. They found that their framework allowed robot swarms to collectively search for and find several targets, even when only a few robots were conducting the search.

In the future, the new scheme introduced in this recent paper could allow teams of robots to search for several targets or objects at once in a highly efficient and organized way. This could open up new interesting possibilities for a wide variety of applications, for instance enhancing surveillance methods or enabling the use of robot teams as a means to search for specific items in a variety of environments.

In their next studies, the researchers plan to further evaluate the effectiveness of their method and its value for specific real-world applications. In addition, they would like to develop their scheme further to improve the overall localization accuracy achieved by the robots.

More information: Qirong Tang et al. Swarm Robots Search for Multiple Targets, *IEEE Access* (2020). DOI: 10.1109/ACCESS.2020.2994151