Robot Swarms Get First Real Test

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The National Science Foundation has awarded a $100,000 grant for University of Wyoming researchers to determine if swarms of mini-robots can successfully detect the sources of chemical or biological hazards.
The research team, led by Diana Spears in the Department of Computer Science, previously demonstrated in simulated environments that the robot sensor network can effectively trace and identify the sources of chemical plumes. The new SGER (Small Grant for Exploratory Research) allows them to take the research a step further and apply the system to the identification of actual chemical substances.
These tiny robots could help clean up oil spills or respond to a terrorist attack.

In previous laboratory experiments, Diana and William Spears, associate professors in the department, successfully demonstrated that the robots, programmed to sense chemical or biological plumes, can "talk" to each other, and move as a group toward the source of whatever they have been programmed to investigate.

Equipped with sensors, the robots continually sense the chemical concentration emitted from the source, and the air flow. They then perform mathematical calculations that allow them to quickly form a geometric lattice formation, and the robots move together to converge on the target.

This system, known as fluxotaxis, was invented by Diana Spears, David Thayer, a lecturer in UW's Department of Physics and Astronomy, and

doctoral student Dimitri Zarzhitsky, all of whom are working on the SGER project.

"The system outperformed all others in terms of consistency in accurately tracing the source of the plumes, and is competitive in the rapidity of the identification," William Spears says.

Each robot will be equipped with a chemical sensor that can detect a specific chemical. Benign chemicals, such as ethanol or acetone, will be used. Each robot also will be equipped with an anemometer to determine wind direction and velocity.

"The robots move toward a chemical flux, by calculating a combination of the chemical concentration and air velocity," says Diana Spears. "The ultimate goal would be remediation, which would either be to encapsulate the source or extinguish it, but that is not part of this grant."

The technology has practical applications in environmental protection and homeland security.

"Wherever facilities produce or use toxic chemicals, there is always concern about leakage and environmental pollution," Diana Spears said in the spring, 2004, issue of UWyo magazine. "And more recently, we've begun to worry about terrorists releasing chemicals or biological agents."

In the same article, William Spears noted the robots can be used in a variety of situations. "The technology is adaptable to any size, shape, and number of robots in any physical environment: land, air, water, even outer space," he said. "This flexibility adds perimeter defense, search and rescue, surveillance, space telescopy, and medical nano-surgery to the robots' potential task list."

Other consultants are Doug Smith, associate professor in the Department

of Mechanical Engineering; Dan Stanescu, assistant professor of mathematics; Cameron Wright, assistant professor of electrical and computer engineering; and John Schabron, principal scientist with the Western Research Institute.

Source: University of Wyoming