



ROACHES TO THE RESCUE

RESEARCHERS HAVE HACKED LIVING COCKROACHES TO CREATE NEW SEARCH-AND-RESCUE TECH.



EARTHQUAKES, tornadoes, air strikes — all around the world, countless lives are lost to disasters and to the wreckage they leave behind.

But search-and-rescue efforts are dangerous, and time is short: The larger the affected area, the harder it is to search efficiently and effectively. To aid in these efforts, scientists out of Singapore and Japan have developed a rather unconventional tool: swarms of cyborg cockroaches.

FOR THE last two decades, researchers have been developing technology to remotely control live insects, including cockroaches, through implants to their nervous systems.

"I have communicated with rescue teams and found that they urgently need insect-sized vehicles capable of traversing small openings in rubble to locate humans trapped in disasters," says Hiroataka Sato, a professor at Nanyang Technological University in Singapore, who has long led this work.

In a January 2025 study in *Nature Communications*, Sato's team announced a new

breakthrough that brings the tech one step closer to launch: a new algorithm that can be used to deploy a swarm of the insects through unknown terrain.

HOW DO you make a cyborg cockroach? Apparently, the process only takes 15 to 20 minutes. While the insect is anesthetized, wires are inserted into its sensory appendages — the antennae and cerci — and a small hole is cut into its abdomen. These wires connect to a tiny backpack affixed to the insect's back, which emits electrical currents that tell the cockroach when to change directions and speeds.

Equipped with cameras for search-and-rescue, these cyborgs have a number of advantages over tiny robots. They're more energy-efficient, fueled more by their own metabolism than by battery pack. And when it comes to navigating tricky landscapes, they don't need to be programmed to move over, under, and around obstacles.

"Despite decades of advancements in robotics, miniature vehicles remain impractical due to high power consumption for locomotion and structural fragility," Sato says. "To address this challenge, we developed the concept of using living insects as a platform."

SENDING individual cockroaches into rubble could be helpful for search-and-rescue teams, but the potential impact of the cyborgs would be multiplied if larger swarms could be deployed to cover more ground.

In their new system, the researchers designate one cyborg in the swarm as the

leader and the rest as followers. This provides a general direction for the group while allowing individuals to choose their own paths. Each cyborg can detect the location of the leader and its nearest neighbors, while only the leader knows the location of the group's destination.

The benefits of this swarm are greater than the sum of its parts. Because the insects have free motion, they naturally avoid obstacles that have caused others to slow down, and they won't pile up on each other. They can even help free their trapped and overturned comrades. This system also limits the need for guiding the cockroaches by 50 percent, reducing the battery power needed in their control backpacks.

The researchers are continuing to refine their swarming algorithms and control systems. They hope their cockroach rescue teams may soon scuttle into disaster zones, helping emergency responders locate survivors in the rubble.

— ANNA FUNK

