Houston, we have ants: Mimicking how ants adjust to microgravity in space could lead to better robots, scientist says

January 20 2014, by Bjorn Carey

By analyzing how ants explored these arenas in microgravity, scientists could develop software that allows autonomous robots to coordinate searches when their radio systems are being disrupted.

Professor Deborah Gordon recently sent hundreds of ants to the orbiting International Space Station. By studying how the ants adjust their behavior to cope with near-zero gravity conditions, scientists could improve the algorithms autonomous robots follow to search disaster scenes for survivors.

Several hundred ants have boldly gone where no ants have gone before: the International Space Station, high above Earth.

This past Sunday, an unmanned supply rocket delivered 600 small black common pavement ants to the ISS. Their arrival marked the beginning of an experiment designed by Deborah Gordon, a professor of biology at Stanford, to determine how the ants, in these exotic surroundings, adapt the innate algorithms that modulate their group behavior.

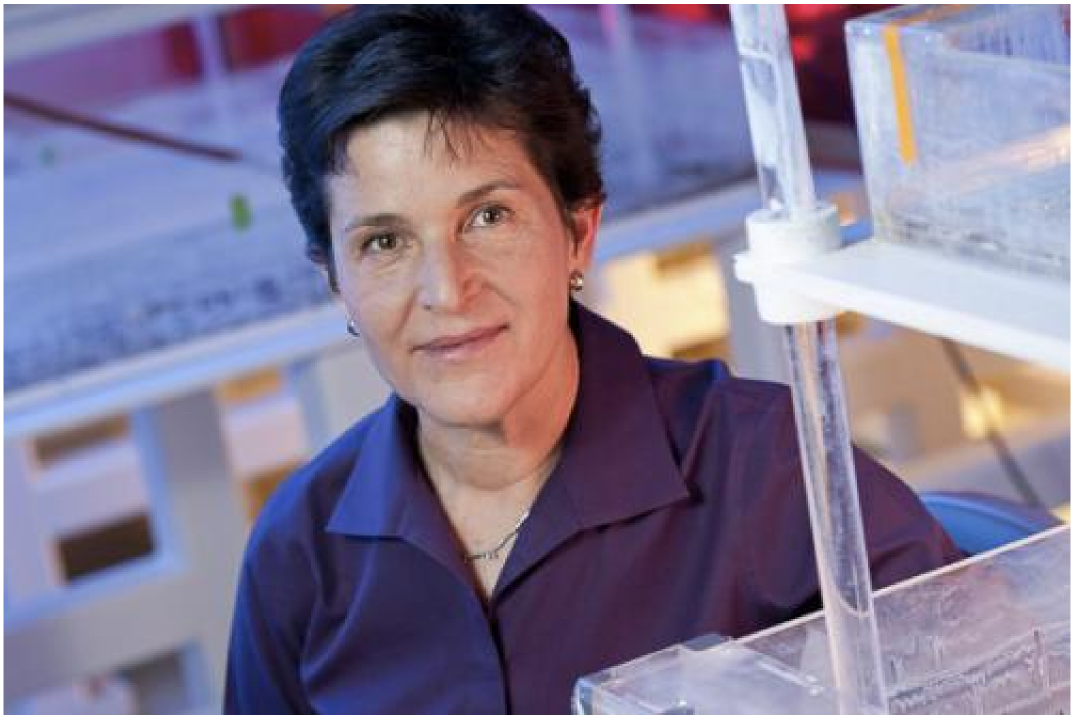
The information that Gordon and her colleagues glean from the ants' behavior has the potential to help us understand how other groups, like searching robots, respond to difficult situations.

An ant colony monitors its environment – whether to identify a threat, find food or map new terrain – by sending out worker ants to search the area. Because most ants have poor vision, and all ants rely on smell, an ant has to be close to something to detect it. Further complicating matters, no single ant is in charge or coordinating the search. So how do they know how best to search?

Ants communicate primarily by contacting each other by smell and touching antennae. Over millions of years, ants have developed algorithms that use the frequency with which these interactions occur to determine how many ants are in their area and, from that, how thoroughly they should conduct their search.

When antennae-to-antennae interactions occur frequently, the ants sense that the area is densely populated, and they circle around in small, random paths to gather robust information about their immediate area.

If the frequency of ant-to-ant interactions is low, however, the ants search in an entirely different manner. Instead of searching in small circles, they walk in straighter lines, giving up thoroughness in favor of covering more ground.



Biology Professor Deborah Gordon recently sent hundreds of ants to the International Space Station to study how they adapt the innate algorithms that modulate their group behavior.

This technique is known as an expandable search network.

Ants aren't the only animals to work out such algorithms. Humans have developed the same sort of protocols to govern how cellphone networks relay signals, or how a fleet of autonomous robots can search a building without the guidance of a central controller.

Like all networks, human-created networks have to deal with disruption. For example, if robots enter a burning building to assess damage or search for survivors, flames, smoke and other elements could interfere with communications between the 'bots and impede the search.

Scientists are developing workarounds for these situations, but Gordon said that ants have already found solutions for conditions where information is not perfect.

Biology Professor Deborah Gordon recently sent hundreds of ants to the International Space Station to study how they adapt the innate algorithms that modulate their group behavior.

In the space experiment, 70 ants were released into each of several small arenas roughly the size and shape of a tablet computer. The arena was divided into three sections, and video cameras tracked the ants' searching patterns as the barriers were lowered, increasing the search area and thus decreasing the density of ants in the arena.

On Earth, Gordon said, ants adjust their search behavior as the arena expands by shifting from the small, circular search routine to straighter, broader paths, thus expanding the search network.

Performing the same experiment in microgravity is a way to introduce interference that is analogous to the radio disruption that robots might experience in a blazing building. In microgravity the ants struggle to walk, which in turn disrupts the ants' ability to bump into each other and share information.

Observing how the space ants modified their search behavior when the loss of gravity interfered with their interactions, and their ability to assess density, could inform researchers how to design similar flexible protocols for robots and other devices that rely on expandable search networks.

"We have devised ways to organize the robots in a burning building, or how a cellphone network can respond to interference, but the ants have been evolving algorithms for doing this for 150 million years," Gordon said. "Learning about the ants' solutions might help us design network systems to solve similar problems."

Now, Gordon and her colleagues will carefully analyze video of the ants in space and compare it to a control experiment conducted on Earth to see how the struggle with microgravity forced the ants to change their searching behavior.

Additionally, the researchers will invite K-12 students to replicate the experiment in their earthbound classrooms. Starting this spring, when the weather is warmer and ants are easy to collect outside, students will be able to repeat the experiment and enter their results in a database, which Gordon said could provide valuable insights.

"There are 12,000 species of ants, and some species will perform better than others in this experiment," Gordon said. "For example, invasive ants find their way into our kitchens because they're very good at searching. Comparing results from student data will allow us to look at different search strategies of the ants in different places on Earth."

The ants will live out the remainder of their days on the space station. In the meantime, astronauts should not fear an infestation: Only sterile worker ants were sent on this mission.

Provided by Stanford University

Citation: Houston, we have ants: Mimicking how ants adjust to microgravity in space could lead to better robots, scientist says (2014, January 20) retrieved 1 May 2024 from https://phys.org/news/2014-01-houston-ants-mimicking-adjust-microgravity.html