# **Fire Ants Could Inspire the Next Rescue Robots**

By Sarah Fecht

Engineers hope that someday more robots will help out after a disaster, finding more victims in time to save more lives. Robots so far have played only a limited role in disaster recovery, but a [paper published yesterday](http://www.pnas.org/cgi/doi/10.1073/pnas.1302428110) in the *Proceedings of the National Academy of Sciences* suggests that a new generation of search-and-rescue robots could take a cue from an invasive pest—the fire ant.

"These animals dig for a living," says Daniel Goldman, a physicist at Georgia Tech and coauthor on the new paper. "You can throw them into any soil and they will do the same behavior, and that is dig."

### Ant Gymnastics

Goldman and coauthor Nick Gravish took some of the stinging, biting bugs into the lab and watched as they bored tunnels through a laboratory-made soil comprising tiny glass beads. They then measured the tunnels and monitored how the ants quickly navigated through such confined spaces.

"This is probably the first study to really detail-out the features of moving in confined environments," Gravish says. "It's so different from traditional biomechanics studies of running and climbing, where you're watching animals move around in a featureless environment."

By watching the ants burrow through glass tunnels, the researchers discovered that the optimal diameter of a fire-ant tunnel is roughly the same as a fire ant's body length. This tunnel diameter presumably provides enough room for two-way-traffic flow through the tunnel while remaining snug enough that the bugs can find something to grab onto when they slip. 

Although the ants zip through the tunnels pretty rapidly, the study reveals that the ants change their climbing posture depending on the tunnel's structure. For wider tunnels, they adopt a sprawled posture with their legs thrown out wide, whereas for narrower tunnels they tuck their middle legs beneath the abdomen and use them to generate a forward thrust. In all terrains the ants use their antennae as extra appendages to grab on to the walls to prevent falls.

The Georgia Tech researchers haven't yet built a robot that implements these new principles. But Robin Murphy, a computer scientist who heads up the [Center for Robot-Assisted Search and Rescue](http://crasar.org/) at Texas A&M University, said this is the first study that really addresses the types of steep and convoluted voids that rescuers see in rubble from building collapses.

"Search-and-rescue robots have been used in 35 disasters," she says. "Most of the time the robots have been very successful, but they could have been more successful if they could handle this twisty, tortuous terrain. Understanding how animals get through these environments is hugely important."

### Better Bots

Current search-and-rescue robots are a lot like the bomb-squad robots seen in movies such as *The Hurt Locker*. They operate aboveground, driving over mostly level terrain and moving in straight lines. "Right now what we're seeing is miniaturized tanks," Murphy says. "We're not really using any insights from biology; for the most part people are just trying to take existing solutions and make them smaller." Those types of robots aren't very helpful when you're looking for survivors after a building collapse.

The new study suggests that instead of seeing the environment as an obstacle, engineers can let the environment do some of the work—such as how the fire ants' snug tunnel dimensions prevent the insects from falling. With such mechanisms built into the structure of the tunnel, engineers wouldn't need to write complex commands to teach the robot how to catch itself when it's falling. That means engineers would be able to build cheaper, more robust, and more reliable robots.

This isn't the first time engineers have looked to nature for rescue-robot design. The [snake robots](http://www.popularmechanics.com/science/4285289?click=main_sr) developed in Howie Choset's lab at Carnegie Mellon University can navigate through tight spaces to potentially locate victims trapped in the rubble of a collapsed building or mine. But the snakebots are also mechanically complex and use a lot of power, Murphy points out. Another creation, the caterpillar-shaped Active Scope Camera, is smaller and uses a vibrating locomotion style rather than slithering. But when researchers [tested it](http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=5981550&url=http%3A%2F%2Fieeexplore.ieee.org%2Fxpls%2Fabs_all.jsp%3Farnumber%3D5981550) after a building collapse in Cologne City, Germany, the robot failed to navigate the rubble.

Can fire-ant bots do better? Future rescue robots will almost certainly utilize legs, although robotic legs raise significant biomechanical and computing challenges in robotics today. Added appendages add more complexity. "Legs still remain a longer-term issue," Murphy says. "We haven't really used them in search and rescue yet. But using the environment makes it more practical and much more likely . . . I think that with a concerted effort you could see prototypes as early as five years from now."

"As robots move into more natural environments, it is anyone's guess as to what the ‘best' form of locomotion behaviors should be," Goldman says.