

SALTO may give us a leg up in aiding disaster relief

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SALTO, the jumping robot, could one day help save lives. Stephen McNally

In the Olympics of the animal kingdom, quite a few creatures are gunning for the gold medal in the high jump: There's the impala, which can soar more than nine feet above the ground. The kangaroo, meanwhile, can leap continuously across long stretches of ground. And then there's the galago, or bushbaby, a tiny nocturnal primate with big eyes and an amazing ability to jump high into the air with barely any windup.

Compared with these champions, the best man-made machines barely qualify for the semifinals.

"It's fair to say that animals can outclass any robot when it comes to jumping," said Duncan Haldane. He studies and builds robots at the University of California at Berkeley.

But Haldane wanted to give machines a fair shot.

One-Legged Robot

In a study published Tuesday in the journal *Science Robotics*, he and his team describe a new one-legged robot that can leap high into the air and spring off walls. It doesn't quite match the rapid jumping ability of the galago that inspired it. Still, bullfrogs soon might have some competition from this robot.

This is good news for humans: One day, Haldane hopes his robot will be used in search and rescue situations, where its ability to swiftly leap over rubble and bounce off walls could help save lives.

In building the robot, Haldane sought to mimic the galago's ability to jump quickly. Most other creatures must spend time gathering energy for their jump before springing into action, but not the galago. It can leap to great heights practically on demand.

The scientists created a new measure to describe this ability, called "vertical jumping agility." It calculates the height an animal can reach, divided by the amount of time it takes to complete one jump. The galago had the highest vertical jumping agility of any known animal: 2.24 meters (7.3 feet) per second. That was twice what the best previous robots can do.

Meet Jumping Sensation SALTO

Haldane's new robot was dubbed SALTO, for "saltatorial locomotion on terrain obstacles." "Saltatorial" refers to one's ability to leap. The bot has a vertical jumping agility of 1.75 meters (5.7 feet) per second. That still isn't as good as the galago, but it's twice as good as the next best robot.

The secret to SALTO's success is its single leg. The leg is made up of several links with very specific dimensions. Each link gives the robot mechanical advantage — that is, the same principle that makes a crowbar a good tool for prying things open. The mechanical advantage programmed into SALTO's leg multiplies the small amount of force from its tiny motor. That buildup creates a lot of energy to put into the leap.

SALTO also has a spring that can store some of the energy built up during its crouch, saving it for later. This way, when the robot hits the wall, it has the energy to bounce off it. Without the spring, the robot would be unprepared for the next leap and simply fall down.

Will Two Legs Be Better?

There's still work to be done before SALTO can be put to use. Haldane's team plans to look into expanding the capabilities of the robot's single foot. They also want to test what it might be able to do with more legs. They must work on extending the life of SALTO's small battery and testing it in more real-world settings.

Ideally, someday a SALTO-like robot will carry small sensors capable of detecting people trapped beneath piles of rubble. The robot's tiny size — it weighs about as much as a bar of soap — and agility make it an ideal scout during a search-and-rescue effort after an earthquake or building collapse. It won't disturb the rubble, and it can scale vertical barriers that would stop a more traditional rolling robot. Once it senses a buried person, a follow-up team of human rescuers will be able to retrieve the victim.

In that scenario, SALTO's speed could be a lifesaver.

"You can plot the chance of survival of a person trapped in rubble against time, and that plot never goes up," Haldane said. "The clock is always ticking."

