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The Stickybot

Elizabeth Corcoran 09.04.06



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Collaborators Mark Cutkosky and Robert Full.

Cockroachlike Sprawliita has scuttled more than 30 miles.

AGE: 49, 48.

BIRTHPLACE: Pittsburgh, Pa.; Buffalo, N.Y.

Robots Cutkosky built: 15.

Species full studied: 50.

Stickybot

AGE: 6,500 manhours

BIRTHPLACE: Palo Alto, Calif.

GRAD STUDENTS WHO HELPED BUILD IT: 4.

Cockroaches inspire Robert J. Full. So do crabs, geckos and a closetful of other creepy creatures. Not that he likes them. "I think they're disgusting!" says Full, a professor at UC, Berkeley. "But how do they move like they do?"

This biologist believes he can best nature. He has spent his life scrutinizing the ways many-legged animals scamper over bumpy terrain and scoot up a wall or even glass. Working with Mark Cutkosky of Stanford University and other mechanical engineers, Full designs robots that use these principles. "We don't want to copy nature," Full says. "That's a totally mistaken idea. Nature *inspires* us."

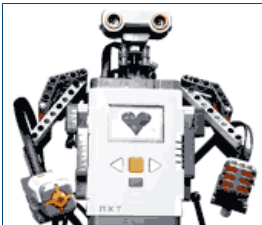
In April Full, 48, and Cutkosky, 49, unveiled their most recent bio-inspired robot, the two-foot long "Stickybot," which strides up a window much like a gecko but at 1.5 inches a second. "Everybody wants to know if Stickybot can do windows," Cutkosky says. "I just want robots that can look for cracks in the Bay Bridge."

Stickybot is the result of a decadelong collaboration between Full and Cutkosky. When they met, Full already was a leader in unraveling the principles of animal locomotion. He has measured the force of cockroaches' footsteps and the stiffness of their legs. (The legs of most creatures, insect or human, work like a pogo stick; the stiffness of the "spring"--the muscle--strongly influences their speed.)

"Cockroaches can run even faster by standing on their rear legs and running like bipeds." Full says.

Working with Irobot (see p. 94), Full developed a crablike machine that walks on land and underwater. With researchers at the University of Pennsylvania, he built a six-legged robot the size of a shoebox; it traverses rocky trails without tipping over. Pixar tapped Full for help in giving characters in *A Bug's Life* more personality through motion.

Cutkosky, meanwhile, had been making a name for himself by developing dexterous robotic hands. He became an expert in bonelike structures built by layering materials with different properties, a technique called shape-deposition manufacturing. Instead of making a robot's limbs with solid plastic, Cutkosky can make them, for instance, with an elastic core and a tough outer shell.



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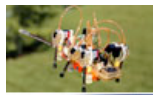
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The Robots Are Coming!

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a tough outer shell.

The duo has made various families of robots, each with their own talents. Some, inspired by cockroaches, sport six legs and can clamber over rocks. The speediest of these moves at 2.7 yards per second.

Getting robots to climb walls is a tougher challenge. "Even five years ago I would have had no clue how to build Stickybot," Cutkosky says. A dozen motors and embedded tendons made of fabric and cables let Stickybot maneuver each of its four legs and 16 toes independently.

Those toes are the real marvel. Geckos can cling to glass by a single toe because each has millions of fibers so tiny they stick to surfaces through weak molecular forces. Stickybot does the same, using hundreds of tiny tapered stalks measuring 10 microns (that's four ten-thousandths of an inch) at the tip. Because the tips are sharply angled, Stickybot's toes stick going in one direction and peel off easily when pulled the other way. Stickybot, funded in part by the Defense Advanced Research Projects Agency, could get stickier still. More sensors and motors would let it sense when it is about to fall off a wall or when it needs to rotate its feet, as geckos do, to climb down.

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