Walking robot navigates bumpy ground (w/ Video)

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(PhysOrg.com) -- A robot named MABEL with a human-like gait can walk over rough terrain in University of Michigan electrical engineering professor Jessy Grizzle's lab.

Grizzle and his students Hae-Won Park and Koushil Sreenath posted a YouTube video of MABEL's first steps over wooden planks, and within five days it was viewed more than 84,000 times.

(**Spoiler alert!**) It doesn't have a happy ending. MABEL breaks a leg and doubles over, but not before she clears planks stacked to 2.5 inches high.

"In the video, MABEL falls, but does not trip," Grizzle said. "Each shin has a built-in mechanical fuse that gives way when the load on the leg exceeds a threshold. This is done to avoid damage to the bearings in the hips. In the experiment, the fuse in MABEL's right shin gave way. The resulting fall is quite spectacular, but does not permanently damage the robot. It takes about an hour to reassemble the leg."

It was the researchers' intent to test MABEL's limits. Grizzle was surprised that she was able to perform as well as she did. What a robot can step over usually depends on what it can see, but MABEL is blind. She has no camera. The engineers had merely programmed her legs to swing higher to step over or onto obstacles. They hadn't programmed her specifically to navigate them.

That's what they'll do in future, more scientific experiments. The researchers are developing feedback control algorithms to give bipedal robots a strong sense of balance.
This early experiment was, for MABEL, the equivalent of walking confidently down a forest trail while talking to a friend—and not looking down to watch your steps.

"Humans rely on a keen sense of balance to pull this off," Grizzle said. "The challenge for engineers is to design this ability into robots."

Grizzle believes MABEL will eventually be able to gracefully step from a stair-height of about 7.5 inches.

So what's the point of all this? Grizzle says more than 70 percent of the Earth's land surface isn't navigable by wheeled or tracked vehicles. Bipedal robots could be capable of traveling in these places.

"If robots are going to perform rescue operations, they're not going to be walking on a nice linoleum floor," Grizzle said. "Even if they're in a building, it's going to be littered with things that have fallen. They have to be able to walk on an uneven surface without tripping."

Grizzle's ultimate goal for MABEL is to make her run. It's a feat he almost achieved with her predecessor, RABBIT, but RABBIT's heavy legs carried motors and no springs. MABEL's motors are in her torso, which leaves her legs light and agile. Her legs also have springs that act like tendons, storing and releasing energy.

"Running would really be one of the highest demonstrations of agile behavior in a machine. It takes such delicate feedback control," Grizzle said. "RABBIT failed to run in steady state. We got six really beautiful steps, but we never got seven or eight."

He hopes to see MABEL jog by winter.

Grizzle will present this research at MIT's Dynamic Walking 2010 conference on July 8 in Boston.

Provided by University of Michigan