A robot that jumps, flips, and does pull-ups

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RHex is an all-terrain walking robot that could one day climb over rubble in a rescue mission or cross the desert with environmental sensors strapped to its back.

Pronounced "Rex," like the over-excited puppy it resembles when it is bounding over the ground, RHex is short for "robot hexapod," a name that stems from its six springy legs.

Legs have an advantage over wheels when it comes to rough terrain, but the articulated legs often found on walking robots require complex, specialized instructions for each moving part. To get the most mobility out of RHex's simple, one-jointed legs, Penn researchers are essentially teaching the robot Parkour. Taking inspiration from human free-runners, the team is showing the robot how to manipulate its body in creative ways to get around all sorts of obstacles.

The RHex platform was first developed through a multi-university collaboration more than a decade ago. Graduate student Aaron Johnson and professor Daniel Koditschek, both of the Department of Electrical and Systems Engineering in the School of Engineering and Applied Science, are working on a version of RHex known as XRL, or X-RHex Lite. This lighter and more agile version of the robot, developed in Koditschek's Kod*Lab, a division of Engineering's General Robotics, Automation, Sensing and Perception (GRASP) Lab, is ideal for testing new ways for it to run, jump, and climb.

By activating its legs in different sequences, XRL can execute double

jumps, flips, and, through a combination of moves, even pull-ups. For the tallest obstacles, the robot can launch itself vertically, hook its front legs on the edge of the object it's trying to surmount, then drag its body up and over. The researchers fully demonstrated this particular maneuver under more controlled conditions in the lab.

The paper where Johnson and Koditschek outlined these capabilities—"Toward a Vocabulary of Legged Leaping"—was selected as a finalist for best student paper at the IEEE International Conference on Robotics and Automation in May.

"What we want is a robot that can go anywhere, even over terrain that might be broken and uneven," Johnson says. "These latest jumps greatly expand the range of what this machine is capable of, as it can now jump onto or across obstacles that are bigger than it is."

More information: kodlab.seas.upenn.edu/Aaron/ICRA2013

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