# 'Self-aware' space rovers would be speedy explorers

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Michael Reilly

Robots armed with an innate sense of self and an insatiable curiosity could be the next big thing in interplanetary exploration, covering an alien terrain much faster than today's turtle-paced rovers.

Robotic explorers like NASA's Spirit and Opportunity spend their lives in the slow lane. Hazard avoidance software restricts them to a measly 10 seconds of movement, followed by 20 seconds of standing still, so that the area ahead can be carefully scanned for potential dangers.

But Josh Bongard of the University of Vermont, US, has designed a simulated rover that shows how to work much faster. This rover "imagines" itself and its immediate surroundings, and heads off to explore the areas that stimulate its curiosity. The approach lets it navigate uncharted territory much more quickly without putting itself in undue danger.

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To simplify the challenge, Bongard created a rover that does not use sophisticated camera vision, but instead relies on just two tilt sensors to gain information about its world.

**Child's play**

His virtual rover first makes a single slow drive through an unknown area gathering as much tilt data as possible. Based on this information, it then builds 15 different simulations of its extended surroundings with itself at its current position. It makes "educated guesses" based on sensor data about the likely features in these the areas beyond its initial route.

The robot combines all 15 models and identifies the direction in which the models vary the most. It then drives off into this region and checks its models against new tilt data, providing more information for further, more accurate simulation building.

This combination of physical model building and "curiosity" allows the robot to explore at an ever faster rate. Although the simulated rover is basically blind, meaning it is prone to bumping into the odd rock or boulder, the same approach could be extended to robots with vision too.

"This behaviour is similar to how babies explore and test their world, why they are always getting into trouble," says Hod Lipson, a roboticist at Cornell University in Ithaca, New York, US, who was not involved with the project.

Bongard says rovers with such "active learning" could perform missions faster, and travel further, than today's probes.

**Complex modelling**

"We can get a general idea of the what a planet looks like from orbiting satellites, then tell the robot to look for things like ice, rocks, and craters," he told **New Scientist**. Once on the ground, the robot would explore on its own.

Lipson and Bongard previously built a four-legged robot that used a similar modelling technique to work out how to walk and to relearn the skill when one of its legs is broken.

However, the researchers say that giving robots the ability to model their environment adds another layer of complexity. For example, Lipson says defining the difference between "body" and "outside world" is both crucial and problematic. A robot on an inclined plane may decide its world is slanted, or that one of its legs is just pushing harder on a level surface.

Lipson notes that the same problem can occur in humans, for example when a person steps on a slippery floor. "At first you can't tell if it's your shoe that's slippery or wet, or if the floor's just been polished."

Robots with greater "self-awareness" represent a key step towards more human-like intelligence, Bongard say, although he is quick to add that the simulated rover is far from conscious. "For consciousness, you need to be able to think about thinking about yourself, which these robots cannot do."

The research was announced at the 9th European Conference on Artificial Life, 10-14 September.

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