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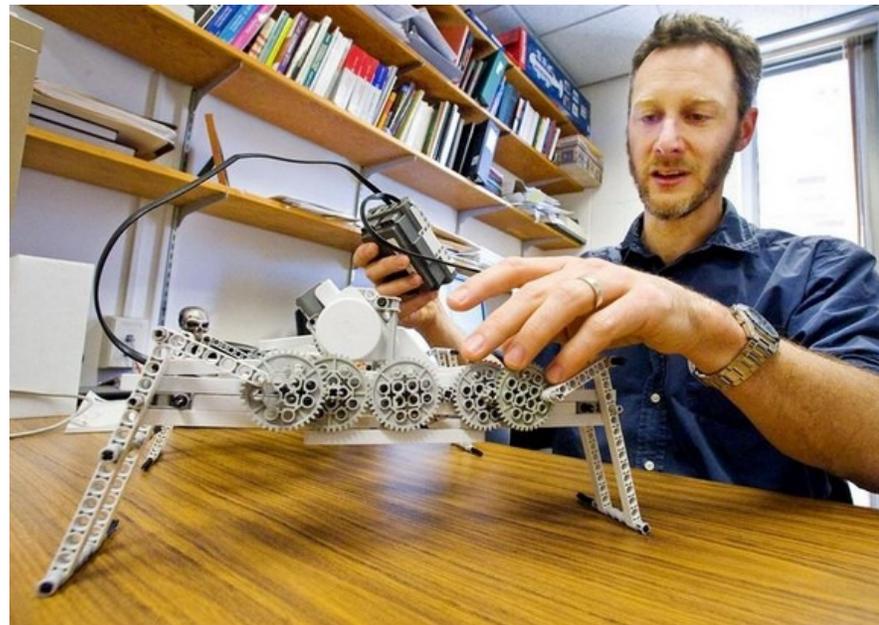


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UNIVERSITY OF VERMONT

UVM professor explores robot's ability to evolve



GLENN RUSSELL, Free Press

Josh Bongard, an assistant professor of computer science at the University of Vermont, works Thursday at the school with the robot he has designed that can evolve.

BY TIM JOHNSON, FREE PRESS STAFF WRITER • MONDAY, FEBRUARY 7, 2011

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Watch The Video

To see Bongard's robots in action — both the computer-simulations and the Lego versions — [click here](#).

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If you had to choose the word that best describes the robots Josh Bongard has been working with lately, "robotic" would not be it.

"Adaptive" is more like it. He designs robots that can change or evolve — in body and in mind. "Mind," that is, to the extent that a robot has a one, or a brain, in the form of the program that's driving it.

Bongard, an assistant professor of computer science at the [University of Vermont](#), got some attention a few years ago for his work on a robot dubbed "Starfish" that taught itself to walk. His recent research, which has also received national notice, looks at a robot with a flexible spine and four legs. Robots with this physique are given a simple task (the scientific term is "phototaxis"): to move from Point A to Point B (a light source) as quickly as possible, without falling.

Rather than providing the robots with a program that prescribes how to walk — as a conventional robotics engineer would do — Bongard feeds them an algorithm that lets them know all the possible ways they might move limbs and spine and then lets them reject the thousands of alternatives that don't work in favor of the few that do.

Bongard does this with two variants: a "fixed body" robot that stands erect, on four vertical legs; and a "variable body" robot, which begins the exercise flat on the ground, with four legs splayed out.

What happens, over the course of many thousands of trial runs?

The variable-body robot starts out slithering like a snake, then totters on outstretched legs somewhat like a lizard, then rises up to the point of walking, and finally, running.

The fixed-body robot starts out by stumbling — and eventually gets to the running phase, but it's not as stable as its counterpart. Add a stiff wind to the experimental mix and the fixed-body version gets blown over, while the other one remains upright, with a smoother gait. Bongard describes the variable-body robot as "more robust."

The more successful robot has not merely changed, but it has also gone through evolutionary stages. Having solved the movement problem in the early going, it builds up speed without sacrificing balance.

The computer algorithm sets up a series of countless trials and errors, much like evolution in the natural world.

"The real goal," Bongard said, "is to demonstrate how biology can help us build better machines, using evolution to design them."

The robot's body and its motion-controlling "brain" change throughout the process, mimicking not just real-world evolution but also the development of an individual organism. Bongard noted that a [baby](#) learning to walk, too, is changing physically and mentally in ways that result eventually in bipedal locomotion.

Evolutionary robotics is a small but promising field, Bongard said. Robots [capable](#) of adapting are likely to be more practical for some tasks — exploring another planet, say, or clearing a construction site — than robots that have to be programmed how to respond to every possible

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