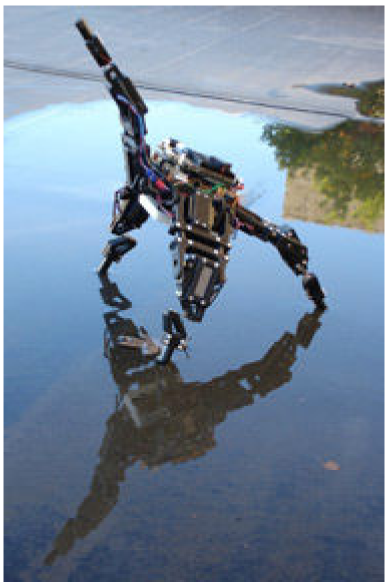

Keeps on ticking.
A new type of robot senses damage and adjusts to it.

Credit: *Science*

New Robot Shrugs Off Injury

By Corinna Wu
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It looks like a four-armed starfish, but so far it's unaware of its own shape. After flailing its arms for a while, however, the robot gets a sense of its design and begins to walk. The real feat comes when engineers remove a part of its leg: The robot senses a change in its structure and begins walking in a different way to compensate. The demonstration is the first proof that a robot can generate a conception of itself and then adapt to damage, a handy skill to have in unpredictable environments.

Most robotic systems today have two main components: a controller that moves the robot's various parts and an internal computer program, called a model. The model gives the robot information about its own structure and how to use it; the model for a four-legged robot, for example, might tell the machine to reverse the motion of its legs to walk backwards. But if the robot loses a limb, it could start walking in circles. Additionally, creating such "fixed" programs takes a lot of work.

To make robots more adaptable, researchers have designed versions that can program their own models. The robots do this by making a variety of movements and "learning" which ones achieve the desired goal. A robot built like a spider, for example, will learn that it can only walk forward efficiently by moving all of its legs in unison. But such strategies "take a lot of energy and could be risky for the robot," says Hod Lipson, a mechanical engineer at Cornell University.

So Lipson and his colleagues designed a robot that could self-generate a model with a few brief movements. First, the robot performs a random motion and collects data from sensors on its joints. This helps it figure out exactly how many appendages it has and how many segments each contains. Then the robot might start testing the range of motion of these appendages--information it will need to develop strategies for walking and climbing, for example. This is quicker than previous robotic models because much less trial and error is involved, says Lipson. Another advantage, he says, is that the team's robot is continually updating its model. So if the robot loses a leg, for example, it begins trying out several alternative gaits. The team describes its resilient robot in tomorrow's issue of *Science*.

The work "represents a major advance in autonomous robotics," says Dario Floreano, director of the Institute of Systems Engineering at the Swiss Federal Institute of Technology in Lausanne, Switzerland. In remote locations, such as underwater or on other planets, "malfunctioning of some components is a very likely event," he says. "If an engineer cannot be dispatched to fix the problem, [this new] robot will attempt to change its own control strategy in order to continue the mission."

Related sites

- Lipson's home page, with more on robotics
- Co-author Victor Zykov's page, which has more about various robots