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Origami robot folds itself in 4 minutes

Robot begins as a flat sheet and uses heat to get into shape.

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Using techniques inspired by the art of origami, a US-based team has built a robot that can fold itself into shape starting from a flat sheet. The results are described in the 8 August issue of *Science*[1].

The robot starts as a sheet of a polymer material — the same one used in Shrinky Dink toys, which shrink when heated in an oven — with embedded electronics and motors attached to the top side. The sheet is cut such that it can be folded to form a desired structure. The folding requires no human intervention — the sheet contains hinges in which heating elements are embedded to cause the hinges to fold. An embedded computer directs the hinges to fold in a pre-determined order. The robot takes about 4 minutes to reach its final shape, after which the motors kick in and the robot starts walking.

The ability to assemble itself autonomously makes the robot particularly suitable for use in confined or hazardous spaces, such as during search-and-rescue missions in collapsed buildings, says senior author Robert Wood, who studies biologically inspired robots at Harvard University in Cambridge, Massachusetts.

“The concept of a self-folding robot is intriguing,” says Jacques Penders, an engineer who heads the Centre for Automation and Robotics Research at Sheffield Hallam University in the UK. “However — as the video also shows — control of the robot will be a major hurdle to overcome before real applications could be considered.” (The current prototype, seen in the video above, wriggles along somewhat clumsily.)

Daniela Rus, director of the Computer Science and Artificial Intelligence Laboratory at the Massachusetts Institute of Technology in Cambridge, and a co-author of the paper, says that her team's methods could make robots more affordable and simpler to produce, and thus “democratize access to robots”.

“Our big dream is to make the fabrication of robots fast and inexpensive,” says Rus.

The authors say that they spent US$11,000 on the project, but now that the designs are in place, they calculate that such robots would

cost $100 each to build in low quantities ($20 for the structure and $80 for the motor and batteries).

But the researchers are not planning to develop their technology for market. Rus says that their objective was to demonstrate the feasibility of the idea. Sam Felton, a mechanical engineer at Harvard and a co-author of the study, says that he and his colleagues are an academic laboratory, so they want to work on “the most interesting and challenging problems, not necessarily the most practical”.

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References

1. Felton, S., Tolley, M., Demaine, E., Rus, D. & Wood, R. *Science* **345**, 644–646 (2014).