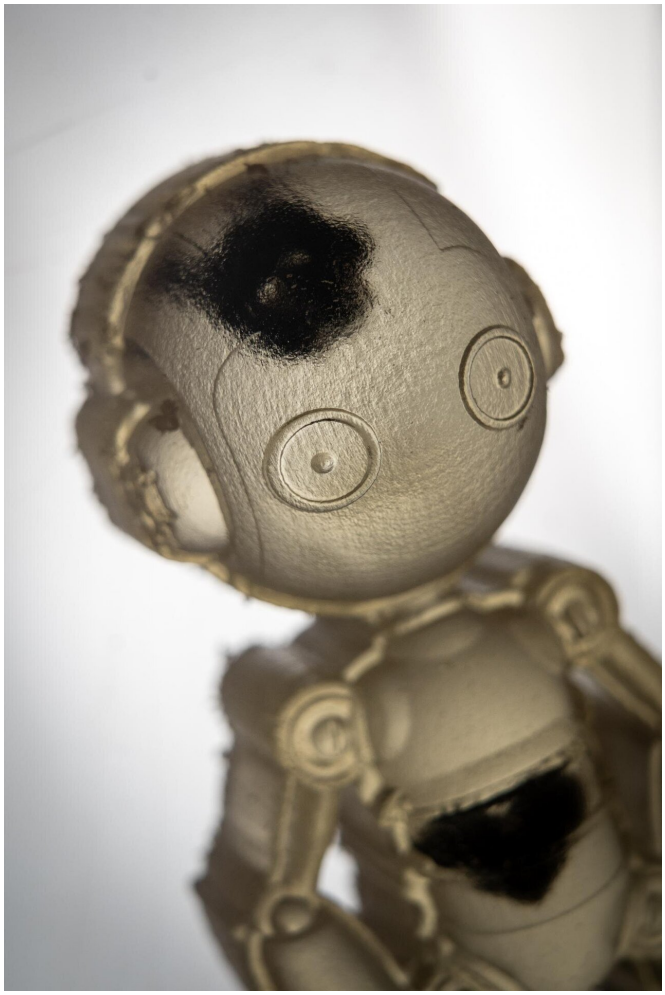
Get up and go bots getting closer, study says

16 July 2019



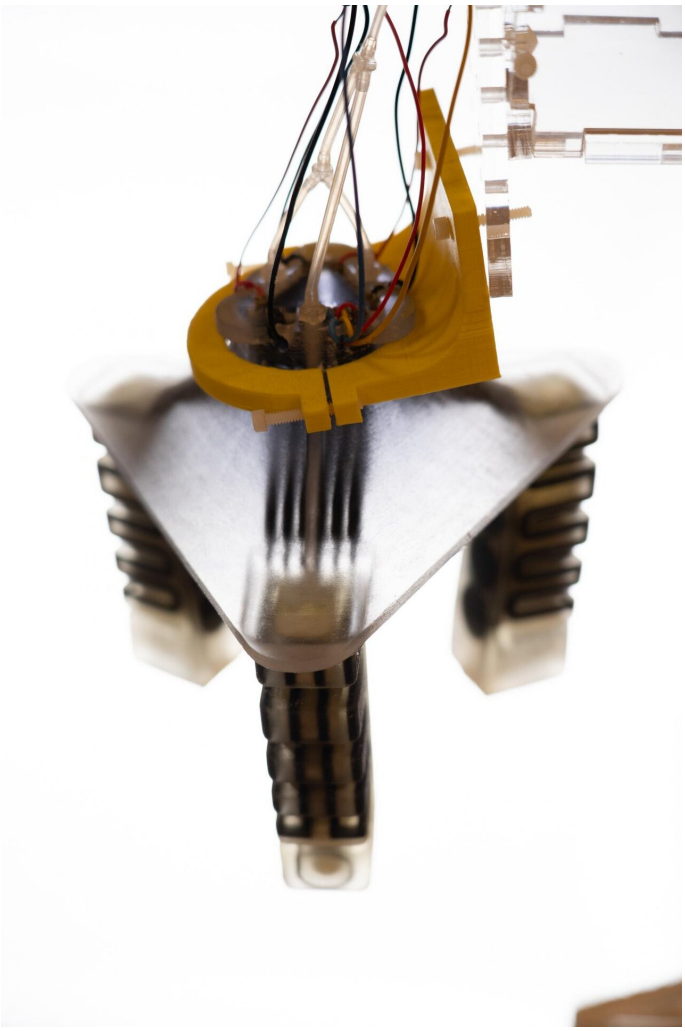
This robot shape and complex sensors are the result of one single print. The sensors can sense strain and pressure. Credit: David Baillot/University of California San Diego

Robotics researchers at the University of California San Diego have for the first time used a commercial 3-D printer to embed complex sensors inside robotic limbs and grippers. But they found that materials commercially available for 3-D printing still need to be improved before the robots can be fully functional.

Researchers who specialize in 3-D printing have long sought to make an entire robot in one print—a machine that would be able to walk itself away from the printer when it's done. This would make it easier to print more robots faster. It would also make it possible to 3-D print robots without human supervision, for example on the moon or Mars.

One of the main roadblocks on the way to this goal is the development of effective sensors for soft robots. That's because soft, flexible robots often have complex surfaces and movements that are difficult to equip and cover with sensors made with traditional manufacturing techniques. These types of robots are more flexible than their rigid cousins and can safely work side by side with humans.

The UC San Diego researchers' insight was twofold. They turned to a commercially available printer for the job, (the Stratasys Objet350 Connex3—a workhorse in many robotics labs). In addition, they realized one of the materials used by the 3-D printer is made of carbon particles that can conduct power to sensors when connected to a power source. So roboticists used the black resin to manufacture complex sensors embedded within robotic parts made of clear polymer. They designed and manufactured several prototypes, including a gripper.



This gripper was manufactured on a commercial, multimaterial 3D printer that prints actuators and sensors together. Credit: David Baillot/University of California San Diego

When stretched, the sensors failed at approximately the same strain as human skin. But the polymers the 3-D printer uses are not designed to conduct electricity, so their performance is not optimal. The 3-D printed robots also require a lot of post-processing before they can be functional, including careful washing to clean up impurities and drying.

However, researchers remain optimistic that in the future, materials will improve and make 3-D printed robots equipped with embedded sensors much easier to manufacture.

"Embedded printing of sensors is a powerful process that could enable and enhance seamless integration of sensors into soft robots, but there does not yet exist a suitable, commercially available, easy to use platform that allows users to simultaneously print soft actuators and sensors," researchers write.

More information: Benjamin Shih et al, Design Considerations for 3D Printed, Soft, Multimaterial Resistive Sensors for Soft Robotics, *Frontiers in Robotics and AI* (2019). DOI: 10.3389/frobt.2019.00030

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