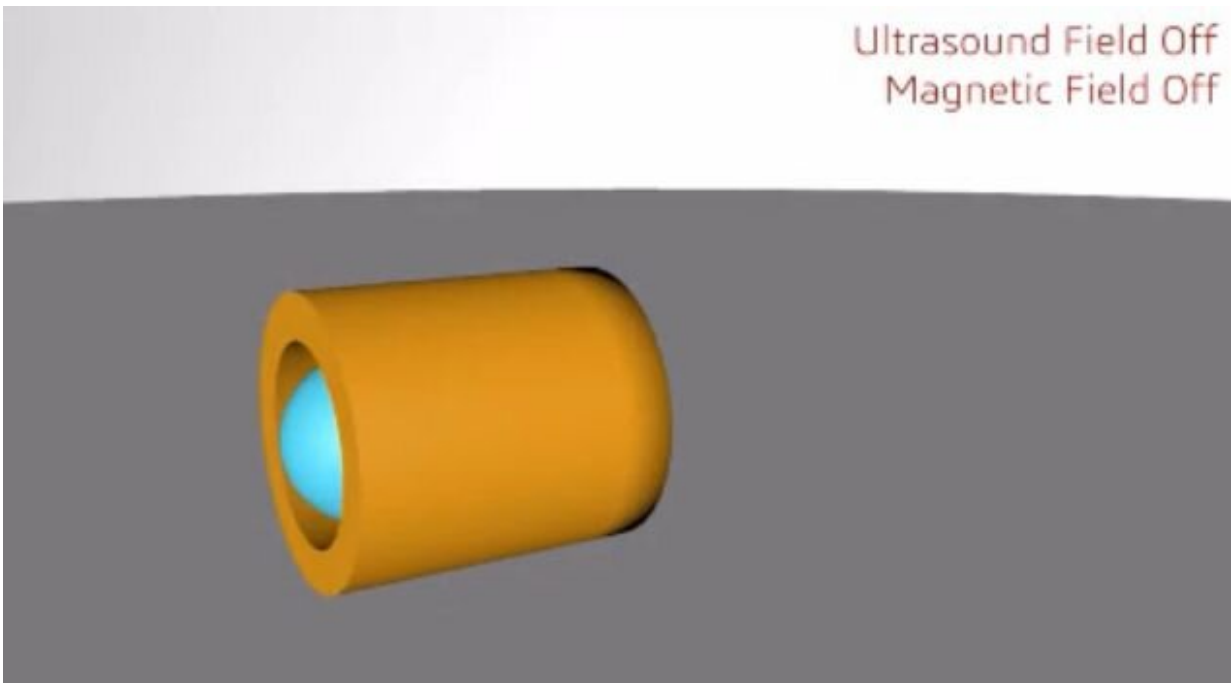


# Micromotors push around single cells and particles

October 25 2019

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A new type of micromotor—powered by ultrasound and steered by magnets—can move around individual cells and microscopic particles in crowded environments without damaging them. The technology could open up new possibilities for targeted drug delivery, nanomedicine, tissue engineering, regenerative medicine and other biomedical applications.

"These microswimmers provide a new way to manipulate single particles with [precise control](#) and in three dimensions, without having to do special sample preparation, labeling, surface modification," said Joseph Wang, a professor of nanoengineering at the University of California San Diego.

Wang, with Thomas Mallouk, a professor of chemistry at University of Pennsylvania, and Wei Wang, a professor of materials science and engineering at Harbin Institute of Technology in China, are senior authors of a paper describing the micromotors, published Oct. 25 in *Science Advances*.

Researchers used the micromotors to push around individual silica particles and HeLa cells in aqueous media without disturbing neighboring particles and cells. In one demonstration, they pushed around particles to spell out letters. Researchers also controlled the micromotors to climb up micro-sized blocks and stairs, demonstrating their ability to move over three-dimensional obstacles.

The micromotors are hollow, half-capsule-shaped polymer structures coated with gold. They contain a small piece of magnetic nickel in their bodies, which allows them to be steered with magnets. The [inner surface](#) is chemically treated to repel water so that when it is submerged in water, an air bubble spontaneously forms inside the [micromotor](#).

This trapped bubble allows the micromotor to respond to ultrasound. When ultrasound waves hit, the bubble oscillates inside the micromotor, creating forces that propel its initial movement. To keep the micromotor moving, researchers apply an [external magnetic field](#). By changing the direction of the magnetic field, researchers can steer the micromotor in different directions and alter its speed.

"We have a lot of control over the motion, unlike a chemically fueled

micromotor that relies on random motion to reach its target," said Fernando Soto, a nanoengineering Ph.D. student at UC San Diego. "Also, ultrasound and magnets are biocompatible, making this micromotor system attractive for use in biological applications."

Future improvements to the micromotors include making them more biocompatible, such as building them from biodegradable polymers and replacing nickel with a less toxic magnetic material such as iron oxide, researchers said.

**More information:** "3D steerable, acoustically powered microswimmers for single-particle manipulation" *Science Advances* (2019). [advances.sciencemag.org/content/5/10/eaax3084](https://advances.sciencemag.org/content/5/10/eaax3084)

Provided by University of California - San Diego

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