Tiny robots controlled by magnetic fields could revolutionize biomedicine

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Researchers at the Nanyang Technological University in Singapore (NTU Singapore) have created a series of millimeter robots that manage to carry out highly complex movements and manipulations. They are managed through magnetic fields: with the size of a grain of rice, they could reach now inaccessible places in our body and facilitate important developments in biomedicine.

According to a press release, the movements of the robots can be controlled remotely by an operator. To do this, a program is used that runs on a control

computer, precisely varying the strength and direction of the magnetic fields, generated in turn by an electromagnetic coil system.

The abilities of these robots will allow that in the near future they can **inspire novel surgical procedures**, for example in vital organs that are more difficult to access, as in the case of the brain.

To that end, the scientists are looking to make the devices even smaller – they plan to take them down to a few hundred micrometers. In the same vein, they will try to make them completely autonomous in terms of control.

THE DOMAIN OF PHYSICS

In the study that led to this technological application, recently published in the journal Advanced Materials, the researchers explained why they consider that the innovation developed can become a significant advance for small-scale robotic technologies.

Thanks to a **deep understanding of the physics of these miniature robots**, the specialists were able to precisely control their movements, at a level of detail and complexity not seen in other developments.

Although the field of miniaturized robots is booming, and there are many similar devices with application in the field of biomedicine, Asian experts explained that the advances achieved place this technology at the forefront in its area.

The dexterity and speed of these miniature robots were demonstrated in experiments conducted by scientists. For example, a bio-inspired device in a jellyfish was able to swim rapidly through a narrow channel, overcoming various barriers and obstacles.

Consequently, they were able to verify that the robots are capable of **face challenges in uncertain environments**. This condition can be crucial if you think about its application in the field of biomedicine, since they will have to overcome similar problems and challenges. How do these robots manage to expand their range of movements and their precision?

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DEXTERITY, SPEED AND DUCTILITY

The data is compelling: Compared to a previously developed range of miniaturized robots, the new devices can rotate their body 43 times faster in certain movements. In the most complex dynamics, they recorded a rotational speed of 173 degrees per second.

In addition, as they are manufactured with soft materials, they are able to carry out tasks with **extreme precision and ductility**, how to collect and place objects of all kinds. For example, a gripper-shaped robot was able to assemble a 3D structure made up of numerous parts in just a few minutes.

The new robots were created from biocompatible polymers, which do not pose any risk of toxicity. At the same time, polymers include **magnetic microparticle inlays**, which make the control mechanism possible through magnetic fields.

REFERENCE

Small-Scale Magnetic Actuators with Optimal Six Degrees-of-Freedom. Changyu Xu, Zilin Yang and Guo Zhan Lum. Advanced Materials (2021) .DOI: https://doi.org/10.1002/adma.202100170

Video: NTUsg on YouTube.

Photo: millimeter robots measure roughly the size of a grain of rice and can be controlled by magnetic fields. They could have multiple applications in the field of biomedicine, for example in complex surgical procedures. Credit: NTU Singapore.