Medical Xpress

Endoscope controlled by MRI: A 'fantastic voyage' through the body

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This is a prototype of the endoscopic "capsule" being tested at Brigham & Women's Hospital, Boston Credit: American Friends of Tel Aviv University

small cameras or optic fibres that are usually attached to flexible tubing designed to investigate the interior of the body — can be dangerously invasive. Procedures often require sedative medications and some recovery time. Now a researcher at Tel Aviv University is developing a "capsule endoscope" that can move through the digestive tract to detect problems independent of any attachments.

According to Dr. Gabor Kosa of TAU's School of Mechanical Engineering, the project is inspired by an endoscopic capsule designed for use in the small intestine. But unlike the existing capsule, which travels at random and snaps pictures every half second to give doctors an overall view of the intestines, the new "wireless" capsules will use the magnetic field of a magnetic resonance imaging (MRI) machine and electronic signals manipulated by those operating the capsule to forge a more precise and deliberate path.

It's a less invasive and more accurate way for doctors to get an important look at the digestive tract, where difficult-to-diagnose tumors or wounds may be hidden, or allow for treatments such as biopsies or local drug delivery. The technology, which was recently reported in *Biomedical Microdevices*, was developed in collaboration with Peter Jakab, an engineer from the Surgical Planning Laboratory at Brigham and Women's Hospital in Boston, affiliated with Harvard Medical School.

Swimming with the current

What sets this endoscope apart is its ability to actively explore the digestive tract under the direction of a doctor. To do this, the device relies on the magnetic field of the MRI machine as a "driving force," says Dr. Kosa. "An MRI has a very large constant magnetic field," he explains. "The capsule needs to navigate according to this field, like a sailboat sailing with the wind."

In order to help the capsules "swim" with the magnetic current, the researchers have given them "tails," a combination of copper coils and flexible polymer. The magnetic field creates a vibration in the tail which allows for movement, and electronics and microsensors embedded in the capsule allow the capsule's operator to manipulate the magnetic field that guides the movement of the device. The use of copper, a non-ferro magnetic material, circumvents other diagnostic challenges posed by MRI, Dr. Kosa adds. While most magnets interfere with MRI by obscuring the picture, copper appears as only a minor blot on otherwise clear film.

The ability to drive the capsule, Dr. Kosa says, will not only lead to better diagnosis capabilities, but patients will experience a less invasive procedure in a fraction of the time.

Microrobotics of the future

In the lab at the Brigham and Women's Hospital, Dr. Kosa and his fellow researchers have tested the driving mechanism of the capsule in an aquarium inside the MRI. The results have shown that the capsule can successfully be manipulated using a magnetic field. Moving forward, the researchers are hoping to further develop the capsule's endoscopic and signalling functions.

According to Dr. Kosa, a new faculty recruit to TAU, this project is part of a bright future for the field of microrobotics. At the university, his new research lab, called RBM2S, focuses on microsystems and robotics for biomedical applications, and an educational robotics lab, ERL, will teach future robotics experts studying at TAU's School of Mechanical Engineering.

Provided by Tel Aviv University

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