
Observed in Vivo the Collective Movement of Nanorobots

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A team of researchers with the participation of UAB professor Esther Julián has monitored, for the first time, the behaviour of a swarm of nanorobots inside living mice. The study has been published in Science Robotics.

Nanobots are machines whose components are at the nano-scale (one millionth of a millimetre), and can be designed in such a way that they have the ability to move autonomously in fluids. Although they are still in the research and development phase, very significant advances are being made to make nanorobots a reality in the field of biomedicine. Their applications are very varied: from the identification of tumour cells, to the release of drugs in specific locations of the body. Nanorobots powered by catalytic enzymes are among the most promising systems because they are fully biocompatible and can make use of “fuels” already available in the body for their propulsion. However, understanding the collective behaviour of these nanorobots is essential to advance towards their use in clinical practice.



Now, in a new study published in the journal Science Robotics, researchers led by ICREA Research Professor Samuel Sánchez at the Institute for Bioengineering of Catalonia ([IBEC](#)), together with the CIC biomaGUNE and Esther Julián, professor at the Genetics and Microbiology Department of the Universitat Autònoma de Barcelona ([UAB](#)), have managed to observe in vivo, using radioactive isotope labelling, the collective behaviour of a large number of nanorobots designed at IBEC to have autonomous movement inside the bladder of living mice.

To do this, the researchers first carried out in vitro experiments, monitoring the nanorobots

through optical microscopy and Positron Emission Tomography (PET). Both techniques allowed them to observe how the nanoparticles mixed with the fluids and were capable of migrating, collectively, following complex paths. The nanorobots were then administered intravenously to mice and, finally, introduced into the bladders of these animals. Since Nanorobots are coated with an enzyme called urease, which uses the urea from urine as a fuel, they swim collectively inducing fluid flows inside the bladder.

The team of scientists found that the distribution of nanodevices in the bladder of the mice was homogeneous, which indicates that the collective movement was coordinated and efficient.

Nanorobots show collective movements similar to those found in nature, such as birds flying in flocks, or the orderly patterns that schools of fish follow”

This study demonstrates the high efficiency of millions of nanoscopic devices to move in a coordinated way in both in vitro and in vivo environments, a fact that constitutes a fundamental advance in the race of nanorobots to become the key players in highly precise therapies and treatments. Future applications in medicine of these nano-scale devices are promising.

Read the [original article](#) on Universitat Autònoma de Barcelona.