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SPARC WEEKLY

MANTA RAYS INSPIRE FAST SWIMMING SOFT ROBOT YET

A team of researchers has beaten its own record for the fastest swimming soft robot, drawing inspiration from manta rays to improve their ability to control the robot's movement in the water.

The soft robot has fins shaped like those of a manta ray, and is made of a material that is stable when the fins are spread wide. The fins are attached to a flexible, silicone body that contains a chamber that can be pumped full of air. Inflating the air chamber forces the fins to bend -- similar to the down stroke when a manta flaps its fins. When the air is let out of the chamber, the fins spontaneously snap back into their initial position.

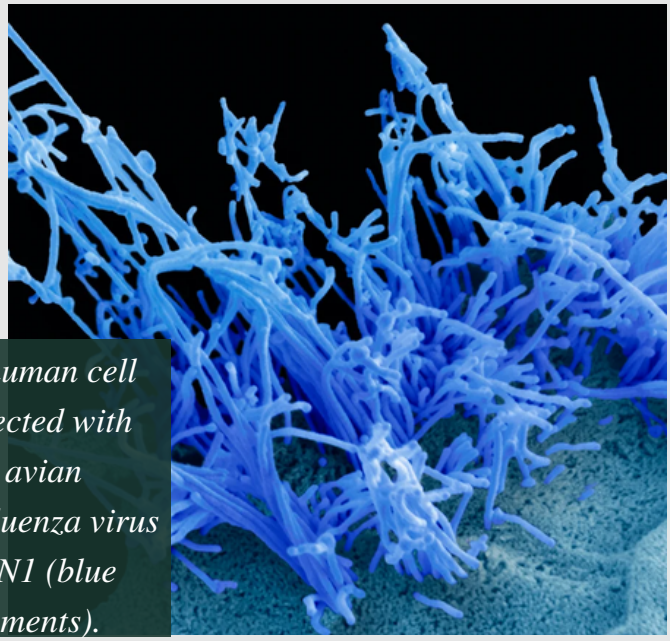
Studying the fluid dynamics of manta rays also played a key role in controlling the vertical movement of the soft robot.

The researchers have demonstrated the soft robot's functionality in two different ways. First, one iteration of the robot was able to navigate a course of obstacles arrayed on the surface and floor of a water tank. Second, the researchers demonstrated that the untethered robot was capable of hauling a payload on the surface of the water, including its own air and power source.

"Two years ago, we demonstrated an aquatic soft robot that was able to reach average speeds of 3.74 body lengths per second," says Jie Yin, corresponding author of a paper on the work and an associate professor of mechanical and aerospace engineering at North Carolina State University. "We have improved on that design. Our new soft robot is more energy efficient and reaches a speed of 6.8 body lengths per second. In addition, the previous model could only swim on the surface of the water. Our new robot is capable of swimming up and down throughout the water column."

The paper, "Spontaneous Snapping-Induced Jet Flows for Fast, Maneuverable Surface and Underwater Soft Flapping Swimmer," is published open access in the journal Science Advances.
https://www.sciencedaily.com/releases/2024/12/241204145135.htm
YouTube Video: Manta ray-inspired fast and maneuverable soft swimming robots

BIRD FLU VIRUS IS ONE MUTATION AWAY FROM BINDING MORE EFFICIENTLY TO HUMAN CELLS



A human cell infected with the avian influenza virus H5N1 (blue filaments).

Scientists have discovered that H5N1, the strain of highly pathogenic avian influenza virus currently spreading in U.S. dairy cows, only needs a single mutation to readily latch on to human cells found in the upper airway. The findings, published today in Science, illustrate a potential one-step path for the virus to become more effective at human transmission—and could have major implications for a new pandemic if such a mutation were to become widespread in nature.

Avian influenza viruses are dotted with surface proteins that allow them to bind to bird cell receptors, which permit the virus to enter the cells.

The cell receptors in birds are different from those in humans, but that variation is “very subtle,” says James Paulson, a study co-author and a biochemist at Scripps Research. “For a new pandemic H5N1 virus, we know that it has to switch receptor specificity from avian-type to human-type. So what will it take?” To his and his co-authors’ surprise, that switch only needed one genetic alteration.

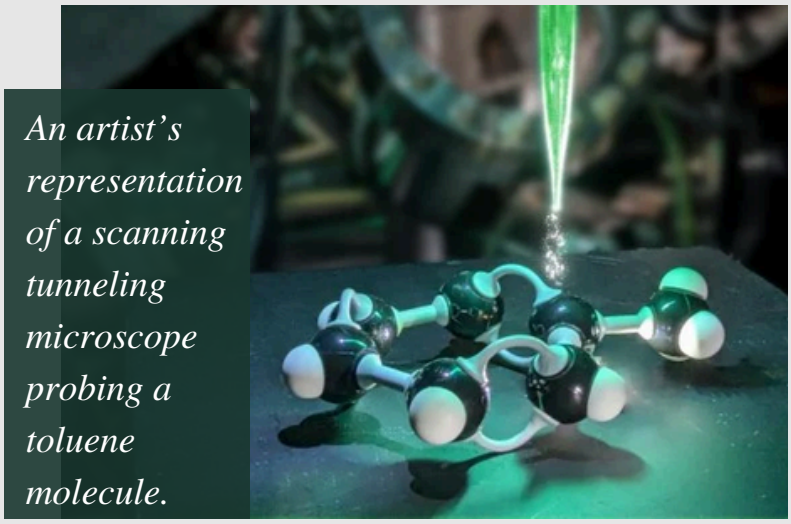
For their study, the research team introduced several mutations into the H5N1that were selected to mimic genetic changes that could occur naturally. When the team assessed the impact of one of these mutations, Q226L, on the virus' ability to bind to human-type receptors, they found that that mutation significantly improved how the virus attached to glycan receptors, which represent those found in human cells.

The shift alone, however, may not be enough to enable human-to-human transmission. However the findings highlight the need for proactive surveillance of evolution in H5N1 and similar avian flu strains.

https://www.scientificamerican.com/article/bird-flu-virus-is-one-mutation-away-from-adapting-to-human-cells/
https://www.science.org/doi/10.1126/science.adt0180

BREAKTHROUGH IN NANOTECHNOLOGY UNLOCKS ATOMIC PRECISION FOR MEDICINE AND ENERGY

Physicists are getting closer to controlling single-molecule chemical reactions – could this shape the future of pharmaceutical research?



An artist's representation of a scanning tunneling microscope probing a toluene molecule.

A groundbreaking study demonstrates control over atomic-level matter through nanotechnology. By leveraging the precision of scanning tunneling microscopy, researchers have shown how competing chemical reaction outcomes can be influenced by manipulating energy levels. This advancement allows for targeted reactions, such as those needed for drug synthesis, while reducing unwanted byproducts.

This breakthrough has far-reaching implications, advancing both fundamental scientific understanding and practical applications. Among these, it holds the potential to revolutionize how researchers develop medications by improving precision and efficiency. The new study set out to demonstrate for the first time that competing chemical reaction outcomes can be influenced by using the atomic resolution of a scanning tunneling microscope (STM). With this microscope, scientists can go beyond mapping the surface of a molecule – they can both reposition single atoms and molecules, and influence and measure the likelihood of specific reaction pathways in individual molecules.

Explaining, Dr. Kristina Rusimova, who led the study from the Department of Physics, said: "Typically, STM technology is employed to reposition individual atoms and molecules, enabling targeted chemical interactions. Our latest research demonstrates that STM can control the probability of reaction outcomes by selectively manipulating charge states and specific resonances through targeted energy injection."
Looking ahead, Dr. Rusimova said: "With applications in both basic and applied science, this advancement represents a major step toward fully programmable molecular systems. We expect techniques such as this to unlock new frontiers in molecular manufacturing, opening doors to innovations in medicine, clean energy, and beyond.

https://www.nature.com/articles/s41467-024-54677-1
https://scitechdaily.com/breakthrough-in-nanotechnology-unlocks-atomic-precision-for-medicine-and-energy/

AS THE CLIMATE WARMS, POLAR BEARS ARE FACING MORE GERMS

Climate change is bringing pathogens into new environments. Now one of the world's southernmost populations of polar bears — and the animals they hunt — are encountering more germs than they used to.

Polar bears are facing more and more challenges as the climate warms. Most of these problems relate to the bears' waning wintery habitats. But increasingly, they also may be infected with germs and parasites, a new study finds.

The researchers screened blood serum and feces from 232 Chukchi bears (These animals live in the waters that lie between Alaska and Russia) between 2008 and 2017. The scientists looked for antibodies in blood against a range of pathogens. These included bacteria, viruses and parasites. If the blood has antibodies aimed at fighting a specific pathogen, it suggests the bear's immune system has already faced that pathogen in the past.

The team then compared this analysis to a similar one of 115 bears that were surveyed earlier — between 1987 and 1994.

The share of polar bears exposed to some of the pathogens has at least doubled since the 1990s, the new study finds. These germs were the parasite Neospora caninum and the two bacteria behind the diseases brucellosis and tularemia. The team also compared ratios of chemical markers in the bears' hair. These markers all related to what the bears eat. Individual bears varied in the prey they ate most. But their specific diets were linked to their pathogen exposure, the new study finds.

"[Polar bears] are probably not the only species that has higher exposure to these pathogens," Rode says (She is a wildlife biologist for the U.S. Geological Survey and an author of the new study). "It's within the food chain that this has increased."

In recent years, ringed seals have died off in large numbers from an unknown disease, Rode notes. Ringed seals are a key prey of the polar bears. This finding helped alert researchers to look at pathogen levels in polar bears.

https://www.snexplores.org/article/polar-bear-more-germs-arctic-climate

WHO ARE WE?

SPARC Robotics Team's mission and vision is to make our environment the best it can be. On a volunteer basis, we look at the problems that are happening around us and make them our problems, both as SPARC and individually, and help as much as we can with appropriate projects. NASA ACCP (Astro Camp Community Partners) was only in the US until four years ago. This year they came to Turkey with us after four years of traveling to many countries. ACCP educates school-age children from kindergarten to high school on science-related topics of interest with practical knowledge and application, while also supporting children's craft development, general culture and questioning skills. As SPARC, we have brought this training provided by NASA to our country in the most comprehensive way and our continuous communication with NASA not only enables us to improve our trainings day by day, but also gives us the opportunity to learn about the innovations in the field of STEM instantly, from the most accurate source and to spread the knowledge we have around us.

EDITOR

Dear reader,

I would be delighted to hear your comments or suggestions and I encourage you to write to us if you have any views or opinions on the stories in SPARC Weekly.
We look forward to hearing from you.
Have a nice week and enjoy the magazine.

Defne Şehidoğlu