New underwater robot swims and senses like a fish

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In recent years, robotic underwater vehicles have become more common in a variety of industrial and civil sectors. They are used extensively by the scientific community to study the ocean. For example, underwater robots have been used to discover or study a number of deep sea animals and plants in their natural environment.

Now, a new class of underwater robot has emerged that mimics designs found in nature. These 'biomimetic' vehicles can achieve higher degrees of efficiency in propulsion and manoeuvrability by copying successful designs in nature.

The EU-funded FILOSE project (Robotic fish locomotion and sensing)

is addressing a key bottleneck for underwater robotics, namely the problem of understanding how fish sense the underwater environment.

A fish swimming in its natural environment is able to sense the flow of water around it and react to changes in flow patterns. FILOSE project partners, led by Tallinn University of Technology's Centre for Biorobotics, believe that once they understand how a fish works, they can potentially apply that knowledge to the development of better underwater robots.

A crucial experimental tool for FILOSE has been a robot prototype that looks and acts like a fish. The 'FILOSE fish' resembles a rainbow trout in shape but also in its behaviour; trout are 'subcarangiform swimmers', i.e. fish that move forward by creating undulations in rear part of the body while the front of the body remains almost rigid.

The FILOSE fish's tail is actuated by a single servomotor located in its thorax. It creates an undulating wave that travels along the body and pushes the robot forward. FILOSE researchers can change the fish's tail to investigate how material properties change the efficiency and swimming pattern of the robot. Meanwhile, the head of the robot is watertight and contains sensors and electronics to control the fish.

The experiments were done in the lab using a flow tank. Project researchers determined that robots equipped with such features not only seek out areas where disruptive currents are weakest, but that they can also use eddies to actually help push them forward.

The results of the FILOSE project have been ground-breaking. Researchers have successfully developed the first-ever flow-sensing underwater robot with flow-aided and flow-relative navigation. A key step in the design of the robot was the development of an artificial hair cell that mimics natural hair cell sensing physiology.

The project has also established new hydrodynamics research facilities and trained personnel who continue the work begun under FILOSE.

Taken together, the results promise to lead to new underwater technologies that could help the oil and gas industry, underwater humanitarian demining, environmental monitoring, search and rescue operations, anti-terrorist activities, harbor surveillance, coastal security and fisheries management, and more. All will feel the impact of more efficient and better-performing underwater robots.

More information: www.filose.eu/tiki-index.php

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