Robojelly gets an upgrade

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Engineers at Virginia Polytechnic Institute and State University (VirginiaTech) have developed a robot that mimics the graceful motions of jellyfish so precisely that it has been named Robojelly. Developed for the Office of Naval Research in 2009, this vehicle was designed to conduct ocean underwater surveillance, enabling it potentially to detect chemical spills, monitor the presence of ships and submarines, and observe the migration of schools of fish.

Recently, a team at VirginiaTech has improved the performance of this silicone swimmer, enabling it to better overcome the limitations of its artificial skin and better mimic the true motion of a jellyfish. Details on this new design and how it might provide new insights into jellyfish propulsion mechanisms will be presented at the 2011 meeting of the American Physical Society's Division of Fluid Dynamics in Baltimore, Md., Nov. 20-22.

According to VirginiaTech mechanical engineer Alex Villanueva, Robojelly looks very similar to an actual jellyfish. "Its geometry is copied almost exactly from a moon jellyfish [Aurelia aurita]," he said. The robot is built out of silicone and uses shape memory alloy (SMA) actuators to swim.

To move through the water, the natural animal uses the bell section of its body, which deforms and contracts to provide thrust. The lower, or lagging, section of the bell is known as the flexible margin, and it deforms slightly later in the swimming process than the rest of the bell. Until recently, however, Robojelly lacked this crucial piece of anatomy in its design.

Villanueva and his colleagues tested a number of different designs for their robot, some with and without an analog to a flexible margin. Initially, the artificial materials used in construction presented a problem. Unlike their natural counterparts, the artificial materials tended to fold as they deformed, reducing Robojelly's performance.

After testing a number of designs and lengths for the folding margin, the engineers discovered that cutting slots into the bell reduced this unwanted folding effect.

This gave Robojelly a truer swimming stroke, as well as a big boost in speed.

"These results clearly demonstrate that the flap plays an important role in the propulsion mechanism of Robojelly and provides an anatomical understanding of natural jellyfish," said Villanuerva.

More information: The talk, "Effects of a flexible margin on Robojelly vortex structures," is on Tuesday, Nov. 22, 2011. Abstract: http://absimage.aps.org/image/MWS_DFD11-2011-001706.pdf

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