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Jellyfish-Inspired Pumps

*Caltech Researchers Investigate Next Generation Medical and Robotic Devices
Presentation at Fluid Dynamics Meeting Today in Long Beach, CA*

EMBARGOED for release until 7:00 p.m. Eastern time (U.S.) on Tuesday, Nov. 23, 2010

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WASHINGTON, D.C., November 23, 2010 -- To the casual aquarium visitor, the jellyfish doesn't seem to be a particularly powerful swimmer; compared to a fish, it glides slowly and peacefully.

But for Janna Nawroth, a graduate student at the California Institute of Technology in Pasadena, the undulations of this simple invertebrate hold secrets that may make possible a new generation of tiny pumps for medical applications and soft robotics -- work she describes today at the American Physical Society Division of Fluid Dynamics (DFD) meeting in Long Beach, CA

"Most pumps are made of rigid materials," says Nawroth. "For medical pumps inside the human body, we need flexible pumps because they move fluids in a much gentler way that does not destroy tissues and cells."

Nawroth is working with Caltech engineer John Dabiri, an expert on jellyfish propulsion. His research has shown these cnidarians tend to fall into two categories -- those that produce faster, harder strokes and those that create weaker but more efficient strokes. He has also studied the flows and eddies created by the strokes, which can be characterized by a dimensionless quantity called a Reynolds number.

"We're really lucky," says Nawroth. "The Reynolds numbers we see in the movement of jellyfish of different sizes and ages are in the right range as what we need for medical applications."

As a step towards creating flexible pumps, Nawroth is studying how jellyfish shape and tissue composition adapt to the demands imposed by flow conditions at different Reynolds numbers. Jellyfish at millimeter scales, for example, exploit the small layer of water that adheres to their surface as they move and use it as additional paddle at no extra cost. Further, a clever arrangement of multiple pacemakers within the jellyfish body allow for a reliable yet tunable pumping mechanism. In the future, Nawroth plans to use this practical understanding to help design a whole spectrum of flexible pumps that are optimized for different tasks and conditions.

The presentation, " Learning from jellyfish: Fluid transport in muscular pumps at intermediate Reynolds numbers is at 4:23 p.m. on Tuesday, November 23, 2010 in the Long Beach Convention Center Room: Grand Ballroom B. ABSTRACT: <http://meetings.aps.org/Meeting/DFD10/Event/134388>

NOTE: a video is available for use by reporters. Contact: jbardi@aip.org. VIDEO DESCRIPTION: Slow motion video recording of a juvenile moon jellyfish (*Aurelia aurita*) propelling itself through the water. Despite the gaps between its 8 lappets, or "arms", the animal achieves efficient paddling instead of sieving: At a scale of 1cm in diameter, the jellyfish is in a fluid dynamics regime where a layer of viscous water adhering to its body closes the gaps between its lappets. This layer of attached water effectively helps shoving away the liquid like an additional paddle. This shows how jellyfish adapted to specific fluid dynamic regimes might inspire the development of novel, non-intuitive designs of flexible pumps. Also note the 8 neuronal pacemakers controlling the synchronized contraction - they are clearly visible as white spots at the distal end of the lappets. CREDIT: Reporters may use this video, or single frames, so long as they credit J.Nawroth, Caltech.

MORE MEETING INFORMATION

The 63rd Annual DFD Meeting is hosted this year by the University of Southern California, California State University Long Beach, California Institute of Technology, and the University of California, Los Angeles.

It will be held at the Long Beach Convention Center, located in downtown Long Beach, California. All meeting information, including directions to the Convention Center is at: <http://www.dfd2010.caltech.edu/>

USEFUL LINKS

Main meeting Web site: <http://www.dfd2010.caltech.edu/>
Search Abstracts: <http://meetings.aps.org/Meeting/DFD10/SearchAbstract>
Directions to Convention Center: <http://www.longbeachcc.com/>

PRESS REGISTRATION

Credentialed full-time journalist and professional freelance journalists working on assignment for major publications or media outlets are invited to attend the conference

free of charge. If you are a reporter and would like to attend, please contact Jason Bardi (jbardi@aip.org, 301-209-3091).

ONSITE WORKSPACE FOR REPORTERS

A reserved workspace with wireless internet connections will be available for use by reporters in the Promenade Ballroom of the Long Beach Convention Center on Sunday, Nov. 21 and Monday, Nov. 22 from 8:00 a.m. to 5:00 p.m. and on Tuesday, Nov. 23 from 8:00 a.m. to noon. Press announcements and other news will be available in the Virtual Press Room (see below).

VIRTUAL PRESS ROOM

The APS Division of Fluid Dynamics Virtual Press Room will be launched in mid-November and will contain dozens of story tips on some of the most interesting results at the meeting as well as stunning graphics and videos. The Virtual Press Room will serve as starting points for journalists who are interested in covering the meeting but cannot attend in person. See: <http://www.aps.org/units/dfd/pressroom/index.cfm>

GALLERY OF FLUID MOTION

Every year, the APS Division of Fluid Dynamics hosts posters and videos that show stunning images and graphics from either computational or experimental studies of flow phenomena. The outstanding entries, selected by a panel of referees for artistic content, originality and ability to convey information, will be honored during the meeting, placed on display at the Annual APS Meeting in March of 2011, and will appear in the annual Gallery of Fluid Motion article in the September 2011 issue of the American Institute of Physics' journal, Physics of Fluids.

This year, selected entries from the 28th Annual Gallery of Fluid Motion will be hosted as part of the Fluid Dynamics Virtual Press Room. In mid-November, when the Virtual Press Room is launched, another announcement will be sent out.

ABOUT THE APS DIVISION OF FLUID DYNAMICS

The Division of Fluid Dynamics of the American Physical Society (APS) exists for the advancement and diffusion of knowledge of the physics of fluids with special emphasis on the dynamical theories of the liquid, plastic and gaseous states of matter under all conditions of temperature and pressure. See: <http://www.aps.org/units/dfd/>

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