Industrial pump inspired by flapping bird wings

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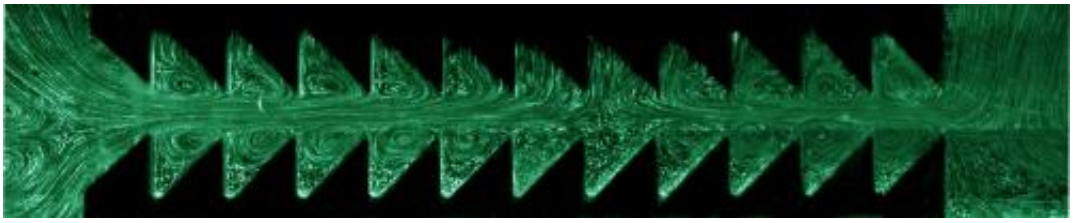

When a fluid is squeezed and expanded repeatedly between two sawtooth-like boundaries, a net flow is generated to the right. Credit: B. Thiria & J. Zhang

Birds are unwitting masters of fluid dynamics—they manipulate airflow each time they flap their wings, pushing air in one direction and moving themselves in another. Two New York University researchers have taken inspiration from avian locomotion strategies and created a pump that moves fluid using vibration instead of a rotor. Their results will be published February 3, 2015, in the journal *Applied Physics Letters*, from AIP Publishing.

"When we use a household pump, that pump is very likely a centrifugal pump. It uses a high-speed rotor to move water by throwing it from the pump's inlet to the outlet," explained Benjamin Thiria, who carried out the work in collaboration with Jun Zhang.

Instead of a rotor, Thiria and Zhang's design has teeth. Two asymmetrically sawtoothed panels, placed with their teeth facing each

other, create a channel that can rapidly open and close. Water rushes into the channel when it expands and is forced out when it contracts.

"When a fluid is squeezed and expanded repeatedly, the asymmetric boundary forces the fluid to move in one direction," said Zhang. The repeated vibration of the channel drives fluid transport because the asymmetry of the ratchet's teeth makes it easier for the fluid to move with them than against them.

The pump could be particularly useful in industrial situations where machinery is vibrating excessively and therefore operating inefficiently. Because it is powered by vibration, it could capture some of the wasted mechanical energy and instead use it for a productive task like circulating coolant. It would also dampen the noise that vibrating machinery tends to emit.

In the future, Thiria and Zhang hope to find other examples of similar pumps in nature—such as the human circulatory system—and use them to further optimize their own design.

"For many years, fluid-structure interaction has been the most important subject for scientists working in fluid physics," said Thiria, who now conducts research at ESPCI ParisTech. "Our pump shows that surprising results come from fluid-structure interaction."

More information: Ratcheting Fluid with Geometric Anisotropy," by Benjamin Thiria and Jun Zhang, *Applied Physics Letters* on February 2, 2015. DOI: 10.1063/1.4906927 . scitation.aip.org/content/aip/ … /5/10.1063/1.4906927

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