

'Flying fish' robot can propel itself out of water and glide through the air

September 11 2019



Illustration of the robot leaping out of the water. Credit: Aerial Robotics Lab/Imperial College London

A bio-inspired bot uses water from the environment to create a gas and launch itself from the water's surface.

The robot, which can travel 26 metres through the air after take-off,

could be used to collect [water samples](#) in hazardous and cluttered environments, such as during flooding or when monitoring [ocean pollution](#).

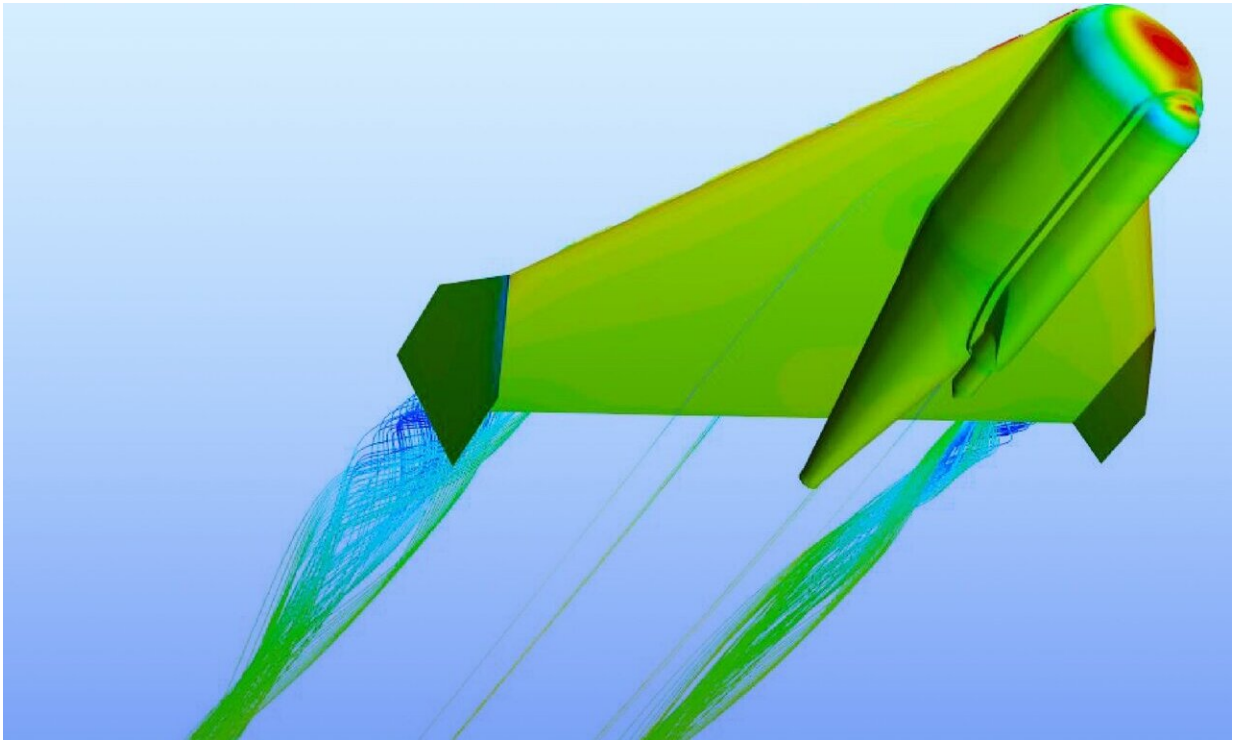
Robots that can transition from water to air are desirable in these situations, but the launch requires a lot of power, which has been difficult to achieve in [small robots](#).

Now, researchers at Imperial College London have invented a system that requires just 0.2 grams of calcium carbide powder in a [combustion chamber](#). The only moving part is a small pump that brings in water from the [environment](#) the robot is sat in, such as a lake or ocean.

The water and the calcium-carbide powder then combine in a reaction chamber, producing a burnable acetylene gas. As the gas ignites and expands, it pushes the water out as a jet, which propels the robot clear of the water and into a glide of up to 26 metres.

The details of the robot are published today in *Science Robotics*.

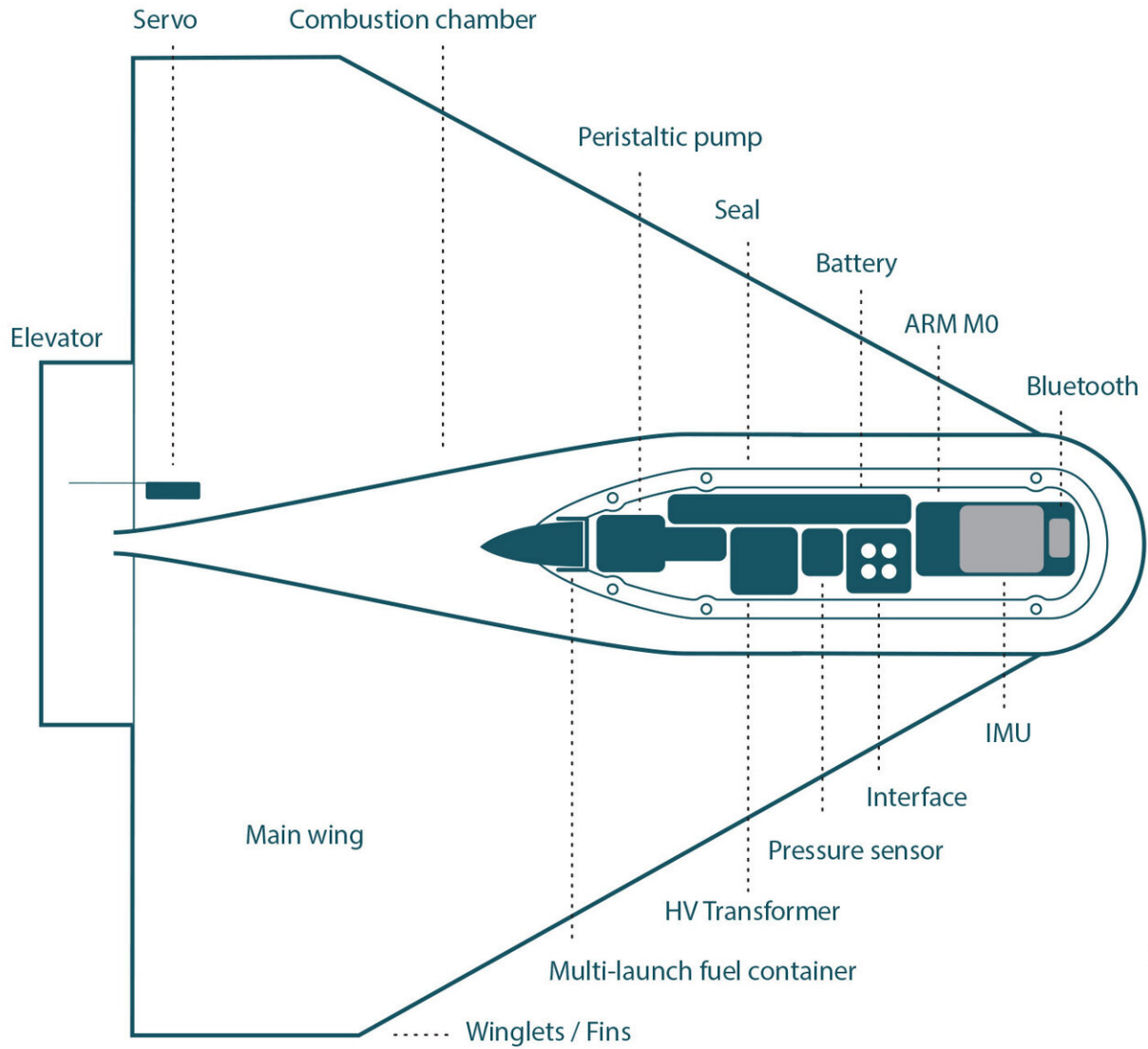
Lead researcher Dr. Mirko Kovac, Director of the Aerial Robotics Laboratory at Imperial, said: "Water-to-air transition is a power-intensive process, which is difficult to achieve on a small-scale flying vehicle that needs to be lightweight for flight."



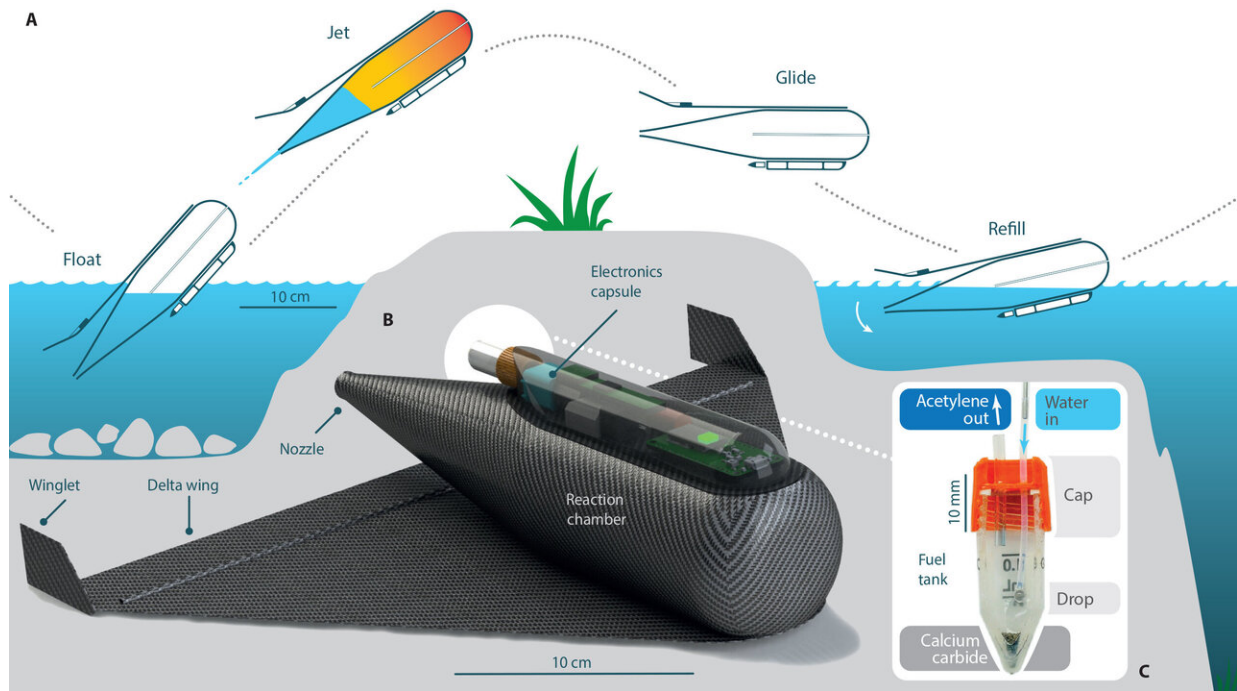
Simulation of flight. Credit: Aerial Robotics Lab/Imperial College London



Composite image of the robot in floating, jetting and flying mode. Credit: Zufferey et al., *Sci. Robot.* 4, eaax7330 (2019)



Labelled parts of the aerial-aquatic robot. Credit: Zufferey et al., *Sci. Robot.* 4, eaax7330 (2019)



A detailed diagram of the aerial-aquatic robot. Credit: Zufferey et al., *Sci. Robot.* 4, eaax7330 (2019)

"We have used water-reactive chemicals to reduce the materials that the robot needs to carry. Since the chamber fills passively and the environmental water acts as a piston, we can create a full combustion cycle with only one moving part, which is the pump that mixes the water with the fuel."

The team tested the robot in a lab, in a lake, and in a wave tank, showing that it can escape from the water's surface even under relatively rough conditions. While similar robots often require calm conditions to leap from the water, the team's invention generates a force 25 times the robot's weight, giving it a greater chance of overcoming the waves.

The robot, which weighs just 160 grams, can 'jump' multiple times after

refilling its water tank. This could allow it to float on [water](#) and take samples at multiple points without additional power, saving energy over longer distances compared to an electrically powered robot.

The team are now working with the Swiss Federal Laboratories for Materials Science and Technology (Empa) to build new vehicles using advanced materials and begin field trials of the [robot](#) in a range of environments, including monitoring the oceans around [coral reefs](#) and offshore energy platforms.

Raphael Zufferey, first author on the paper said: "These kinds of low-power, tether-free robots could be really useful in environments that are normally time- and resource-intensive to monitor, including after disasters such as floods or nuclear accidents."

More information: R. Zufferey et al., "Consecutive aquatic jump-gliding with water-reactive fuel," *Science Robotics* (2019).
robotics.sciencemag.org/lookup.../scirobotics.aax7330

Provided by Imperial College London

Citation: 'Flying fish' robot can propel itself out of water and glide through the air (2019, September 11) retrieved 18 April 2024 from <https://techxplore.com/news/2019-09-fish-robot-propel-glide-air.html>

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