Naval Research Laboratory shatters endurance record for small electric UAV

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Fueled by liquid hydrogen (LH2), the Ion Tiger unmanned aerial vehicle (UAV) completes a record flight time of 48 hours and 1 minute. The electric fuel cell propulsion system onboard the Ion Tiger has the low noise and signature of a battery-powered UAV, while taking advantage of high-energy hydrogen fuel and the high electric efficiency of fuel cells. Credit: U.S. Naval Research Laboratory

Researchers at the U.S. Naval Research Laboratory flew their fuel cell powered Ion Tiger UAV for 48 hours and 1 minute on April 16-18 by

using liquid hydrogen fuel in a new, NRL-developed, cryogenic fuel storage tank and delivery system. This flight shatters their previous record of 26 hours and 2 minutes set in 2009 using the same vehicle, but with gaseous hydrogen stored at 5000 psi.

Liquid hydrogen is three times denser than 5000-psi compressed hydrogen. The cryogenic liquid is stored in a lightweight tank, allowing more hydrogen to be carried onboard to increase flight endurance. Success in flight requires developing a high quality, lightweight insulated flight dewar for the cryogenic fuel, plus matching the boil off of the cryogenic hydrogen to the vehicle fuel consumption.

"Liquid hydrogen coupled with fuel-cell technology has the potential to expand the utility of small unmanned systems by greatly increasing endurance while still affording all the benefits of electric propulsion," said Dr. Karen Swider-Lyons, NRL principal investigator.

The NRL flight crew holds the Ion Tiger unmanned aerial vehicle (UAV). From left to right: Dan Edwards, Mike Baur, Steve Carruthers, Joe MacKrell, Rick

Stroman, Mike Schuette (Sotera Defence), Drew Rodgers and Chris Bovais. Credit: U.S. Naval Research Laboratory

Although long endurance is possible with conventional, hydrocarbon-fueled systems, these are usually loud, inefficient, and unreliable in this aircraft class. Similarly, small, electric, battery-powered systems are limited to endurances of only several hours.

To address the logistics of in-theater supply of liquid or gaseous hydrogen, NRL proposes in-situ manufacture of LH2 for use as fuel. An electrolyzer-based system would require only water for feedstock, and electricity, possibly from solar or wind, to electrolyze, compress, and refrigerate the fuel.

The NRL LH2 flight capability is being developed by NRL's Tactical Electronic Warfare and Chemistry Divisions, and is sponsored by the Office of Naval Research.

Provided by Naval Research Laboratory