Researchers use hydrogen fuel cells to power unmanned aerial vehicle

T.J. Becker
Research News

Georgia Tech researchers have conducted successful test flights of a hydrogen-powered unmanned aircraft believed to be the largest to fly on a proton exchange membrane (PEM) fuel cell using compressed hydrogen.

The fuel-cell system that powers the 22-foot wingspan aircraft generates only 500 watts. “That raises a lot of eyebrows,” said Adam Broughton, a research engineer who is working on the project in Georgia Tech’s Aerospace Systems Design Laboratory (ASDL). “Five hundred watts is plenty of power for a light bulb, but not for the propulsion system of an aircraft this size.” In fact, 500 watts represents about 1 percent of the power used in a hybrid car like a Toyota Prius.

A collaboration between ASDL and the Georgia Tech Research Institute (GTRI), the project was spearheaded by David Parekh, GTRI’s deputy director and founder of Tech’s Center for Innovative Fuel Cell and Battery Technologies.

Parekh wanted to develop a vehicle that would both advance fuel cell technology and galvanize industry interest. While the automotive industry has made strides with fuel cells, apart from spacecraft, little has been done to leverage fuel cell technology for aerospace applications.

“A fuel cell aircraft is more compelling than just a lab demonstration or even a fuel cell system powering a house,” Parekh explained. “It’s also more demanding. With an airplane, you really push the limits for durability, robustness, power density and efficiency.”

In November, the researchers will present details of the project at the Society of Automotive Engineers’ Power System Conference in New Orleans.

Fuel cells, which create an electrical current when they convert hydrogen and oxygen into water, are attractive as energy sources because of their high energy density. Higher energy density translates into longer endurance.

Though fuel cells don’t produce enough power for the propulsion systems of commercial passenger aircraft, they could power smaller, slower vehicles like unmanned aerial vehicles (UAVs) and provide a low-cost alternative to satellites. Such UAVs could also track hurricanes, patrol borders and conduct general reconnaissance.

Breaking new ground
A few other research groups have also done to leverage fuel cell technology for aerospace applications.

Tech welcomes its largest freshman class in history

David Teraso
Institute Communications and Public Affairs

This fall, Georgia Tech has more incoming freshmen on campus than anytime in its 111-year history. Approximately 2,607 students entered Tech this fall, while another 250 began their college career this past summer as part of Tech’s first summer admissions program. At this time last year, Tech’s freshman class counted 2,487. The unplanned growth in enrollment was a result of increased interest in Tech.

“This year we had more students accept our offers of admission than ever before,” said Ingrid Hayes, director of Undergraduate Admission. “Typically we plan for 3 to 5 percent of the students who commit to enrolling at Tech to go elsewhere. This year, less than 1 percent chose to attend a school other than Tech.”

In Brief

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• Georgia Tech Emeritus Professor Stephen L. Dickerson and his wife, Jane, have provided $1.5 million to create the first endowed chair to reside in the School of Civil and Environmental Engineering (CEE). Pending final approval from the Board of Regents, it will be named the Frederick R. Dickerson Chair in honor of his late father.

• The Dickerson Chair is intended to serve as the foundation for major CEE research and education efforts in urban transportation systems, particularly the application of advanced communications and computing to facilitate congestion reduction and energy efficiency. The Chair’s research will help alleviate traffic and air pollution through real-time communications and data processing that enhances public transit, ride-sharing systems, and car rentals.

• ‘A great father and mother, the benefit I received from association with Georgia Tech and the desire to contribute to resolving a significant problem all motivated our gift to Tech,’ Dickerson said.

The next wave of robots in domestic life will be the personal robot [which will] physically interact with and assist people in their daily life. It's already started in trivial applications like vacuum cleaners, pool cleaners and lawn mowers. Now we're ready to go to the next level. —Henrik Christensen, director of the College of Computing's Robotics and Intelligent Machines Center, on the future of robots in domestic life.

McClatchy Newspapers

Ice cream social

Undergraduate students Katie Yurman and Emma Reuter enjoy ice cream bars courtesy of Mayfield Dairy Farms President Scottie Mayfield. The visit to the Woodruff Dining Hall corresponded with a new dessert bar enabling students to make their own sundaes and milkshakes.

Mayfield is an alumnus of Georgia Tech, graduating in 1973 with a degree in management.

Some design challenges:

- **Slim performance margins:** Researchers developed innovative methods to analyze performance, which enabled them to optimize the propulsion system and aircraft design.

- **Weight management:** Creative methods trimmed pounds, such as using carbon foam for the power plant's radiator.

- **Reducing drag:** The team used long, slender wings, a rear-mounted propeller and an inverted V-shaped tail.

- **Miniaturization:** Finding components small enough to fit in this space included a pump from a liquid-cooled computer and a hydrogen tank designed for a paintball gun.

Hayes. "Whether it was a phone call, the smaller receptions or an e-mail, our students and alumnae," said Hayes. "People were able to have meaningful conversations with people who understand the dynamics of studying at this type of institution and have succeeded here. It is an important and effective message for us to communicate."
Students work to improve sanitation in developing countries

By Megan McRainey
Institute Communications and Public Affairs

When given a choice this summer between helping out with designs for environmentally friendly luxury condoms less than a mile away from campus and designing and building solar latrines to improve sanitation in Bolivia, Georgia Tech undergraduate student Calvin Johnson chose the latrine project without hesitation.

"Are you sure?" pressed Kevin Caravati, a student project advisor and senior research scientist at the Georgia Tech Research Institute. "The other project is right down the street."

But Johnson, who is also an All-American wide receiver on Tech's football team, was brief and to the point. "I want to help the less fortunate," he said.

He began the work next day on designs for an inexpensive dry latrine system that could provide schoolchildren in remote areas of Bolivia with much needed basic sanitation facilities that use the sun’s rays to safely transform bacteria-laden waste into fertilizer.

"You realize how fortunate you are when you see that people around the world don’t have clean water and sanitation," Johnson said.

Four billion people globally suffer from chronic waterborne disease, and an estimated 15 million children die annually of diarrhea — conditions linked to a lack of adequate sanitation. In a developing country with extreme conditions like Bolivia, poor sanitation poses a serious health risk, contaminating the limited water supply and attracting disease-carrying insects.

Emory University’s Center for Global Safe Water approached Tech’s School of Civil and Environmental Engineering and GTRI to help remove a sanitation roadblock faced by developing countries — the design and cost flaws of current United Nations latrines.

"We wanted help with the project, but it was tough to find students enthusiastic about latrines," Caravati said.

Johnson was joined by his project partner Brad Davis, a building construction undergraduate student, and the two hammered out a final design with Caravati. The goal was to create an improved solar latrine out of the most affordable and available materials. The waste needed to be heated by the sun to a temperature that would kill pathogenetic bacteria, but the design and materials had to be as simple as possible.

"We focused on designing the most inexpensive and durable model, taking into account what materials would be readily available in those nations," Davis said.

The team made two prototypes from a hodgepodge of household items including a bicycle tire to insulate the waste and retain heat, a bleach bottle, Plexiglas, scrap wood and tin foil. The central idea was to "bake" the waste with an oven-like design that could reach temperatures of more than 150 degrees Fahrenheit while still keeping the inhabited area cool enough for users.

Johnson, Davis and Caravati built two very effective prototypes that would cost only $78 per unit, compared to $120 for existing models. In an area where families make less than $3 per day, that cost difference could make the latrines available for schools, villages and families.

With the initial prototypes completed, the team plans to travel in January to a remote area of Bolivia’s Andes Mountains to build several of the new latrines and instruct locals on how to build their own.

"It has been a great experience for Calvin and me to design and build a latrine that has the ability to vastly improve sanitation throughout the developing world," Davis said.

Georgia Tech undergraduates Calvin Johnson and Brad Davis stand with Christine Moe and Robert Dreibelbis of Emory University’s Center for Global Safe Water as they build a solar latrine prototype. The lack of water and infrastructure contribute to millions of deaths annually from inadequate water supplies and poor sanitation practices.

Tech Alumni Association for his work as a non-alumnus on behalf of the greater good of Georgia Tech. He holds several patents that have been the basis for Georgia Tech spin-off companies in robots and machine vision for manufacturing applications.

Panel discussion on avian flu

The Georgia Tech Pandemic Influenza Task Force and Student Government Association sponsoring an avian influenza briefing to provide Georgia Tech faculty and students with an overview of the potential threat posed by a flu pandemic and to provide information on preparation efforts being made by Georgia Tech, local hospitals and county, state and federal authorities.

The briefing, to be held Monday, Sept. 18 at 6 p.m. in the Student Center Theater, will include participants representing the Georgia Emergency Management Agency, the Fulton County Department of Public Health and Wellness, the Emory University School of Medicine and Georgia Tech Health Services.

For more information, visit elizabeth.campbell@epa.gatech.edu.