# UTA aerospace engineering graduate first to flight test UAV with mass-actuated controls

August 3 2016

Sampath Vengate. Credit: UT Arlington

A recently graduated University of Texas at Arlington student is the first person to successfully flight test an unmanned aerial vehicle that uses moving weights in its wings instead of traditional control surfaces or ailerons to turn.

Sampath Vengate, who graduated in May with a master of science

degree in aerospace engineering, used existing UTA research to design, build and test a UAV that uses mass actuation - weights that move back and forth within the wings to change the center of gravity from side to side - to turn while airborne.

He presented his findings in a paper at one of the two annual American Institute of Aeronautics and Astronautics conferences, held in July in Washington, DC.

The research team Vengate belongs to is led by Atilla Dogan, an associate professor of Mechanical and Aerospace Engineering. That team performed an exhaustive search of existing research, academic papers and publications, and found nothing like what this technology accomplished.

Vengate became interested in the concept as an undergraduate when he entered a competition that called for a UAV to carry a weighted payload that was off-center on the aircraft and successfully drop it on a target. The challenge was to get the aircraft back to ground safely by coming up with a way to handle the imbalance after the drop. He failed to complete that objective. That's when the idea struck him that masses inside an aircraft can be used not only for getting back the aircraft to level, but also to help maneuver the aircraft in different directions.

"I missed the target and I realized that the ailerons, elevators of the aircraft can be completely replaced if I can develop a mechanism to perform the same actions as on a conventional aircraft", Vengate said.

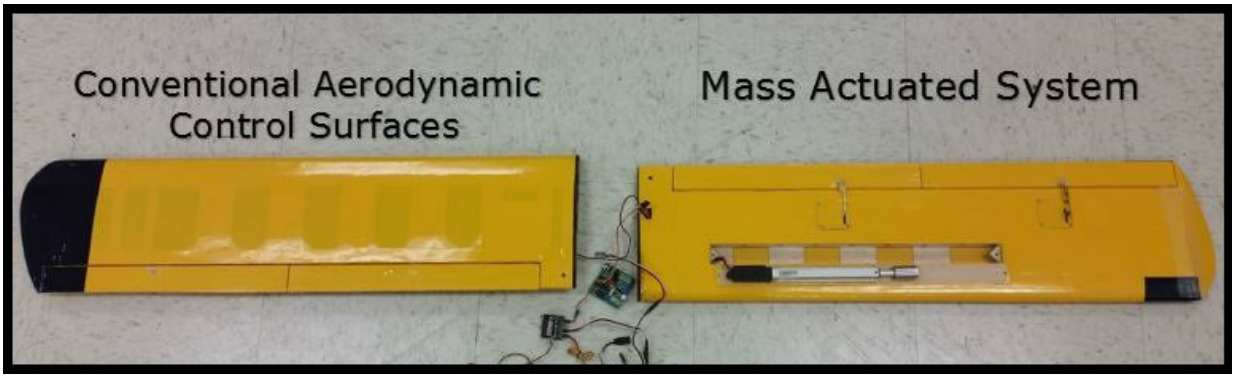
Ailerons/elevators is an aeronautic term that accounts for the movable surfaces, usually near the trailing edge of a wing and tail respectively. They control the roll and pitch of the airframe and affect maneuvers, like banks.

"I had seen research where fuel was redistributed to help stabilize an aircraft, and I wondered if I could build one with mass actuators that would be a constant in the aircraft," Vengate said.

Vengate's successful test could be important in future aircraft because it would allow designers to eliminate ailerons and elevators, which inherently increase drag. Removing those control surfaces would make the aircraft much more efficient by greatly reducing drag, which saves fuel and money. It also would increase the aircraft's range because of the fuel savings.

The technology has potential applications for stealth aircraft and hypersonic aircraft as well, because it cuts down on surfaces that could increase a radar signature or allow a build-up of unsafe temperatures that could damage the aircraft.

Previous students of Dogan, who also is Vengate's graduate advisor, have studied how to control an aircraft in formation flight and during aerial refueling by redistributing fuel, and he is excited by Vengate's findings.




A wing designed by a University of Texas at Arlington team that uses internal weights instead of traditional means to maneuver is shown. Credit: UT Arlington

"We had shown that redistributing fuel between fuel tanks can be used to help trim the aircraft flying within the wake of another in aerial refueling or formation flight, which reduces or eliminates the need for deflection of control surfaces," Dogan said. "In fact, the Concorde pumped fuel back and forth in its fuselage when it went supersonic to compensate for insufficient elevators."

Wendy Okolo, who was one of Dogan's former doctoral students, did extensive research on how to redistribute fuel to maintain level flight during formation flight and spent several summers working on the problem at the Air Force Research Laboratory.

"However, Sampath has done something that is unique according to our research reviews, and the fact that he has successfully applied his theory in flight could have a great effect on future aviation design," Dogan said.

Vengate began his research by using a simulation environment created by Akif Erturk, another Dogan doctoral student, to test the feasibility and potential benefits of his theory in computer simulation.

Once the simulation showed that mass actuation could work, Vengate began designing his airplane using Computer Aided Design tools. He built it from scratch using a laser-cutter to create custom braces to form the wings and hold the actuators in place. His aircraft had ailerons, elevators and a rudder, in addition to the actuators in case the test failed. But he was able to successfully use the actuators to turn the aircraft.

"I was excited that my idea worked, and it's even better that no one else has ever successfully applied this idea to an aircraft," Vengate said. "I'm hoping to spend my career working with UAVs, and this is a great start."

The research displayed by Vengate, Okolo, Erturk and Dogan aligns with the major themes of global environmental impact and data-driven

discovery as outlined in the Strategic Plan 2020: Bold Solutions | Global Impact.

One of UTA's increasingly important research areas involves UAVs. Two years ago, the UTA Research Institute was named to a national consortium charged with integrating UAVs into general airspace. Dogan and three of his colleagues - Frank Lewis, Moncrief-O'Donnell chair at UTARI and electrical engineering professor; Kamesh Subbarao, associate professors of mechanical and aerospace engineering; and Brian Huff, associate professor of industrial and manufacturing systems engineering; composed the UTA team.

That team conducted research studies that enable safe and reliable deployment of unmanned aircraft systems for civilian, law enforcement, military and other uses.

UTA also has started unmanned vehicle systems undergraduate and graduate certificates for students interested in careers in one of the nation's most exciting engineering fields.

In addition, UTARI secured a Federal Aviation Authority Certificate of Authorization, which allows for UAV test flights.

Provided by University of Texas at Arlington