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NEWS

UCF researching how to fly hypersonic in rain

By DANIELA VIVAS LABRADOR
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Imagine boarding a flight from Orlando to Los Angeles and instead of languishing on the plane for five and half hours, you arrive in about an hour, ready to enjoy the palm trees on the Pacific Coast six times faster. That may be decades away but the hypersonic propulsion technology that could make it possible is currently being developed in a University of Central Florida lab.

UCF has been researching hypersonic propulsion for six years, funded by $7.86 million in grants from the U.S. Department of Defense, the Air Force, and other sources. A team of 33 students led by four faculty researchers is exploring and experimenting with this new technology.

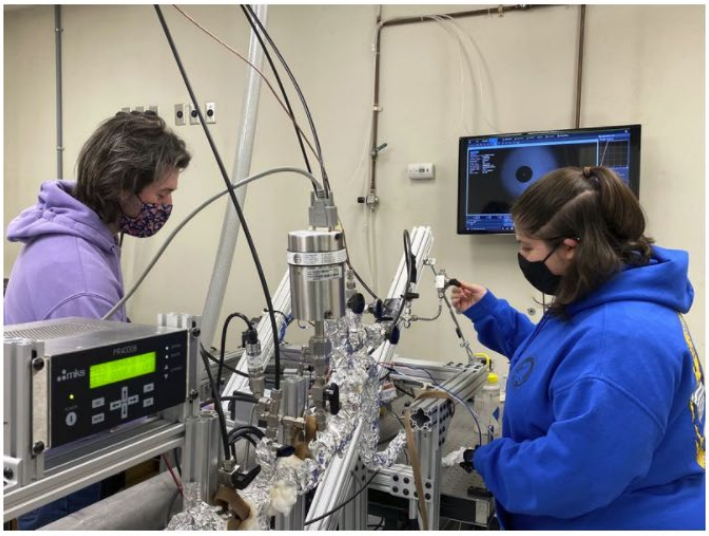
Hypersonic propulsion aims to send a yet-to-be-designed aircraft out of the atmosphere to travel at hypersonic speed, which is about six times faster than the speed of a commercial airplane. But this research goes beyond commercial travel and has become a competitive field among developed nations, said Subith Vasu, a professor in UCF's department of mechanical and aerospace engineering.

"Russia is working on it, China is working on it, and then other countries in the European Union, Japan, India," he said. "It is very difficult, so nobody really has a real hypersonic vehicle. Some people claim that they have but it is only pretending they do because there are a lot of technical challenges."

One of those challenges could be the effect of rain droplets on a vehicle traveling at hypersonic speeds, and its become a focus of study for the researchers.

Michael Kinzel, project co-investigator and assistant professor in UCF's department of mechanical and aerospace engineering, said that every time speed is doubled, the impact force from a raindrop quadruples. With hypersonic speed, they are going six times faster. Researchers are trying to figure out how to design a vehicle that can withstand that kind of pressure as it travels through the rain.

"You can imagine the loads we have to worry about with rain," he said. "When we do some real quick calcs, each raindrop actually has a load that is equivalent to the weight of an elephant."



UCF students Nicolas Berube (left) and Sydney Briggs (right) working with the detonation tube model on Thursday, February 10, 2022. Both are working with Subith Vasu on raindrop effect research for hypersonic propulsion. (Daniela Vivas Labrador / Orlando Sentinel)

Research assistant Reed Forehand found his passion for the hypersonic field during his undergraduate study. Now, he is working with Kinzel on an Air Force Office of Scientific Research-funded project to help advance the country's knowledge in this area.

"This project kind of fell onto my lap actually," Forehand said. "I had done previous research into multiphase flows, and shock waves, and hypersonics, so all of that kind of combined together and led me to being able to take on this project and being a good candidate for it."

Together they are challenging the U.S. Navy's hypothesis of raindrops instantly boiling due to the high temperatures of the hypersonic vehicle, Kinzel said. In fact, other research at UCF focuses on designing high-temperature coatings and materials.

Yet so far the rain droplets research shows boiling is a relatively slow process, and hypersonic speed does not allow enough time for it. Meanwhile, cavitation is a fast enough mechanism. This phenomenon happens when the water's pressure is lowered below the vapor pressure of the liquid in movement, acting as an alternate and quicker boiling mechanism.

"Water can cavitate," said Vasu, research lead co-investigator for this study. "These are kind of like microexplosions that will happen because of how the fluid moves and when that happens, it can cause significant physical damage because it is like a real explosion, so it can actually dent steel and so on."

Vasu emphasized that everything about this topic is new.

"This kind of vehicle did not exist before," Vasu said. "Flying at that speed is new, and even if you were able to fly, how do you deal with water droplets?"

Kinzel said the applicant pool was full of prospective students like Forehand for this research assistant position.

"I think a lot of UCF students are really engaged in hypersonic vehicle design and research," Kinzel said.

UCF students' interest in this topic could be attributed to associate professor of engineering Kareem Ahmed's journey in the field. Ahmed has been researching hypersonic propulsion for over six years at the university.

"It started with passion. From a young age, I was fascinated with speed, and the only way to get you there is propulsion, that engine that propels you from one point to another," Ahmed said.

Last year, during the pandemic, UCF's hypersonic propulsion project won a **$1.5 million grant from the U.S. Department of Defense**. Since 2016, the group has received about $6 million.

"It was exhilarating," Ahmed said. "Now we are accelerating towards developing an engine prototype for the Department of Defense."

Ahmed's success and achievements are also offering a unique experience to 16 students who work with him, like UCF mechanical engineering graduate student Adam Kotler.

"This was a very exciting new hypersonics project that came in and we needed all hands on deck for this and I was very fortunate to be selected to work on this," Kotler said. "This is an opportunity for me to make a name for myself in academia and also to prepare myself for the industry, to be one of the leading experts in this particular type of hypersonic propulsion after I leave UCF."

Vasu said the main goal of hypersonic research overall is commercial travel, but that still is about 100 years away. Yet the progress and promise of the research are attracting more students to work in this field after finishing their undergraduate degrees.

Sydney Briggs, a UCF graduate student in mechanical engineering, started working with Vasu a year ago and said the recent Air Force funding gave her that feeling of a major breakthrough.

"It is something that definitely feels important like we are actually doing something that is valuable," she said. "There is still so much we don't know, but there is a lot we have learned along the way."

This story is part of a partnership between the Orlando Sentinel and UCF's Nicholson School of Communication and Media.

Link to the story's video on the Orlando Sentinel YouTube channel: https://youtu.be/PC8DQUMBoTo