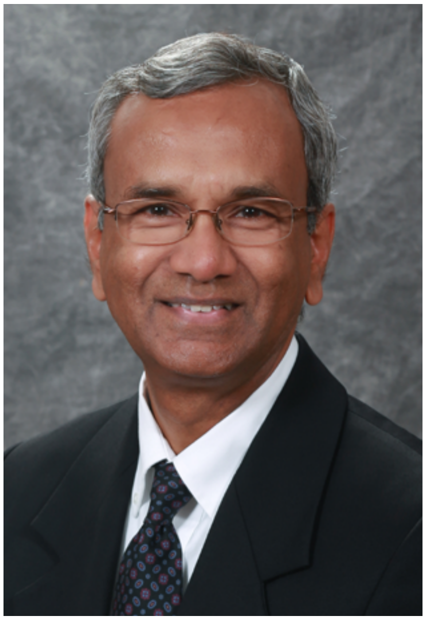
TEXAS A&M UNIVERSITY

2020

DEPARTMENT OF

AEROSPACE ENGINEERING

LETTER FROM THE DEPARTMENT HEAD



The Department of Aerospace Engineering at Texas A&M University is proud to be among the top nationally ranked aerospace engineering programs in the United States. Over the past eight years, under the leadership of former department head Dr. Rodney Bowersox, we saw growth in every corner of our department.

Members of our faculty have secured support from the likes of NASA and the National Science Foundation to pursue ground-breaking research. This research includes working with shape-shifting metals that could control spacecraft temperatures on future missions to the moon, studying propulsion systems that could enable us to travel to the nearest stars in our lifetime, developing novel optomechanical sensing technologies to enable high precision autonomous navigation and challenging the theories behind the driving failure of metal alloys.

Our students are equally as enthusiastic about the possibilities within the field of aerospace engineering. Many of our students received scholarships to support their studies, and internships that have brought them closer to their passions. They have participated in cutting-edge research at the undergraduate and graduate levels, and have won national and international competitions, including first place in the SAE International Design East competition.

As we prepare for another academic year, I am proud to reflect on the department's past achievements and the resilient commitment we have seen from our students, faculty and staff. I look forward to advancing the department in my new role as interim department head as we continue to learn, innovate and create opportunities for the future minds in our field.

Sincerely,

Srinivas Rao Vadali
Interim Department Head

TEXAS A&M UNIVERSITY

Department of Aerospace Engineering

BY THE NUMBERS

RANKINGS (2021)

#7 Undergraduate Program Ranked No. 7 (Public) (*U.S. News & World Report*)

#5 Graduate Program Ranked No. 5 (Public) (*U.S. News & World Report*)

ENROLLMENT*

(FALL 2020)

868 Total

676 Undergraduates

192 Graduates

**preliminary*

FACULTY

42 Tenured/ Tenure Track

6 Distinguished Professors

8 National Academy of Engineering Members

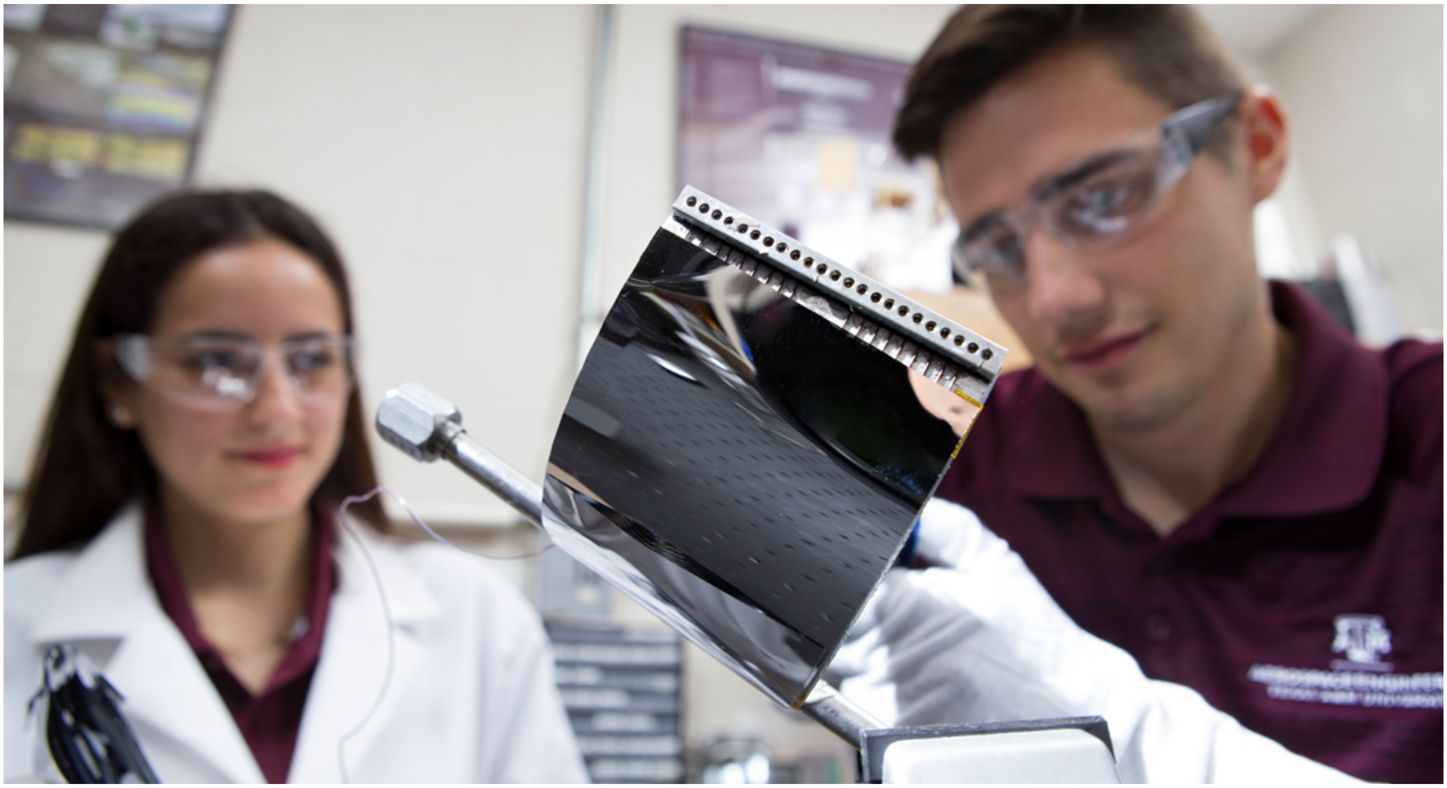
DEGREES AWARDED (FALL 2019-SUMMER 2020)

138 Undergraduate

28 Master's

11 Ph.D.

SHAPE-SHIFTING METALS TRANSFORM LUNAR MISSIONS



With lunar explorations on the horizon, including putting astronauts back on the moon by 2024, NASA is investing $2 million in cutting-edge thermal technology to make regulating temperatures during missions possible.

This technology will be developed by a team of researchers from Texas A&M, the Boeing Company and Paragon Space Development Corporation. The team is focused on creating shape-shifting technology to adjust thermal control systems automatically.

“Our proposed solutions incorporate shape-shifting metals that adjust their own heat rejection based on how hot or cold they are, so it solves the problem for us,” Dr. Darren Hartl said.

Hartl and his team have a successful history partnering with both Boeing and Paragon on shape memory alloy (SMA) technology. Most recently, Hartl and Dr. John Whitcomb have worked on an idea with Paragon to create a morphing radiator composed of SMAs.

Prototypes of the morphing radiator were developed by former graduate students Christopher Bertagne, now at NASA’s Jet Propulsion Laboratory, and Patrick Walgren, current doctoral student. They successfully tested the prototypes in a small thermal vacuum chamber at NASA’s Johnson Space Center.

The funding from NASA, awarded through the Tipping Point initiative, will launch the SMA-based thermal control technology into its next phase.

Texas A&M will further develop the morphing radiator as well as the modeling and optimization of an accompanying thermal switch, also composed of SMAs. These thermally sensitive technologies represent uncharted territory, yet are critical to the operations of future space expeditions.

“It will be another successful example of morphing structures enabling something that couldn’t have been done before,” Hartl said. “It will be another example to the aerospace industry that you can have a structure adapt itself to its environment.”

FEATURED RESEARCHERS

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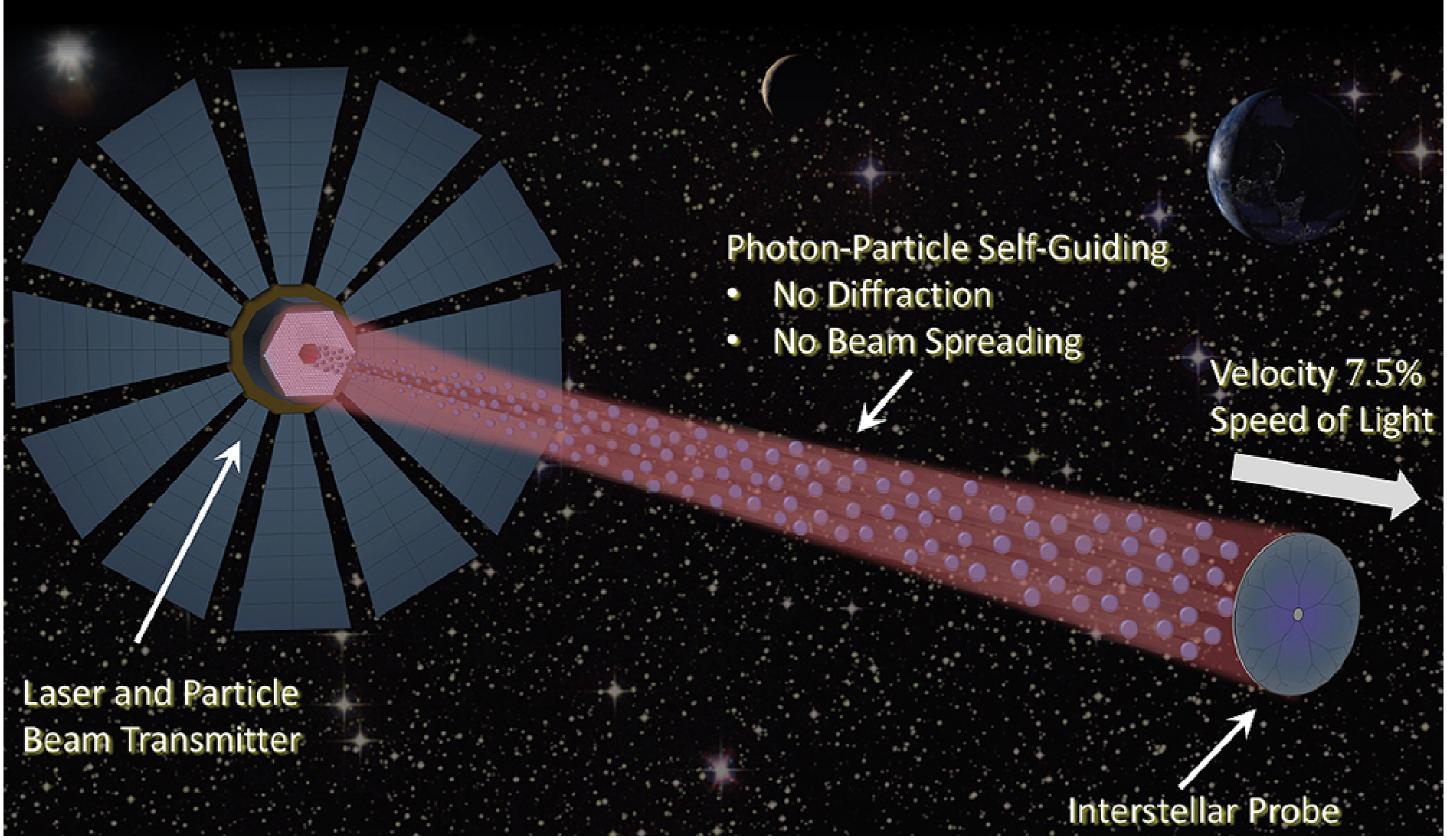

NEW PROPULSION SYSTEM FOR MISSIONS **TO THE STARS**

To explore beyond the outer planets and into interstellar space, you would need to traverse vast distances in a reasonable time, which requires tremendous speed. These daunting requirements far exceed the current capabilities of chemical or plasma propulsion systems.

With the help of a NASA Innovative Advanced Concepts Phase II grant, a Texas A&M-led research team will continue to develop a new type of propulsion system, possibly enabling missions in our lifetime to the nearest stars.

The team, led by Dr. Chris Limbach, has proposed combining a laser beam and a neutral particle beam, using them to push a spacecraft to nearly 10% the speed of light. Unlike either beam alone, the researchers are tailoring the beam parameters to exploit the refraction of light and optical forces to eliminate the spreading or expansion of the beams, which would otherwise decrease thrust and limit the maximum speed. This process, known as self-guiding, enables the beams to propel the spacecraft over millions of kilometers.

Experiments will be conducted at the Aerospace Laboratory for Lasers, Electromagnetics and Optics. At the end of Phase II, the team plans to demonstrate progress toward future implementation of this propulsion technique, including beam source development, an improved understanding of the physics and the completion of modeling tools needed to design a full-scale system.

In addition to Limbach, the team includes Dr. Ken Hara, assistant professor at Stanford University, and Dr. Alexandros Gerakis.

FEATURED RESEARCHERS

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UNRAVELLING THE MYSTERY OF WHY **MATERIALS SUCCUMB TO PRESSURE**

Texas A&M researchers are challenging current theories behind the driving failure of metal alloys. Their findings could unravel the mystery of why load-bearing structures like commercial aircrafts and bridge suspension beams suddenly crack under physical stress.

The leading theory is porosity softening, which creates voids in the alloy that grow and join under constant tension. These cause shear fractures — the particular type of break that occurs in metal alloys.

Dr. Amine Benzerga and his colleagues noticed that most studies investigating the cause of shear fractures were based on experiments using rectangular-shaped alloys. For their experiments, Benzerga's team turned to cylindrical-shaped alloys. With the new shape, they found their specimens less frequently had shear fractures.

"The fact that the shape of our specimens was influencing how often we saw shear fractures told us that something else is driving shear failure and that porosity softening was not the whole story," Benzerga said.

To examine the cause, researchers built a sophisticated simulation model that considered porosity softening along with other potential causes, including plastic anisotropy — the property by which a pull or load on a material from one direction causes damage that is different from that in another direction.

"Our simulations were telling us something very different from the accepted theory for the cause of shear fractures," Benzerga said.

The researchers speculate that plastic anisotropy causes internal damage to the material, leading to voids. As damage continues, these voids become larger naturally, then coalesce over time and cause failure.

FEATURED RESEARCHER

Dr. Amine Benzerga
Professor
General Dynamics Professor in Aerospace Engineering
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REED AWARDED TEXAS A&M UNIVERSITY DISTINGUISHED PROFESSORSHIP

Dr. Helen Reed was among seven faculty members appointed as a Texas A&M University Distinguished Professor. The designation identifies faculty who are preeminent in their fields and have made at least one landmark contribution to their discipline. The title is among the highest honors awarded to faculty members.

Reed directs the Computational Stability and Transition Lab, as well as the AggieSat Lab satellite program. She is widely regarded as an expert in small satellite design, hypersonics, boundary-layer stability and transition, and energy-efficient aircraft.

Reed is a licensed professional engineer in the state of Texas and has received numerous professional awards and honors, including being named a fellow of the American Institute of Aeronautics and Astronautics (AIAA), the American Physical Society and the American Society of Mechanical Engineers (ASME). She is the recipient of the 2018 AIAA/National Academy of Engineering (NAE) Yvonne C. Brill Lectureship in Aerospace Engineering, the 2018 AIAA Fluid Dynamics Award, the 2016 Kate Gleason Award from ASME, the 2007 Atwood Award from the American Society for Engineering Education and AIAA, and the 2014 Minnie Stevens Piper Professor Award from the state of Texas.

Reed is a member of the United States Air Force (USAF) Scientific Advisory Board, the USAF Studies Board Development Planning Roundtable, the NAE Intelligence Science and Technology Experts Group, and the NATO Science and Technology Organization Applied Vehicle Technology 346 Technical Team in Hypersonic Transition. She is a co-founder of Chandah Space Technologies.

DEPARTMENT OF AEROSPACE ENGINEERING

AREAS OF FOCUS

Aerodynamics and Propulsion

Dynamics and Controls

Materials and Structures

Systems, Designs and Human Integration