TEXAS A&M
UNIVERSITY

2021

DEPARTMENT OF

AEROSPACE ENGINEERING

LETTER FROM THE DEPARTMENT HEAD

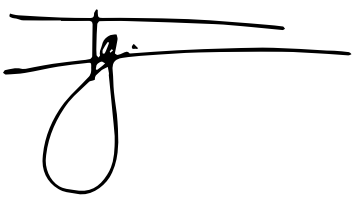
The Department of Aerospace Engineering at Texas A&M University has been on an impressive upward slope over the last eight years to be one of the top 10 nationally ranked aerospace engineering programs in the United States. This achievement reflects greatly on the leadership of former department head Dr. Rodney Bowersox, the interim department head Dr. Srinivas Rao Vadali and all of the faculty and staff in the department.

The department's four research concentrations: aerodynamics and propulsion; materials and structures; dynamics and control; and systems, design and human integration; afford students a variety of relevant and current research topics in aerospace engineering. Members of our faculty are recognized with funding by the Department of Defense, NASA, the National Science Foundation and industry to pursue discovery and find answers for cutting-edge scientific questions. A few examples of current research areas are shape-memory alloys for a variety of applications, hypersonic flight, space life support systems and human performance in extreme environments, vertical flight, new uses of lasers and electromagnetic concepts for aerospace applications, bio-nano materials and structures for aerospace vehicles, robotic sensing and controls, and vehicle systems and controls for small to medium unmanned fixed-wing aircraft and rotorcraft.

Our students are at the core of any past and future successes for the department. We are proud that many of our students receive scholarships, internships and fellowships that recognize the quality of the students we attract and provide them with more freedom to pursue the research they are most passionate about. Our students have opportunities to do hands-on on cutting-edge research at the undergraduate and graduate levels. They have won national and international competitions including, in the last two years, four vertical flight foundation scholarships, the 2020 and 2021 Society of Aerospace Engineers Aero Design competition (an international competition), an NSF Graduate Research Fellowship and a Department of Defense's Science, Mathematics and Research for Transformation Scholarship.

I am the new department head starting this semester. I am humbled to assume this position at such an exciting time for the department. I was attracted to pursue this role because I see all the right conditions for the department to continue on its upward path. I look forward to embarking, alongside the department's stakeholders, on a renewed effort to achieve even higher levels of recognition, academic and teaching excellence, and relevance to today's and tomorrow's aerospace scientific challenges.

Sincerely,



Ivett A. Leyva, Ph.D., P.E.
Department Head

TEXAS A&M UNIVERSITY
Department of
Aerospace Engineering

BY THE NUMBERS

RANKINGS (2022)

#6 Undergraduate Program
Ranked No. 6 (Public)
(*U.S. News & World Report*)

#6 Graduate Program
Ranked No. 6 (Public)
(*U.S. News & World Report*)

ENROLLMENT* (FALL 2021)

**preliminary, 5th class day*

963 Total

734 Undergraduates

229 Graduates

FACULTY

39 Tenured/ Tenure Track

5 Distinguished Professors

7 National Academy of Engineering Members

DEGREES AWARDED* (AY 2020-21) **preliminary*

169 Undergraduate

39 Master's

15 Ph.D.

FUTURE OF SPACE NAVIGATION

Dr. John Junkins, inspired by the space race and a prominent aerospace engineer T.N. Edelbaum, set out to answer a question Edelbaum posed over 50 years ago: How many impulses?

Specifically, how many velocity impulses — and in what direction and at what time — must be used to allow a spacecraft to "fly" from its starting point to reach a specified destination with a minimum total impulse?

Prior to Junkins' and his team's recent work, there was no rigorous process to answer Edelbaum's question, which arises in virtually every space flight mission.

By varying the theoretical maximum thrust allowed by x amount, Junkins, alongside Dr. Ehsan Taheri, revealed the solution for any maximum thrust level. As the theoretical maximum thrust is allowed to approach infinity, longer coasts appear between ever shorter optimal thrust arcs. The limiting case is the answer to Edelbaum's optimal impulse question for any feasible orbit transfer.

FEATURED RESEARCHER

Dr. John Junkins

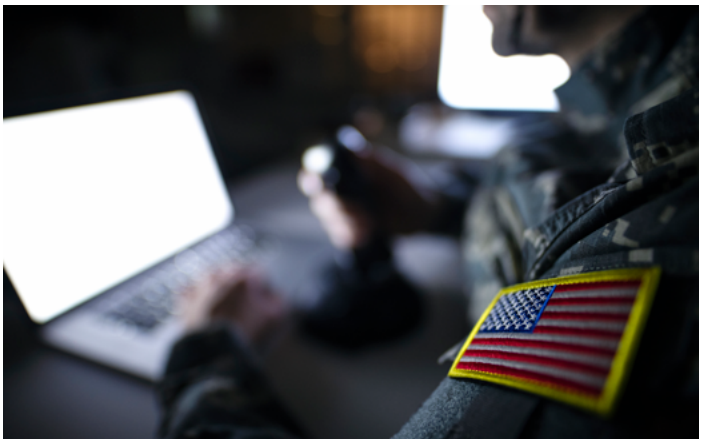
Distinguished Professor of Aerospace Engineering, Regents Professor, Holder of the Royce E. Wisenbaker Chair; Director, Hagler Institute for Advanced Study

MORPHING DRONES RESEARCH

Researchers in the Combat Capabilities Development Command Army Research Laboratory are developing a drone with the ability to morph while in flight to better fit its mission. For example, in situations involving the shortening and lengthening of a drone wing for efficiency and speed. To begin their work, they turned to the expertise of researchers at Texas A&M for assistance with the complex analysis and design stage.

Tackling part of this first step, a team led by Dr. Darren Hartl developed a novel fluid-structure interaction algorithm. This vital tool will provide the Army Research Laboratory's researchers with a streamlined means to analyze the interaction between fluid and air flows and flexible or adaptable solid structures in their pursuit of a transforming drone.

Their algorithm substantially cuts down on the computational cost by simultaneously running analyses for various pressures and structure shapes and then using mathematical tools to stitch together two matching solutions.



FEATURED RESEARCHER

Dr. Darren Hartl

Assistant Professor

DETONATION TESTING FACILITY UNDER CONSTRUCTION

A new Detonation Research Test Facility (DRTF) is being built on The Texas A&M University System RELLIS Campus, adding to its array of capabilities for solving complex global problems.

Dr. Elaine Oran, a world authority on the physics and chemistry of explosions, will lead a team at the DRTF in examining how flammable gases and other materials interact and sometimes — though not always — detonate on a massive scale.

The discoveries could help prevent horrific mining, industrial and home accidents, predict the path of wildfires and make high-speed engines run more efficiently. It could potentially improve the understanding of supernovas.

The Texas A&M System Board of Regents approved a plan to invest $5 million for the construction of what is likely to be the largest university-based facility of its kind in the world.

FEATURED RESEARCHER
Dr. Elaine Oran
Professor, O'Donnell Foundation Chair VI

NASA FUNDS ALTERED GRAVITY RESEARCH

NASA's Human Research Program is funding two proposals led by Dr. Ana Diaz Artiles to study the effects of altered gravity on bimanual coordination and cardiovascular and ocular health.

Her first proposal looks at uncovering the effects of altered gravity on bimanual coordination by having subjects complete a series of tasks during parabolic flight.

The second looks at the health of subjects who experience altered gravity, specifically concerning ocular and cardiovascular changes that have been associated with spaceflight. This is investigated by tilting subjects at different angles on a tilt table and using a device to generate negative pressure on lower parts of the body.

While different in method, both research projects look to solve complex problems associated with human health and performance during spaceflight.

FEATURED RESEARCHER
Dr. Ana Diaz-Artiles
Assistant Professor

MATHEMATICAL TOOL SELECTS BEST SENSORS

Incidents like the 2019 Boeing 737 Max crash, which hinted at a failed pressure sensor, have fueled a larger debate on sensor selection, number and placement to prevent the recurrence of such tragedies.

Researchers have developed a comprehensive mathematical framework to help engineers make informed decisions about which sensors to use and where they must be positioned in aircraft and other machines.

"During the early design stage for any control system, critical decisions have to be made about sensors so that the system is optimized for measuring certain physical quantities of interest," said Dr. Raktim Bhattacharya. "With our formulation, engineers can feed the model with information and the output will be the fewest sensors needed and their accuracy.

FEATURED RESEARCHER
Dr. Raktim Bhattacharya
Associate Professor

HYBRID NANOMATERIALS IMPROVE ARMOR

A research team led by Dr. Mohammad Naraghi is receiving funding support over the next three years from the U.S. Army Research Office to explore the protective potential of hybrid nanomaterials for armor applications.

A class of hybrid 1D and 2D nanomaterials, where 1D materials reinforce 2D materials, shows promise in providing superior resiliency. However, there are significant unknowns about the hybrid materials' mechanical performance that the research team hopes to answer.

In developing ideas, they have found inspiration in tree leaves. The team compared the nanomaterials to the venation system (vein pattern) and epidermis of leaves. Although the main function of the leaves' venation system is arguably not load-bearing, it certainly contributes to deflecting the propagating cracks.

FEATURED RESEARCHER
Dr. Mohammad Naraghi
Associate Professor

TEXAS A&M LEADS **HYPERSONICS CONSORTIUM**

The DOD named a state agency of The Texas A&M University System to lead a national consortium for modernizing hypersonic flight capabilities.

The Texas A&M Engineering Experiment Station (TEES) will manage a five-year, $20 million-per-year DOD initiative involving many of the nation's top research universities. The universities will work cooperatively among themselves and with other key research institutions.

The University Consortium for Applied Hypersonics (UCAH) works on everything from basic research to real-world capabilities in hypersonic flight systems. Together, researchers will accelerate innovation to address the nation's hypersonic needs and nurture the next generation of researchers in aerospace engineering and related fields.

The UCAH is managed by TEES under the leadership of one of the nation's foremost hypersonic researchers, Dr. Rodney Bowersox.

FEATURED RESEARCHER

Dr. Rodney Bowersox

Professor, Associate Dean for Research, Holder, Ford Motor Co. Design Professorship I, Director, Texas A&M National Aerothermochemistry & Hypersonics Laboratory

MULTIDISCIPLINARY PROJECT INCORPORATES EDUCATIONAL INITIATIVE

A $10 million NASA project led by a Texas A&M research team headed by Dr. Dimitris Lagoudas has extended its reach to include an educational component.

The core objective is to design a civil transport supersonic aircraft capable of adapting its shape during a supersonic flight to reduce noise emissions.

Students who participate in the project's AggiE-Challenge initiative will be introduced to aspects of the problem through a series of lectures followed by hands-on experiences in developing, designing, manufacturing and/or testing solutions.

To mitigate the sonic boom generated when the aircraft breaks the sound barrier, the group will investigate the use of smart material actuators to adapt the aircraft's Outer Mold Line.

FEATURED RESEARCHER

Dr. Dimitris Lagoudas

Professor, Senior Associate Dean for Research, University Distinguished Professor, Robert C."Bud" Hagner Chair of Engineering, Associate Vice Chancellor for Engineering Research, Deputy Director, TEES

TEXAS A&M UNIVERSITY
Department of
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DEPARTMENT OF AEROSPACE ENGINEERING

AREAS OF FOCUS

Aerodynamics and Propulsion

Dynamics and Controls

Materials and Structures

Systems, Designs and Human Integration