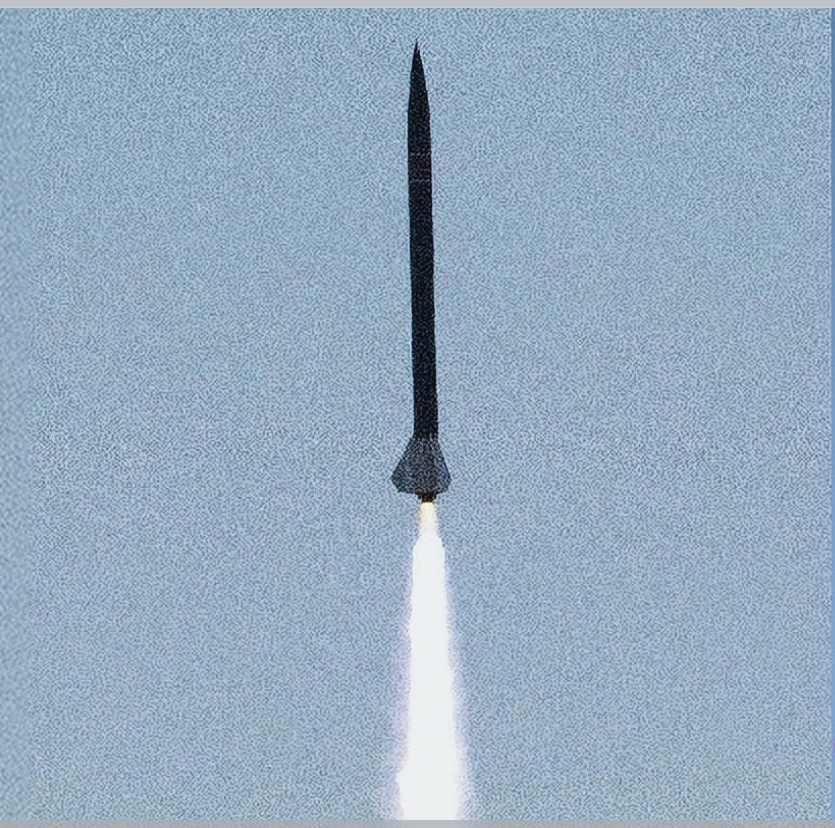
Texas Tech Mechanical Engineering



SPRING 2025

From Concept to Creation: The Power of Mechanical Ingenuity

CHAIR'S MESSAGE

Song-Charng Kong, Ph.D.

Department Chair, Don Kay Clay Cash Endowed Chair

Our students are known for their hands-on ability and being good team players. This academic year brings forth many accomplishments from our student organizations. The Pi Tau Sigma earned the right to host a national convention on the TTU campus this spring. The convention was a massive success for the students and our institution. The Raider Aerospace Society competed in the Spaceport America Cup, in which they launched their homemade rocket to 10,000 ft. and retrieved it successfully. You can enjoy the video here (https://youtu.be/hJQgAgu9wrw). The Red Raider Racing has transitioned to the era of electric vehicles. The Space Exploration Raiders continued to qualify and compete for the NASA Rover challenge this year. Lastly, the robotics team expanded its operations to utilize the Reese Technology Center space 10 miles west of campus. We are excited to see all the student organizations thrive and enrich students' educational experience.

We continued renovating our buildings and implementing additional study space for students, saving their trips to the library between classes. To accommodate the future need for graduate students as we grow the research program, we have renovated two large offices with cubicles to house graduate students. We are in the process of renovating two more large offices. We have refurbished several research laboratories for new faculty members and will repurpose more space to accommodate the growth of the Department. Such investments align with TTU's vision of becoming a major research university. Meanwhile, I thank you for your generous support, which enables the Department to enhance the Energy & Propulsion Laboratory by purchasing new instruments. Nonetheless, we are in the process of raising funds to renovate this lab space. Your continued support will be greatly appreciated.

Our Aerospace Engineering Minor is widely popular among the students. We anticipate graduating ~60 students with Aero E minor among the ~280 ME graduates this academic year. Effective F24, the College implemented a Robotics Minor. To receive a minor in robotics, ME students will take one foundational robotics course and two electives and complete their capstone design projects in robotics. Since mechanical engineering is such a broad discipline, our students will be very marketable with an additional minor.

To support the growth in research and curriculum, we continue to hire new faculty members in strategic areas. Three assistant professors joined the Department in F24; their research is in high-speed flows, supersonic combustion, and flight controls and dynamics. We are currently recruiting new faculty members in robotics and hypersonic areas. These new and existing faculty will continue providing students with high-quality education to prepare them for their careers and advance our society.

Lastly, as the BIG 12 Conference expands its membership and every ball game has become increasingly competitive (and loud), we need all the members of the Red Raider family to return to campus to cheer for our teams. If you return to Lubbock on any occasion, please contact me (sokong@ttu.edu), and I will show you around the Department!

ME Pi Tau Sigma Society hosted the National Convention on TTU campus on March 7 - 9, 2025.

Focusing on New Faculty

Recognizing New Faculty and their Work in the ME Department

Thanakorn Khamvilai
Assistant Professor

Dr. Thanakorn Khamvilai holds a PhD in Aerospace Engineering from Georgia Tech and a BS from Kasetsart University, Thailand. His research spans safety-critical applications, including unmanned aircraft systems, multi-core avionics, and distributed engine control. He receives research funding from DoD, NSF, FAA, and private companies. Prior to TTU, he worked at Penn State's Unmanned Aircraft Systems Research Lab and was a visiting scholar at KAUST. He also holds Private Pilot and Remote Pilot Certificates, and he is a lifetime member of the Experimental Aircraft Association. Among his hobbies, he loves to fly an airplane and engage with local aviation communities.

Dhawal Buaria
Assistant Professor

Dr. Buaria earned his PhD in Aerospace Engineering from Georgia Tech, and his research focuses on understanding and modeling large-scale fluid dynamics phenomena that are critical to both engineering systems and geophysical processes. Notably, by integrating theory with state-of-the-art numerical simulations and deep learning paradigms, his work seeks to decipher universal properties of fully turbulent flows and associated mixing and transport phenomena. His research has been published in numerous high-impact journals, including Nature Communications, Physical Review Letters, PNAS, and Science Advances, reflecting the broad relevance and significance of his research.

Chang-Hsin Chen
Assistant Professor

Dr. Chen's research focuses on the physics of shock waves, turbulent flows, and high-performance computing. He has proposed theoretical solutions for turbulent shock waves and built one of the largest databases of shock-turbulent interactions in the literature. His work on shock-turbulence interactions was highlighted in HPCwire and InsideHPC. In 2018, he received the Outstanding Achievement Award from the Department of Aerospace Engineering at Texas A&M University for his academic work. Additionally, Dr. Chen has collaborated with leading aerospace organizations and contributed to high-impact journals, advancing the understanding of complex fluid dynamics and computational modeling.

Introducing Minor in Robotics

The Robotics Minor is an interdisciplinary program designed for students eager to explore innovation, automation, and emerging technologies in robotics. ME students need to take one foundational course (Introduction to Robotics), complete a capstone design project relevant to robotics, and take two additional courses from the approved list of electives, including Robot and Machine Dynamics, Modern Digital System Design, Unmanned Aircraft Systems, and Mechatronics. Additional electives are planned. Students can also work with faculty members to conduct a research course related to robotics.

Research Grants and Awards

Michelle Pantoya
Horn Distinguished Professor

Power Unleashed: Dr. Pantoya's Aluminum Innovation Boosts Rocket Fuel Potential

Dr. Michelle Pantoya has discovered a way to dramatically enhance the power of aluminum particles used in rocket fuels and explosives through an innovative coating technique. Her research team at Texas Tech University developed a method to transform the traditional protective alumina shell into bayerite using a water-based process, which enables the particles to burn faster while remaining stable.

The breakthrough resulted in aluminum particles that burn 17.75% faster and combust more efficiently, especially under high-pressure conditions. With 96% of the aluminum core preserved during the transformation, her work, funded by the US Army Research Office, demonstrates significant potential for advancing rocket fuel technology and other high-power applications.

Indrajit Srivastava
Assistant Professor

Indrajit Srivastava has discovered how to make light linger in tumors to ensure more accuracy in the removal process.

Dr. Indrajit Srivastava's research focuses on revolutionizing tumor removal surgeries through an innovative technique called afterglow imaging. Unlike the current fluorescence-guided surgery, which uses dye that fluoresces only under continuous laser illumination, afterglow imaging enables the dye to persistently glow for up to 10 minutes after the initial laser exposure. This "glow-in-the-dark" effect allows surgeons more time to differentiate between cancerous and healthy tissues with precision, even during deep tissue surgeries. By addressing the limitations of fluorescence imaging, such as poor penetration depth and scattering of light, this technique significantly enhances the accuracy and efficiency of tumor removal procedures. His groundbreaking research exemplifies a commitment to improving medical technology and patient outcomes through continuous scientific innovation.

Ming-Chien Chyu
Professor

Ming-Chien Chyu, known globally as the "Father of Healthcare Engineering," was inducted into the Forbes Technology Council.

Dr. Chyu, a professor at ME and the Founding President and Executive Director of the Healthcare Engineering Alliance Society (HEALS), is known as the "Father of Healthcare Engineering." He has recently been inducted into the esteemed Forbes Technology Council, an exclusive organization for top-tier CIOs, CTOs, and technology executives, in recognition of his commitment to enhancing healthcare through engineering, along with his impressive accomplishments.

Minliang Liu
Assistant Professor

Advancing Digital Twin Technology in Biomedical Research: NSF-Funded Initiatives for Healthcare Innovation

The U.S. National Science Foundation (NSF), in collaboration with the National Institutes of Health (NIH) and the Food and Drug Administration (FDA), has awarded over $6 million to seven research projects focused on advancing the digital twin technology in biomedical applications.

Among the recipients, Dr. Minliang Liu's Cardiovascular Biomechanics Lab, in partnership with Dr. Liang Liang from the University of Miami's Department of Computer Science, has been awarded funding to develop high-fidelity, machine learning-accelerated digital twin models for virtual clinical trials of cardiovascular medical devices.

This research aims to enhance patient-specific simulations, improving medical device evaluation while reducing the time and financial costs associated with real-world trials. The project will create advanced computational methods for real-time digital twin simulations of patient hearts and cardiovascular devices, incorporating AI-driven image analysis and physics-based modeling.

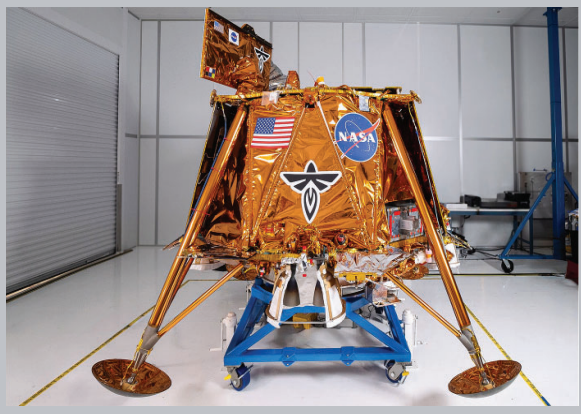
By enabling safer and more efficient virtual clinical trials, the research has the potential to revolutionize regulatory science and cardiovascular treatment. The developed methods and cyberinfrastructure will also serve as an educational resource for students, researchers, and industry professionals, fostering further innovation in digital twin technologies.

Alumni Spotlight

Texas Tech Engineering Alumnus Designs Lunar Mission Hardware, Advancing University's Space Research Legacy

Texas Tech's footprint in space exploration reached a milestone as alumnus Joe Quirk, a 2014 graduate of the Mechanical Engineering, served as lead CAD designer for Firefly Aerospace's Blue Ghost lunar lander. The spacecraft, launched January 15 aboard a SpaceX Falcon 9 rocket, represents a critical advancement in NASA's Commercial Lunar Payload Services (CLPS) initiative, carrying ten sophisticated scientific instruments to the lunar surface.

At the heart of this historic mission is the groundbreaking research led by Texas Tech geophysics professor Seiichi Nagihara. His instrument, LISTER (Lunar Instrumentation for Subsurface Thermal Exploration with Rapidity), will drill three meters into the moon's surface to collect vital heatflow data marking the first such measurements since the Apollo missions of the 1970s. This research will provide unprecedented insights into the moon's geological history and thermal properties, essential data for future lunar exploration and potential colonization.



The successful collaboration between Quirk's engineering expertise and Nagihara's scientific innovation showcases Texas Tech's expanding influence in space research. As NASA prepares to return humans to the moon through the Artemis program, this mission positions Texas Tech at the forefront of lunar science, contributing crucial data that will shape our understanding of Earth's closest celestial neighbor and advance the possibilities of establishing a permanent human presence on the moon.

Student Organization Spotlight

Innovation Takes Flight with Raider Aerospace Society

Raider Aerospace Society (RAS) is Texas Tech's premier aerospace student organization. We develop and build rockets and planes for flight at intercollegiate competitions. Our research and development team are continually developing and testing exciting new technologies.

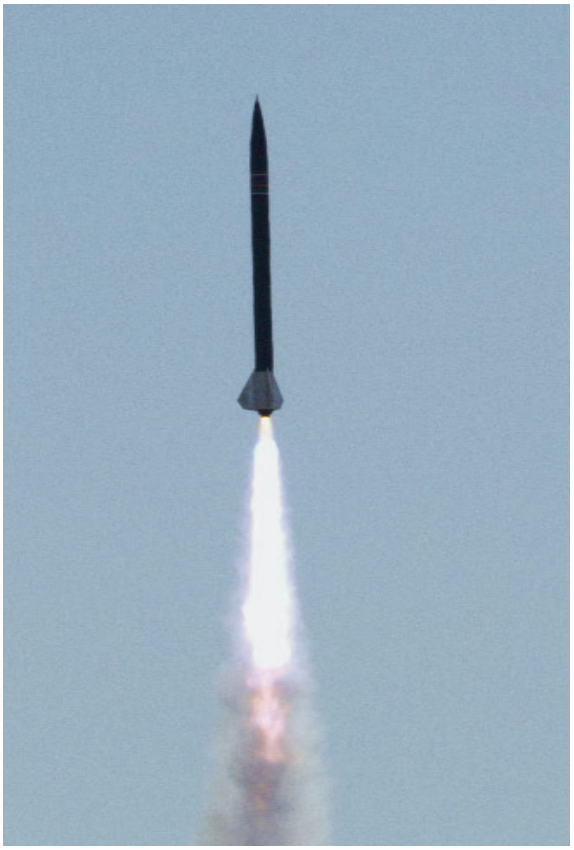
Space Raiders is the rocketry division of RAS. They take part in the annual Intercollegiate Rocket Engineering Competition (IREC) that had 122 teams. The Space Raiders team gives an opportunity for students to gain hands-on experience by being closely involved with the design, manufacturing, and assembly of a high-power solid-fuel rocket. In 2024 Space Raiders placed 23rd in their division, 16th overall in the technical report category, and was the first team to recover their rocket with no damage. For IREC 2025 Space Raiders will be entering the Student Research and Development category. This year's focus includes solid motors, a parachute reefing system, airbrakes, and custom avionics.

Pegasus is the airplane team of RAS. Pegasus takes part in the annual AIAA Design, Build, Fly aeronautics competition, competing with 100+ other universities from around the world to design a plane that best meets the rules of the year's competition. This year's challenge requires the plane to carry externally mounted fuel tanks, filled with inert material, and drop an autonomous glider. The glider must execute a 180 degree turn before descending to a GPS target.

PigeonWorks is the special projects and R&D division of RAS. Current projects include an industrial autoclave, a hybrid motor, and a drone team. The autoclave team aims to support composite manufacturing for Space Raiders and Pegasus. The team is now focused on finalizing the design and starting construction. The hybrid motor team is focused on testing and expanding motor development capabilities, they are building upon the design and prototype created by an award-winning senior design team. RAS has introduced a new drone team with the goal of developing a drone targeting 200 mph.

RAS is excited about our new outreach programs. Our students volunteer at a local children's museum, host an after-school aerospace club for middle school students, and RAS has adopted a highway. RAS is proud to give back to the community and inspire future generations.

Raider Aerospace Society continues to see exponential growth in our organization. We are filled with talented individuals from the College of Engineering, and we are expanding our membership to the greater population of Texas Tech.



2025 Pi Tau Sigma National Convention

A Weekend to Remember

The Texas Tech Sigma Epsilon Chapter of Pi Tau Sigma proudly hosted the 2025 Pi Tau Sigma National Convention, bringing together over 100 students from more than 50 universities across the country. This year's convention provided a unique opportunity for mechanical engineering students to engage with industry leaders, explore graduate research opportunities, and connect with peers from across the nation.

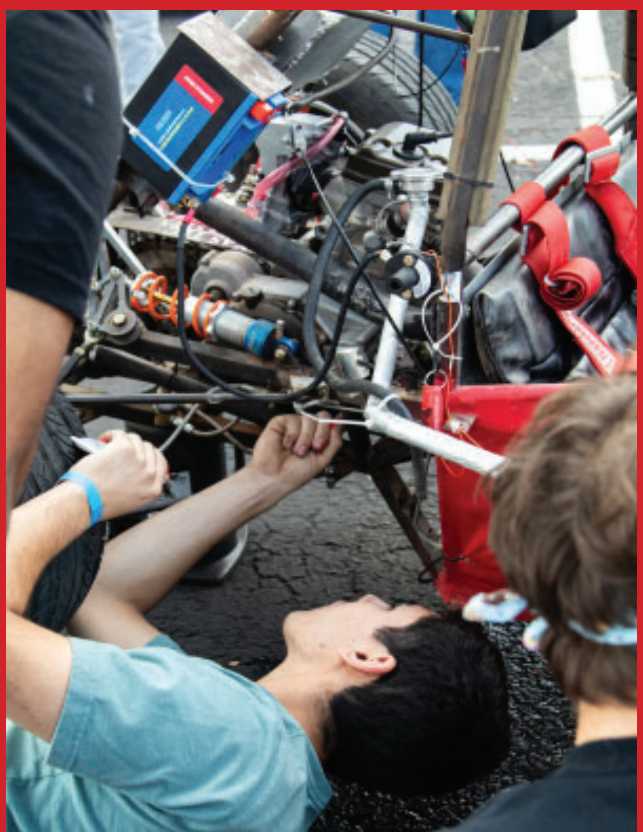
A highlight of the event was the keynote address from Jerry Rawls, namesake of the Jerry S. Rawls College of Business and founding member of our organization, who shared insights into leadership, innovation, and the future of engineering. Additionally, we were honored to welcome Abe Mathews from CNS Y-12, who provided a compelling perspective on national security and advanced manufacturing. Following his presentation, representatives from CNS Y-12 hosted an information session, offering students valuable career guidance and insights into the field of nuclear security.

To showcase Texas Tech's cutting-edge research, attendees toured several advanced lab spaces within the Whitacre College of Engineering (WCOE), highlighting the university's graduate programs and research opportunities. These tours allowed students to engage directly with faculty and graduate researchers, gaining a deeper understanding of the groundbreaking work being done at Texas Tech.

The convention was a tremendous success, fostering professional growth, networking, and collaboration. We extend our gratitude to our distinguished speakers, industry sponsors, and faculty for making this event possible.

Silent Power Thunderous Impact : Our Formula SAE

FSAE EV competition at Michigan International Speedway in Brooklyn, Michigan



Red Raider Racing recently built and competed with their first-ever electric vehicle (EV), marking a historic achievement for the team. This high-performance EV, the fastest in their history, provided members with invaluable hands-on experience in electric powertrains, energy management, and advanced engineering design. By embracing cutting-edge technology, the team pushed the boundaries of speed, efficiency, and innovation while laying the foundation for future electric racing endeavors.

The team showcased their EV at the prestigious Formula SAE competition in Michigan, where university teams are judged on design, cost, business strategy, and dynamic performance events such as acceleration, skid pad, autocross, and endurance.

Their groundbreaking entry not only demonstrated engineering excellence but also proved their ability to compete at the highest level of student motorsports. This milestone achievement sets the stage for even greater advancements in the coming years, as Red Raider Racing continues to innovate and push the limits of automotive engineering.

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Michelle Pantoya Earns Horn Professor Honor

Dr. Michelle Pantoya, J.W. Wright Regents Chair in Mechanical Engineering, has been named a Horn Professor, Texas Tech's highest faculty honor. Since joining in 2000, she has led groundbreaking research in energetic materials, published over 200 papers, and holds five patents. A mentor to dozens of graduate students, Dr. Pantoya is also passionate about STEM education, co-authoring children's books to inspire future engineers.

Natalie Castillo, Yoosr Hassan, Itzel De Leon, Olivia Lira, Riley Philips, Breanna White, Kallista Kunzler (from left).

Women in Mechanical Engineering

Women in Mechanical Engineering at Texas Tech celebrated the accomplishments of leaders in our Lubbock community at the YWCA Women of Excellence ceremony on Tuesday, March 25, 2025. The award recognizes and honors women in our community who have achieved excellence in their careers and whose contributions to business, industry, organizations, and the community are crucial to the success of the same. Since 1989, Women of Excellence award recipients have been inspiring others in Lubbock not only with their professional achievements but also with the work they do for others. By promoting women as leaders in Lubbock, the YWCA strives to empower women and their families in order to establish strong role models for future generations of young women.