MAE

MECHANICAL AND AEROSPACE ENGINEERING

REACHING NEW HEIGHTS WITH HYPERSONIC TECHNOLOGY

2018 NEWSLETTER

MISSOURI S&T

MESSAGE FROM THE CHAIR

Dear Friends,

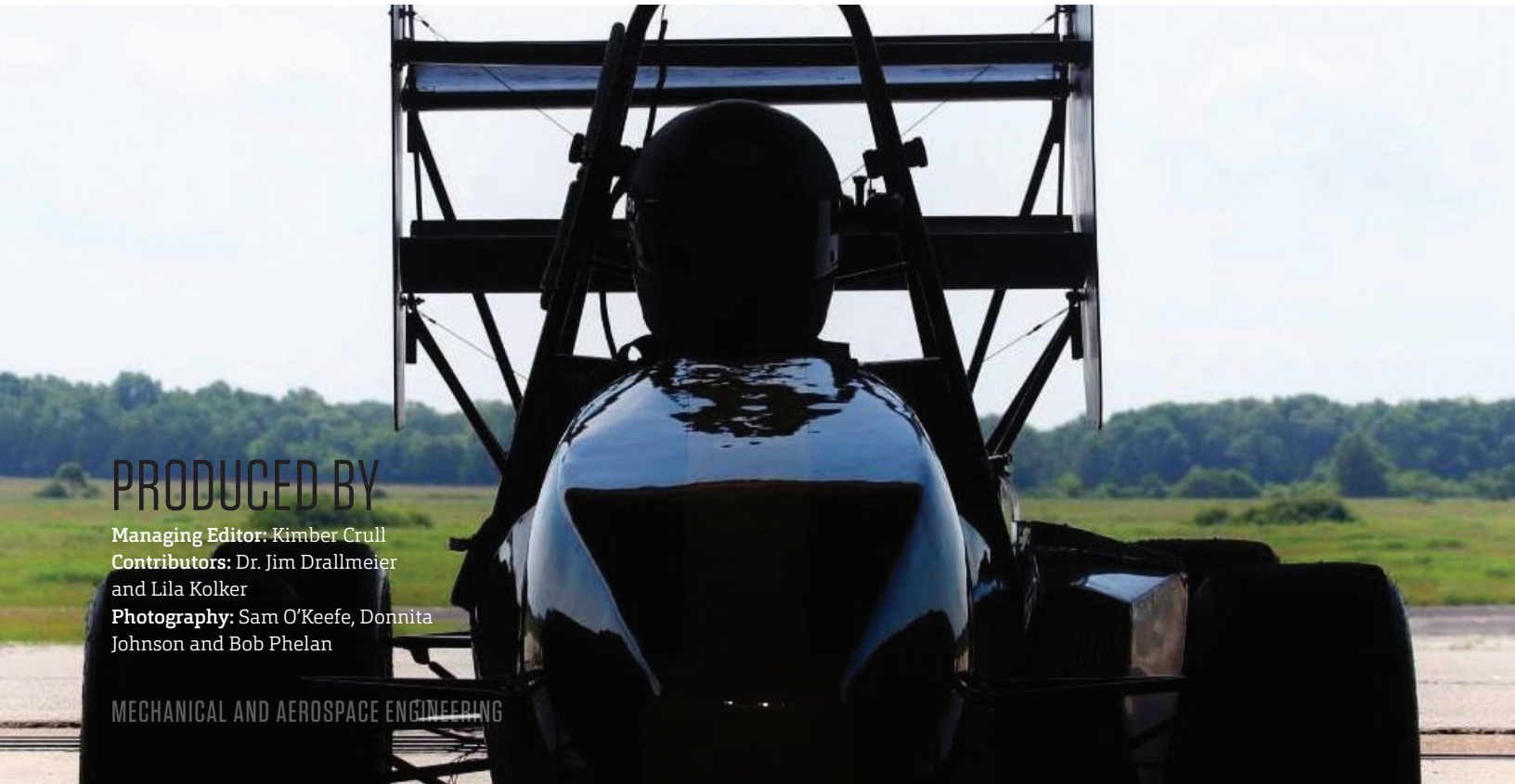
Welcome to the Missouri S&T mechanical and aerospace engineering department 2018 newsletter. Inside this edition of our newsletter, you will find that our students are as busy and as successful as ever. I am sure you'll agree their achievements through several design teams are impressive, including a top 10 finish by S&T Racing at the FSAE Lincoln competition and ranking 9th in the world out of 556 teams. You will read about the many national and international fellowships awarded to our graduate students, including the Amelia Earhart Fellowship earned by our Aslihan Vuruskan. The department faculty and graduate students have set an impressive pace, having doubled research expenditures over the past five years. Highlighted in the newsletter are a few examples of their activities, including groundbreaking research in hypersonic technology, an area of research that is seeing renewed interest worldwide for both commercial and military applications. Several other faculty and student achievements and awards are highlighted in the newsletter along with honors of our alumni.

Over the past year, we have had two new faculty join us. I am pleased to introduce Dr. Xiangyang Dong, assistant professor of mechanical engineering. Prior to joining the department, he conducted research in the Center for Laser-Based Manufacturing in the School of Mechanical Engineering at Purdue University. Dr. Dong joins the internationally recognized faculty working in the Advanced Manufacturing Signature Area. I am also pleased to introduce to you Dr. Daoru (Frank) Han, assistant professor of aerospace engineering. Dr. Han received his Ph.D. from the Department of Astronautical Engineering at the University of Southern California. His research focuses on developing and applying first-principle-based plasma simulation models on supercomputers to resolve fundamental plasma physics phenomena arising from space explorations. He also has served as an assistant research professor at Worcester Polytechnic Institute.

Finally, I would like to extend my sincere thanks to the many alumni and friends whose many contributions continue to enhance the activities of the department and contribute to the education of future Miner engineers. I would also like to invite those of you who have not been back to the department for a few years to return and allow us to show you the many activities and accomplishments of the students, faculty and staff which have us excited about a very bright future.

Warm Regards,

Jim Drallmeier
Chair, Mechanical and Aerospace Engineering



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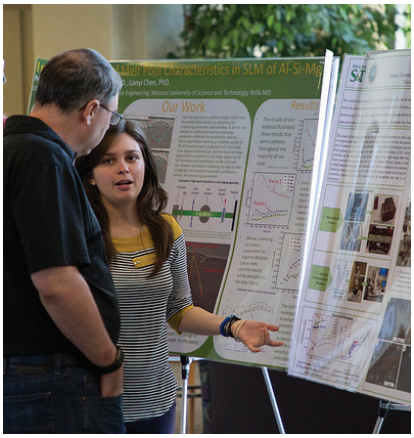
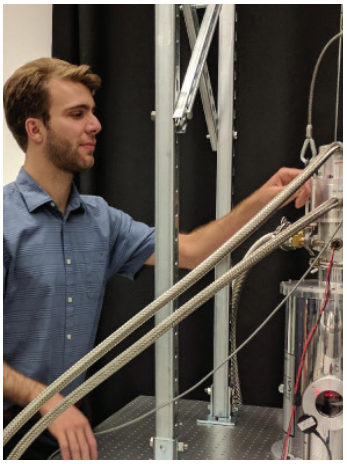
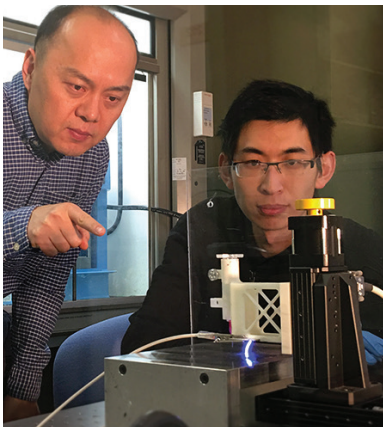






IN THIS ISSUE

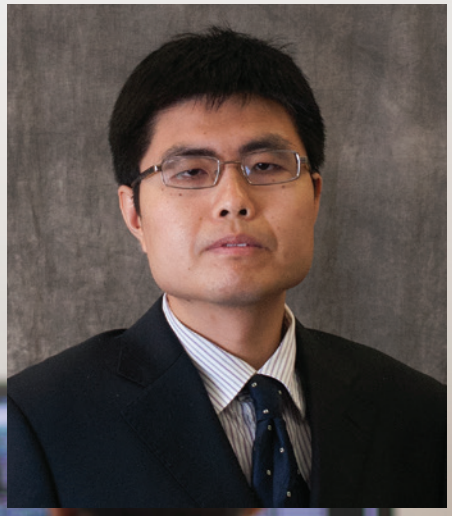
Over the last several years, at the forefront of aerospace technology – hypersonic flight has been transforming aviation.

The mechanical and aerospace engineering department has a solid research program in aerospace engineering, spanning space technology as well as autonomous air vehicles and intelligent systems. However, there has been a significant increase in interest and activity by the aerospace research community in the specific and extremely challenging area of hypersonic atmospheric flight. The term hypersonics refers to atmospheric flight spanning speeds from approximately a mile per second to five miles per second (orbital velocity). The design and operation of hypersonic vehicles are driven by challenging physics and extreme engineering requirements, far beyond those associated with conventional flight. The department has three dedicated faculty leading research in this area: Drs. Lian Duan, Serhat Hosder, and David Riggins. They also have an extraordinary team of students dedicating their studies to this research.

SIMULATING EXTREME ENVIRONMENTS

Computational fluid dynamics (CFD) is used for the simulation of extreme environments over hypersonic vehicles involving high-temperature, chemically-reacting flows with non-equilibrium thermo-chemistry. Due to limited ground and flight test data, CFD plays an important role in the analysis, design, and flight qualification of various hypersonic systems. Dr. Hosder and his students focus on uncertainty quantification and multi-fidelity modeling of hypersonic flows, robust design of hypersonic vehicles, and thermal management of hypersonic systems, which have been funded by NASA, DoD, and industry. "Several graduate students in my group also received prestigious fellowships from NASA including Space Technology Research Fellowships and Pathways Internships, and they regularly

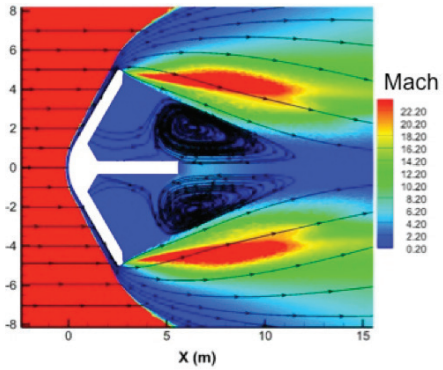
Dr. Serhat Hosder, associate professor of aerospace engineering.



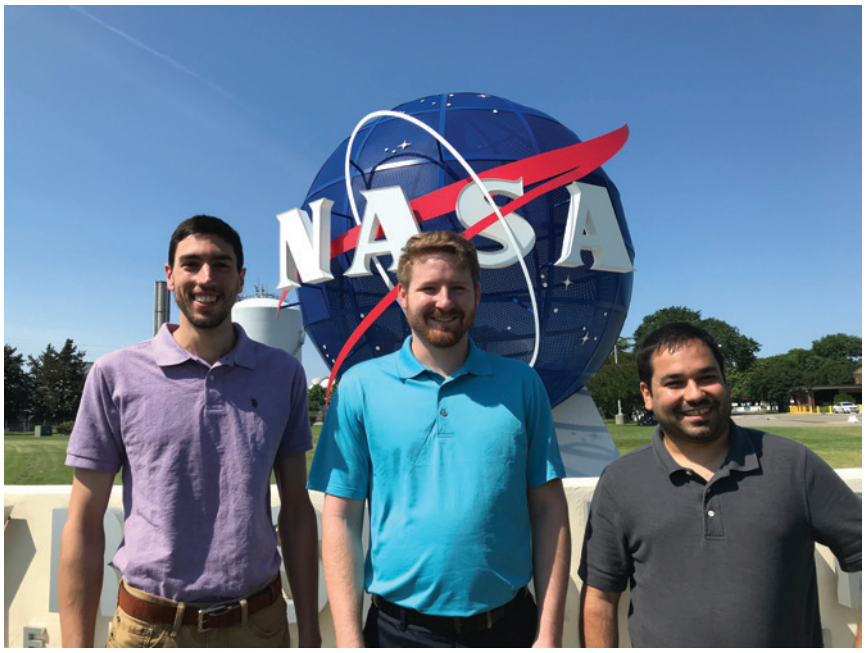
Dr. Lian Duan, assistant professor of aerospace engineering.

Dr. David Riggins, Curators' Distinguished Teaching Professor of aerospace engineering.

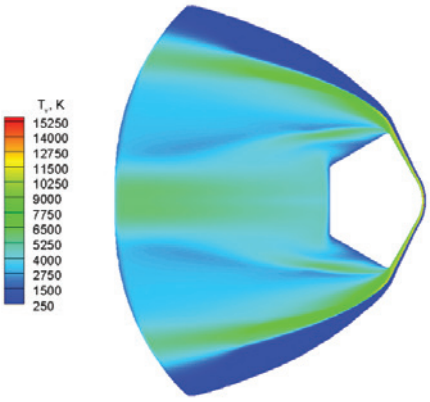
HYPERSONICS: THE NEXT FRONTIER IN AEROSPACE TECHNOLOGY



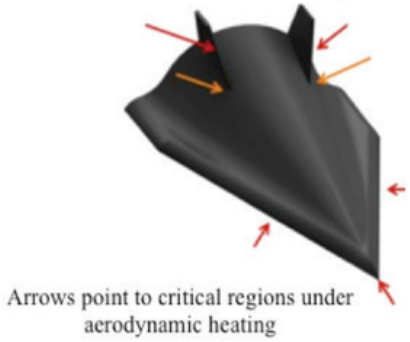
Centerline Mach contours of a Hypersonic Inflatable Aerodynamic Decelerator during Mars entry.



(From left to right) Martin Di Stefano, Andrew Hinkle, and Mario Santos, Dr. Serhat Hosder's PhD students working on research from NASA Langley Research Center.



Sample CFD solution over a reentry vehicle used in radiative heat transfer uncertainty analysis.



A generic hypersonic cruise vehicle with actively-cooled critical regions.

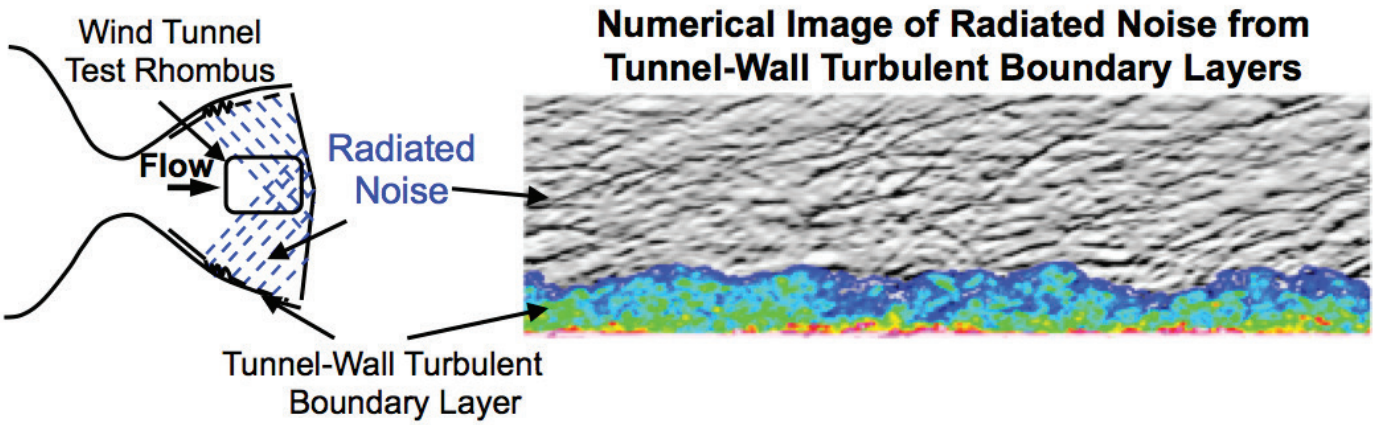
visit NASA centers to conduct hypersonics research" says Hosder, who is also the current vice chair of the Hypersonic Technologies and Aerospace Planes Technical Committee of the American Institute of Aeronautics and Astronautics, the leading international society in hypersonics.

The uncertainties associated with operating conditions and complex physical models used in simulations can have negative impact on the design of hypersonic systems including thermal protection system (TPS). Dr. Hosder emphasizes that quantification of these uncertainties in the simulations is crucial for the improvement of the computational models, flight qualification of hypersonic technologies, and designing reliable vehicles, and adds: "Our research targets this challenge by developing advanced uncertainty quantification and physics-based multi-fidelity modeling techniques, which has been applied to the analysis of planetary entry vehicles including hypersonic inflatable aerodynamic decelerators , radiative heating during reentry, TPS sizing, turbulence modeling, shock wave-boundary layer interactions, and hypersonic air-breathing propulsion flow path analysis. We also integrate uncertainty quantification and multi-fidelity modeling methods to aerothermodynamic shape optimization to minimize the impact of uncertainties on the performance of hypersonic vehicles."

Hypersonic vehicles travel in the atmosphere at extremely high speeds and therefore experience significant amount of aerodynamic heating, which require them to use different types of TPS. "Under this area, we investigate active cooling strategies for reusable TPS applied to critical regions of the atmospheric hypersonic flight systems with high thermal loads such as the leading edges. Recently, we have focused on numerical simulation of a variable transpiration cooling concept with a coupled high-fidelity CFD and a material thermal response modeling approach" says Hosder. These numerical simulations, along with the experimental research conducted at high-temperature arc-heated wind tunnels at the University of Texas at Arlington, are used to develop reduced order models that can be applied to the design of actively cooled hypersonic vehicles.

HYPERSONIC BOUNDARY LAYER TRANSITION

A boundary layer is the layer of fluid in the immediate vicinity of a body's surface. The process of a laminar boundary layer becoming turbulent is known as boundary layer transition (BLT). BLT and wall-bounded turbulence remain two of the most important unsolved problems not just in fluid mechanics but in all of classical physics. Our ability to predict the aerodynamic lift, drag, surface heating, propulsion, and maneuverability of high-speed vehicles is crucially dependent on the knowledge

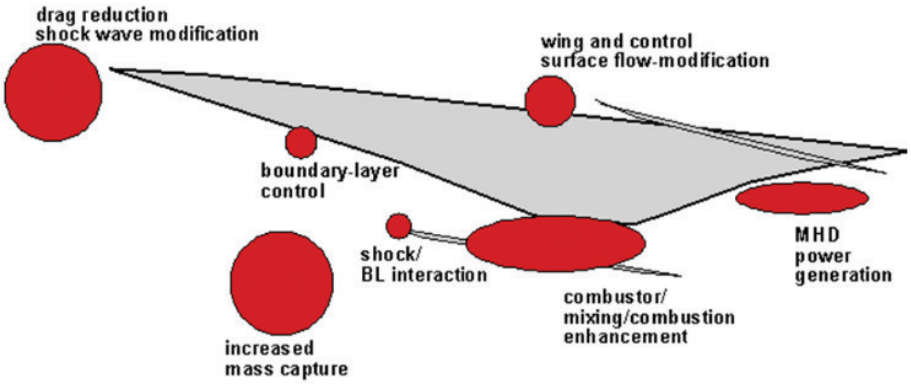


"Such simulations will provide the basis for an in-depth understanding of the disturbance environment in conventional hypersonic wind tunnels and contribute to an improved ground-to-flight scalability of transition data," Duan says.

of transition and turbulence at high Mach numbers. Dr. Lian Duan and his team are performing ground breaking direct numerical simulations (DNS) to contribute significant advances in the area of fundamental turbulence physics and non-equilibrium effects in hypersonic turbulent boundary layers (TBLs), as well as toward an explanation of how those flows transition from laminar to turbulent flow in the first place.

One of the recent achievements by Duan and his team is to exploit advances in high-performance computing (HPC) for synthesizing the naturally occurring, random acoustic disturbances in hypersonic wind tunnels. A wind tunnel is one of the most common tools for experimental aerodynamics research. Wind-tunnel testing allows initial characterization of a flight vehicle without the cost or risk of a flight test. However, at supersonic/hypersonic test speeds, a conventional wind tunnel has a more erratic air flow, due to disturbances in the air, compared to what would be found in flight. These disturbances are generated by walls of the wind tunnel and interact with the test object in a complicated way. This interaction makes the measurement of BLT over test models less comparable to what would be seen in a flight test. An accurate extrapolation of erratic or noisy wind-tunnel results to steady free flight is thus critical for predicting the drag and heating of high-speed vehicles.

In collaboration with colleagues at NASA Langley Research Center, the Technical University of Braunschweig, Germany, Purdue University, the AEDC Hypervelocity Wind Tunnel 9 in White Oak, Maryland, and the Sandia National Laboratories in New Mexico, Duan and his team are using the world's largest supercomputers to define the disturbances caused by the tunnel walls and understand how they interact with the test models. The process is known as "wind tunnel rebuilding."



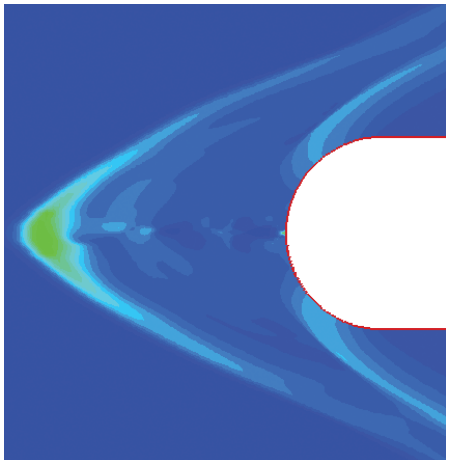


Photo by NASA

"The knowledge gained, and the database generated through this effort, will be critically important to expanding the utility of conventional high-speed wind tunnels for studying hypersonic flows in which boundary-layer transition plays an important role. This will save the cost of new quiet facilities, an investment of multi-million dollars with at least 5-10 years of development."

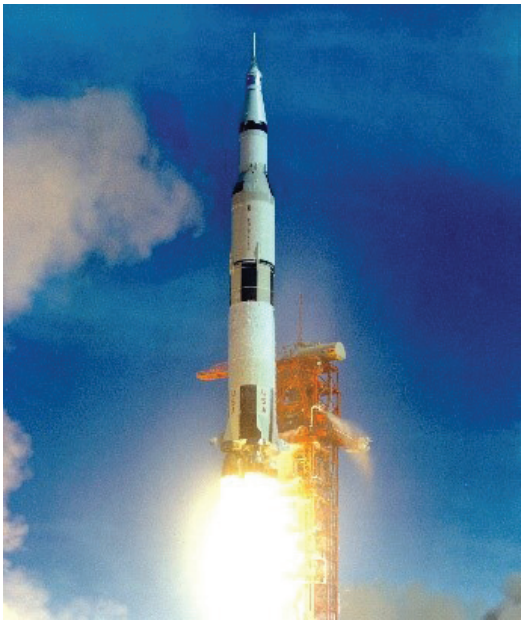
ENERGY UTILIZATION IN HYPERSONIC FLIGHT

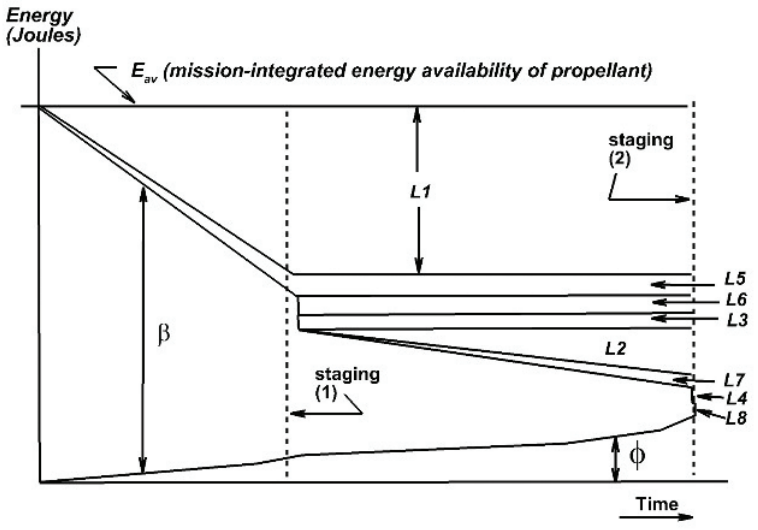
Dr. David Riggins, Curators' Distinguished Teaching Professor of aerospace engineering, and his PhD students have been focused on developing methodologies and techniques for correctly assessing the effect of the 2nd law of thermodynamics on system losses and performance in hypersonic flight systems (both air-breathing and rocket-powered vehicles). This research is based on the fundamental linkage between entropy generation and conventional vehicle performance and can be applied across all levels of fidelity in modeling and simulation techniques. The research provides the ability to make comparative analyses of existing and proposed access-to-space and atmospheric hypersonic systems, and has significant potential in design and optimization of such systems. It is also being applied in order to provide fundamental system-level, performance-based assessment of highly futuristic (proposed) techniques for facilitating hypersonic flow-field modification and control using plasma and other innovative flow-modification technologies.

An example of the analysis of energy utilization and entropy generation for an access-to-space multi-stage rocket systems is shown below. In this case, the analysis provides (as illustrated by the accompanying plot) the quantification of the complete energy break-down (energy usage) versus time for the first two stages of the legacy Apollo 11 mission to the moon. This kind of detailed description of energy utilization in such systems provides significant information within the design process, as well as in optimization efforts involving hypersonic aerospace systems.

Research utilizing multi-dimensional computational fluid dynamics is also being conducted on energy utilization in terms of drag reduction, mitigation of engine unstart, and control of hypersonic vehicles. In order to optimize the performance of a hypersonic vehicle, the use of energy in locations other than the engine combustor (for thrust production) can be shown to be very beneficial. The figure below illustrates possible energy utilization modes around a generic hypersonic vehicle. Studies include very fundamental unit problems such as the flight of a blunt body in hypersonic flow with flow-field modification in order to reduce drag and heat transfer, as well as entire hypersonic vehicle configurations. Innovative usage of on-board energy for hypersonic flight vehicles can result in more robust vehicles, larger payloads, longer ranges and increased endurances, and allow greater mission flexibility and choices.

The physical phenomena that determine hypersonic flight systems performance and operability represent significant challenges for current modeling and analysis capabilities. These challenges also frame the engineering hardware design constructs and methodologies that are required in order to configure, build, ground-test and flight test vehicles capable of atmospheric flight at speeds above a mile per second. High-fidelity modeling and simulation techniques and approaches for this flight regime are often at the very limit of current capabilities and resources. Some modeling and simulation requirements are arguably still beyond current capabilities—at least, in terms of ensuring a comfortable level of confidence – and continued and expanded research in this area at Missouri S&T by research teams under the direction of Drs. Hosder, Duan, and Riggins (as well as other faculty) are providing significant advances necessary for the successful development of current and futuristic hypersonic vehicles.





DESIGN TEAM UPDATE

AN UPDATE FROM THE TEAMS ON THEIR 2017-2018 SEASON.

University of Missouri President, Mun Y. Choi with S&T Rocket Design Team leaders

ROCKET DESIGN TEAM

The Missouri S&T Rocket Design Team is dedicated to the university's mission statement of integrating education, research, application, creating knowledge, conveying knowledge, and helping to solve the world's challenges through High Power Rocketry. This past year the team has worked hard to increase their knowledge in electronics and antenna technology so they can improve their in-house made telemetry suite. The S&T Rocket Design Team has also continued their research on high power, solid motors after their 2nd Place Finish and Award for Excellence in Flight Dynamics in the 2017 Spaceport America Cup in the 10,000ft Student Research and Designed Motor category in the hope of, quite literally, reaching new heights.

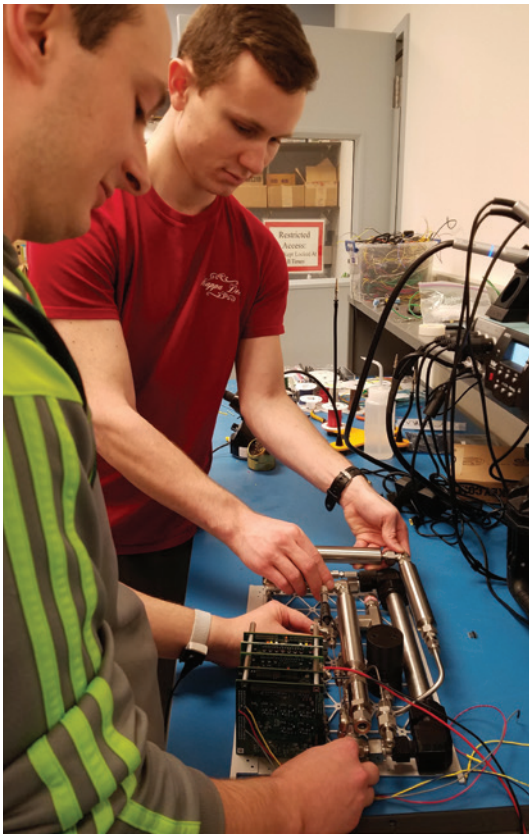
At the 2018 Spaceport America Cup, the team competed in the 30,000ft Commercial Off the Shelf Motor category with a revamped telemetry suite and an experimental payload consisting of strain gauges to better understand the stresses and strains the airframe of a rocket undergoes while in flight. The team was able to successfully build and launch a 10.5 foot tall rocket. At the time this was published, competition results were not in. The team will continue to push to new heights and ambitions as it looks to go higher and higher, with more space grade payloads and technologies, as they set their long term goal as being one of, if not the only, collegiate team to reach true space.

M-SAT

The Missouri S&T Satellite Research Team (M-SAT) continues its innovative work on small satellites into the Fall 2018 semester with two of M-SAT's three spacecraft programs approaching potential launch dates.

The Air Force-sponsored Nanosat-8 mission, which involves a pair of small satellites: the Missouri-Rolla Satellite (MR SAT) and Missouri-Rolla Second Satellite (MRS SAT), is well on the way to launch manifestation. Students are hard at work to begin satellite integration, continue licensing processes, and work with the University Nanosat Program (UNP) conducted by the U.S. Air Force Research Laboratory. Team alumni continue to support the endeavor to see the mission launch from the International Space Station. The mission aims to conduct stereoscopic imaging research with bistatic cameras. The upcoming school year will pave the way for S&T's legacy with spaceflight.

In 2016, the M-SAT team was accepted into the NASA Undergraduate Student Instrument Project (USIP) program with its Multi-Mode Mission Cube Satellite (CubeSat) dubbed M3.



The object of the mission is to demonstrate the effectiveness of an experimental thruster developed by the Missouri S&T Advanced Propulsion laboratory. M-SAT is integrating the thruster into a "3U" satellite (a rectangular prism with dimensions 30x10x10 cm). Over the past year, the M-SAT students tested several key components of the spacecraft and are working with NASA's Kennedy Space Center to secure a launch opportunity as early as Spring 2019.

M-SAT's APEX (Advanced Propulsion Experiment) mission is a larger "6U" demonstration of the experimental thruster found on M3 and is also funded by the Air Force's UNP program. In January, the team performed well in the Flight Selection Review, showcasing the "flat sat" prototype, propulsion feed system, and radio demonstrations as well as guidance and navigation control simulations. The team is working hard on integrating the APEX Engineering Design Unit (EDU) and writing flight code. M-SAT is also looking forward to applying to a proposal call, expected to be issued early in the fall semester, for the UNP Nanosat 10 competition. Away from the lab, two students on the APEX team (Shannah Withrow and Matthew Klosterman) received a first place award, in April, at the AIAA Regional Student Paper conference for their paper on the planned enhancements of the APEX mission.

FORMULA SAE

The 2017-2018 racing season showed that the Formula SAE racing team is resilient Through changes in team members and team roles, policies and regulations, they were still able to produce the high performing vehicle that has been seen in the past. As it was the second year of the rules cycle and no major changes had to be made to meet competition requirements, the team took the year to get new members up to speed on the systems, processes, softwares, and race car building techniques they use every day. This was one of the biggest retention rates the team has seen in several years and these members will go on to be valuable leaders next year and in years to come.

While there were no major changes to be made to the car to meet compliance, the team took the opportunity to redesign the intake and exhaust systems, as well as try new manufacturing techniques and improve other systems throughout the car. Through testing and competition, they were able to see where those changes were helping and hindering the performance. This gives them a fantastic jumping off point for next year to make the car even better and learn from the experience.

S&T Racing attended two competitions this year, FSAE Michigan in May and FSAE Lincoln in June. Michigan was, as normal, cold and rainy. The car performed well in the dynamic events, but due to a failure in

endurance, was not able to complete the last event. Even with this setback, the team placed 30th out of 114 teams from around the world. Lincoln showed us cooler weather that was not expected and rained on the team for two out of four days of competition. Once again the car performed well at the dynamic events, and after a rebuild of the system that failed in Michigan, finished Endurance! S&T Racing placed 9th out of almost 80 teams at FSAE Lincoln. Overall, S&T racing has been one of the top 10 cars in the world for the past year, currently at 9th in the world out of 556 teams internationally.

We cannot thank the MAE department, the SDELC staff, the MAE Academy, S&T FSAE Alums, our families, friends, professors, and team sponsors enough for all they do for us during the racing season. We could not do it without all the support and encouragement we receive from all of them. Thank you from all of us at S&T Racing and we'll see you in August!

MINER AVIATION

Miner Aviation competed in the SAE Aero Design West competition in Van Nuys, California on April 6th - 8th. They are proud of their results for the 2018 competition season but they can see where improvements can be made. The aircraft itself flew beautifully and has been one of the best planes they have built as far as performance is concerned. One of the challenges the team faced was the electronics. Many teams were having difficulties with interference between signals. They would lose connection between the base station and plane as well as FPV feed. The feed was due to another team not switching off their transponder but the connection between the plane and base station was a much harder challenge. In the end, it proved too difficult of an issue to fix within the time frame of competition.

One of the requirements of the competition is to carry and drop a payload from the craft. Out of all the teams in the advanced class, only 7 teams were successful at dropping a sandbag from their plane. The team pulled through with 4th in Design, 13th in Presentation, tied for 8th in Flight, and overall S&T's Miner Aviation placed 13th in the advanced class.

The future leadership of the team sat down and discussed how they would proceed after competition concluded. For the past 6 - 9 years, the SAE Aero competition has remained stagnant with little to no design changes or new challenges. While they did address this issue, the SAE representatives said they were looking towards focusing more on systems engineering with electronics and such on the planes; the part with which almost all the advanced class teams had issues. With this information in hand, the leadership of Miner Aviation

made the difficult choice of switching competition from SAE to AIAA. The AIAA competition focuses more on the actual design of the plane and how it performs than what task the plane must perform. Even more, the task for the competition, as well as design parameters, change every year so it is always a new challenge to engage and solve, and provides much more experience and hands on learning. The planes themselves also call for much smaller designs that require a great deal of testing. This way, the team will be building more than two or three planes every year and performing more test flights to perfect the designs and show new members how to deal with failure and work out a new solution. Overall the team is excited and optimistic for the coming year and cannot wait to see what is achieved.

HPV

Missouri S&T's Human Powered Vehicle Design Team focused on team development during the 2017-2018 build season. While growing in numbers and enthusiasm, the team encouraged members to find their niche by distributing projects and working to share knowledge of design, machine skills, and team traditions. The team finished the year with 44 members encompassing diverse interests across 13 majors.

The vehicle design targeted innovation techniques for the modelling and fabrication of the trusty leaning tricycle. Featuring a safer rollover protection system, suicide-style door, and live hubs for ease of tire and brake maintenance, Trikeceratops is truly new and improved.

Having to meet deadlines earlier than ever, the HPVT finally made it back to ASME's E-Fest West. Being the first competition of all design teams' 2018 competition season, HPVT challenged 16 international teams in Pomona, California. The Human Powered Vehicle Challenge remained similar to years prior, including men's and women's speed challenges and the 3-hour obstacle course to test endurance. Out of 17 teams, S&T placed 8th in Design, 8th in Innovation, 9th in Women's Speed, 8th in Men's Speed, 11th in Endurance, and 10th overall.

Utilizing the week between competitions, the team made some adjustments and added some more character before taking Trikeceratops to Penn State. Of the 47 international teams, Missouri S&T placed well overall, while bringing first in aesthetics thanks to the entire team's contribution. The team placed 6th in Design, 17th in Innovation, 5th in Women's Speed, 9th in Men's Speed, 31st in Endurance, and finished 14th overall.

HPVT is looking forward to competing at both East and West competitions again in 2019. The team strives to progress every year after learning from the past. The academic year of 2018-2019 will begin with SOLIDWORKS design, progressing into prototyping in the early fall and final fabrication ensuing in by the end of the fall 2018 semester. The Human Powered Vehicle Team will continue to develop the education of young engineers, which is an invaluable experience available to all students at Missouri S&T.

Visit humanpowered.mst.edu or contact humanpowered@mst.edu

FORMULA ELECTRIC

The Missouri S&T Formula Electric Racing Team employed new tactics this season to build on the success of last year's car. Immediately after last year's competition, strict guidelines were established on what projects and improvements were to be put on the car. This was a year full of refining old designs and transferring knowledge to the newer members.

The biggest project this year was creating and installing the team's first-ever aerodynamics package. Multiple team members conducted research and went through several designs before settling on the ultimate result. In the end, they created a spectacular package that increased the vehicle's overall downforce. A unique feature of the aero package is the DRS, Drag Reduction System. The DRS is controlled from the newly redesigned driver controls on the steering wheel, and opens two elements on the rear wing to reduce drag at high speeds. The suspension system was also improved which resulted in a lower ride height center of gravity and made the car's handling easier to control during high speeds.

At the FSAE Lincoln competition, the car passed hrough the electrical and mechanical technical inspections. The team also performed admirably at the design, cost, and sales presentations, scoring in the top 3 for sales and top 4 for cost. Unfortunately, a brake system issue prevented the team from competing in the dynamic events, which resulted in 11th place.

The team is already hard at work getting the car ready for the season ahead, where they expect to participate in multiple competitions in addition to FSAE Lincoln. Pedal box and power train redesign and optimization are top priority this year along with designing a new battery for the upcoming 600 volt rule change. Along with these plans, they will be recruiting heavily and passing on knowledge to new members.

Formula Electric would like to thank all our sponsors and supporters, without whom any of their work would be possible.

DR. LOGANATHAN RECEIVES **ASME DSCD BEST STUDENT PAPER**

Muthukumaran Loganathan, 2017 Ph.D. graduate in mechanical engineering, received the Best Student Conference Paper on Mechatronics for his paper, "Quasi-Repetitive Control for Fast and Accurate Atomic Force Microscopy," presented at the American Control Conference in July, 2016 in Boston, Massachusetts. The 2017 Best Paper award is given by the ASME Dynamic Systems and Controls Division for the best paper with a student author as the primary author from four 2016 conferences: the American Controls Conference, the ASME Dynamic Systems and Controls Conference, the IEEE/ASME International Conference on Advanced Intelligent Mechatronics Conference, and the International Symposium on Flexible Automation. The award was announced at the ASME Dynamic Systems and Control Division Conference in October 2017.

Dr. Loganathan's paper presents a new control methodology to track a class of quasi-periodic signals that are of practical importance for the control of Atomic Force Microscopy (AFM). The developed controller enables AFMs to generate highly accurate 3D digital images of samples with sub-nanometer resolution. This research was funded by the National Science Foundation.

Dr. Loganathan completed his M.S. and Ph.D. in mechanical engineering at Missouri S&T in 2012 and 2017, respectively, under the advisement of Dr. Doug Bristow, associate professor of mechanical engineering. He is currently a Senior Design Engineer at ASML US, Inc. in Wilton, Connecticut.

Pictured from left to right: Brian West, Nicholas Capps, and James Urban. Not pictured: Josh Pribe.

MAE UNDERGRADUATES PUBLISH THEIR RESEARCH IN **ADDITIVE MANUFACTURING**

Four Missouri S&T undergraduates have been conducting research on applying modal analysis techniques to understand and detect defects in additively manufactured metal components. Drs. Ed Kinzel, Robert G. Landers, and Douglas Bristow, faculty of mechanical and aerospace engineering, are advising the students in their research. The four students include Nicholas Capps, Josh Pribe, James Urban, and Brian West.

The students have conducted a number of experimental and numerical studies to determine how defects that arise in parts fabricated with additive manufacturing affect the vibration response of the parts and whether the vibration response can be used as a signature to screen the parts for defects. The students and faculty work on this project in close collaboration with their funding partners at the Kansas City – National Security Campus (KC-NSC). To date, the students have produced one journal article and three conference papers, with more to come.

Nicholas Capps is a senior in mechanical engineering. After graduation, he plans to attend graduate school to further his education, likely focusing on additive manufacturing or material science. Josh Pribe completed his degree in mechanical engineering in Spring 2016 and is now pursuing a Ph.D. degree at Purdue University. James Urban is a senior in mechanical engineering and will work for KC-NSC after graduation. Finally, Brian West, also a senior in mechanical engineering, plans to do a post-bachelors program at Los Alamos National Laboratory before starting work on his Ph.D. degree in mechanical engineering.

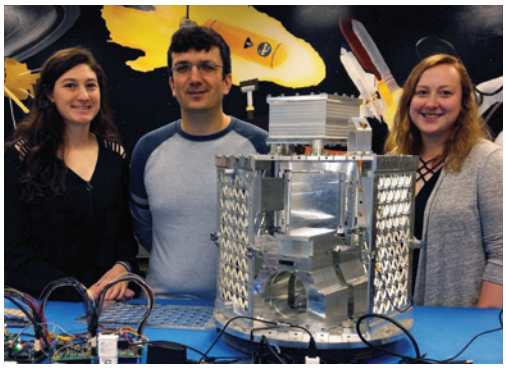
ASLIHAN VURUSKAN RECEIVES PRESTIGIOUS **AMELIA EARHART FELLOWSHIP**

Aslihan Vuruskan, a Ph.D. student in aerospace engineering, has received a prestigious 2017 Amelia Earhart Fellowship from Zonta International Foundation. Aslihan is one of the 35 recipients of this award from all over the world in 2017, which is given to women of any nationality pursuing a Ph.D./doctoral degree who demonstrate a superior academic record in the field of aerospace-related sciences or aerospace-related engineering.

Ms. Vuruskan's research focuses on robust aerodynamic shape optimization by using advanced numerical methods on high-performance computers and funded by NASA. Aslihan performs her research in Aerospace Simulations Laboratory at the MAE department under the guidance of her advisor, Dr. Serhat Hosder. Aerodynamic shape optimization of wings for drag reduction is critical as it increases the performance of the aircraft by reducing the fuel consumption. This has a huge impact on operational cost for airline companies and the emission of greenhouse gases. Current design optimization is typically performed at fixed flight conditions, without considering the variation and uncertainty in operational parameters. The objective of Aslihan's research is to design an aerodynamic configuration, which will keep its optimum performance under varying conditions such as the speed of aircraft. In her project, Aslihan has been using high-fidelity computational fluid dynamics (CFD) tools, gradient-based optimization algorithms, and efficient uncertainty quantification methods based on stochastic expansions on high performance computers. Her initial studies have focused on optimization of airfoil shapes. Her current and future work include three-dimensional robust aerodynamic shape optimization of airplane wings at transonic conditions.

The Amelia Earhart Fellowship was established in 1938 in honor of famed pilot and Zontian, Amelia Earhart. The US$10,000 Fellowship is awarded annually to 35 women pursuing Ph.D./doctoral degrees in aerospace-related sciences or aerospace-related engineering. Previous recipients of this award include fellows who have gone on to become astronauts, aerospace engineers, astronomers, professors, geologists, business owners, heads of companies, even Secretary of the US Air Force in their careers.

AEROSPACE ENGINEERING STUDENTS **WIN GRANT FUNDING SUPPORTING MR & MRS SAT MISSION**



Jill Davis, Pavel Galchenko, and Donna Jennings (pictured above left to right), Ph.D. students in aerospace engineering, were the winners of the competitive Educational Alliance Program's University Grant Program. This program is sponsored by Analytical Graphics, Inc. (AGI) and the applicants must demonstrate their problem solving and creative skills using AGI software. Their project "Verification and Validation of Student-Designed Guidance, Navigation, and Control Algorithms" received $1,000 in funding.

The funding will go towards research related to the MR & MRS SAT (Missouri-Rolla Satellite & Missouri-Rolla Second Satellite) mission, in which Missouri S&T placed first as one of ten universities in the Air Force Research Laboratory's (AFRL) University Nanosat Project's Nanosat 8 competition. The team was selected for a launch opportunity and with the launch quickly approaching the team is working on ensuring that the satellite's guidance, navigation, and control (GNC) algorithms perform as expected. The team's advisor, Dr. Hank Pernicka, challenged the students to devise a plan to better validate the algorithms, and the students took it from there by merging the Matlab GNC algorithms with the STK software. As a result of this, a number of improvements to the algorithms were made that will improve the chances of success once the spacecraft pair reaches orbit.

AARON ERB AWARDED **NASA PATHWAYS INTERNSHIP**

Aaron Erb, a Ph.D. student in aerospace engineering, has recently been awarded a prestigious Pathways Internship at the NASA Langley Research Center. Through the Pathways Internship, Aaron will complete work as a member of the research team at NASA while working on a research project towards his graduate degree, with an opportunity to be hired full-time after the completion of his Ph.D.

Aaron's research under this internship focuses on the verification, validation, and uncertainty quantification of turbulence models used in the numerical modeling of supersonic and hypersonic flows. In particular, Aaron's research will aim to improve the prediction capability of computational fluid dynamics tools used in the analysis and design of next generation low-boom supersonic aircraft being developed by NASA and Lockheed Martin under the Quiet Supersonic Technology (QueSST) program. The goal of this program is to achieve successful design and flight demonstration of a supersonic civil transport with a significantly reduced sonic boom (noise) signature.

"With a reduced sonic boom signature, the next generation supersonic passenger aircraft will be certified to fly over land at speeds greater than the speed of sound, which will be a significant achievement for high speed air transportation" says Dr. Serhat Hosder, associate professor of aerospace engineering at Missouri S&T and Aaron's Ph.D. advisor. Aaron's research will also focus on the validation and improvement of turbulence models used in the design of hypersonic vehicles that fly at speeds greater than five times the speed of sound.

MARIO SANTOS RECEIVES **NASA SPACE TECHNOLOGY RESEARCH FELLOWSHIP**

Mario Santos, a PhD student in aerospace engineering at Missouri S&T has recently received a prestigious NASA Space Technology Research Fellowship (NSTRF), which is awarded to a select group of graduate students every year in the United States who show significant potential to contribute to NASA's goal of creating innovative new space technologies for our Nation's science, exploration and economic future.

Mario's research under this fellowship will focus on identification and validation of multi-fidelity modeling methods for computationally efficient but accurate modeling and simulation of the hypersonic flow, aerodynamic heating, and thermal response of deployable re-entry technologies. These tools will then be used in the analysis, design, and reliability assessment of re-entry technologies under uncertain operating environments. The deployable re-entry technologies to be investigated by Mario will include the Hypersonic Inflatable Aerodynamic Decelerator (HIAD) and Adaptable, Deployable Entry Placement Technology (ADEPT) concepts. These technologies are being developed by NASA to be able to land large payloads on Mars, Venus and any other planet with an atmosphere, which is not possible with the current re-entry capsules with rigid aeroshells. A more detailed description of Mario's research can be found on the following NASA link: https://www.nasa.gov/directorates/spacetech/strg/nstrf_2017.

"The eventual goal will be to use the deployable re-entry technologies for sending humans to Mars and this further emphasizes the importance of Mario's research under this fellowship" says Dr. Serhat Hosder, associate professor of aerospace engineering at Missouri S&T, who is the PhD advisor of Mario and will serve as the principal investigator for Mario's NSTRF project. Mario started to work with Dr. Hosder during his senior year as an undergraduate student and was supported by a NASA Missouri Space Grant Consortium (MOSGC) internship. He also received a NASA MOSGC graduate fellowship in his first year as a graduate student.

The fellowship award is intended for three years with renewal every year. The award includes stipend, tuition allowance, faculty advisor allowance and on-site NASA Center experience allowance for the student each year. Mario will his spend his summers at the Vehicle Analysis Branch of NASA Langley Research Center during the fellowship to collaborate with Dr. Thomas West, his NASA mentor, and other researchers working on deployable re-entry technologies.

ROBERT G. LANDERS NAMED CURATORS' PROFESSOR AT MISSOURI S&T

One of the highest honors bestowed by the University of Missouri System Board of Curators is the Curators' Distinguished Professor title. This honor recognizes faculty who are outstanding scholars with established reputations in their field of study. Dr. Robert G. Landers, professor of mechanical engineering at the Missouri University of Science and Technology, has been named Curators' Distinguished Professor of mechanical engineering for his exemplary work in the automation and control of manufacturing processes.

Landers has brought in nearly $5 million in grants in controls applications and manufacturing automation. His research focuses on the modeling, analysis, monitoring and control of manufacturing processes such as metal cutting, wire saw machining, friction stir welding, laser metal deposition, freeze–form extrusion fabrication, glass direct energy deposition, and selective laser melting, as well as the estimation and control of electrochemical alternative energy systems including hydrogen fuel cells and lithium ion batteries.

Landers has authored nearly 200 refereed technical publications, including 76 journal articles and five book chapters. In addition, he holds one U.S. patent. Among many awards, Landers received the M. Eugene Merchant Outstanding Young Manufacturing Engineer Award from the Society of Manufacturing Engineers in 2004. In 2014, he was elected Fellow of ASME and received the ASME Blackall Machine Tool and Gage Award for a paper he co-authored describing an additive manufacturing method for fabricating 3-D parts by extrusion of water-based ceramic pastes. He has also received numerous awards for research, faculty excellence and outstanding teaching.

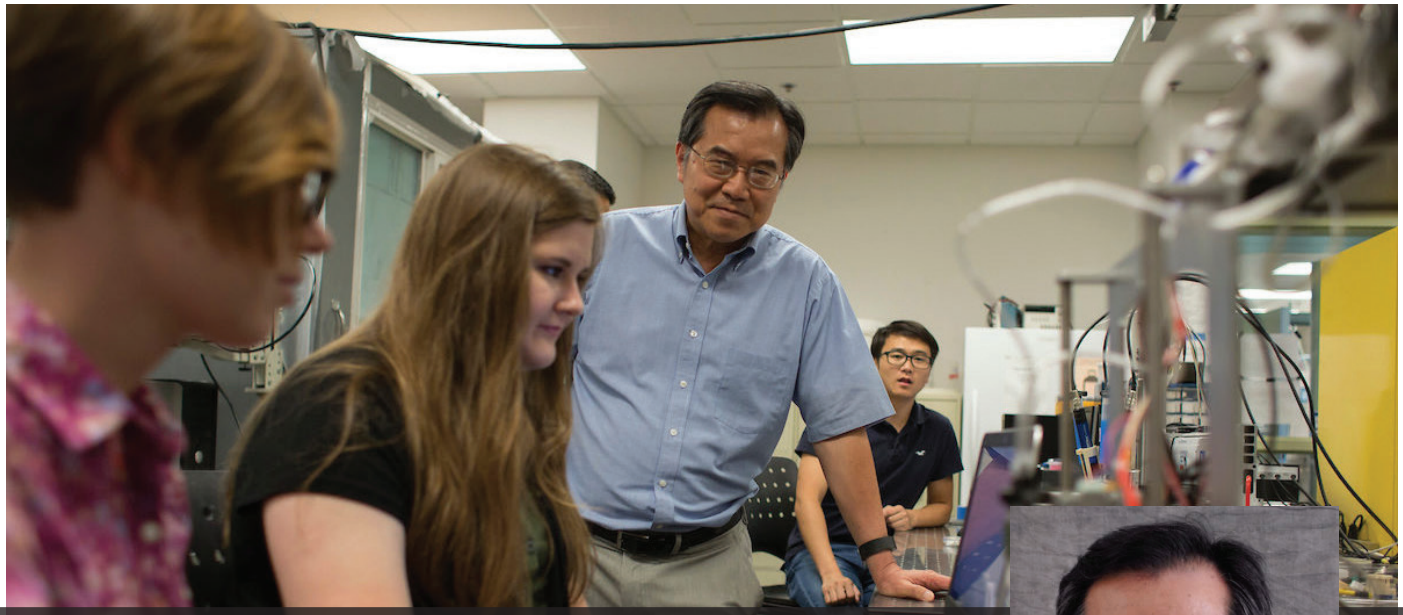
Landers, who also serves as the associate chair for graduate affairs in the mechanical and aerospace engineering department, joined the Missouri S&T faculty in 2000 as an assistant professor of mechanical engineering. He was promoted to associate professor in 2006 and to professor in 2012. Landers earned a Ph.D. from the University of Michigan in 1997, a master of science degree from Carnegie Mellon University in 1992 and a bachelor of science degree from the University of Oklahoma in 1990, all in mechanical engineering.

DR. WOJNAR TO RECEIVE THE 2018 JOURNAL OF APPLIED MECHANICS AWARD

Dr. Charles S. Wojnar has been selected to receive the 2018 Journal of Applied Mechanics Award for the paper "Linking Internal Dissipation Mechanisms to the Effective Complex Viscoelastic Moduli of Ferroelectrics", Journal of Applied Mechanics, v 84, #021006, 2017. The paper developed a new theoretical framework for linking together two previously distinct material modeling regimes: inelasticity and incremental viscoelastic models. This approach will improve the accuracy of physics-based material modeling efforts to better predict and understand how materials behave under both low and high frequency deformation.

The Journal of Applied Mechanics Award is provided by the Applied Mechanics Division of the American Society of Mechanical Engineers to honor the best paper which has been published in the Journal of Applied Mechanics during the two calendar years immediately preceding the year of the award. The award is made annually to the corresponding author of the paper who received their Ph.D. no more than 10 years prior to the year of award. The award will be presented at the Applied Mechanics Division Banquet at the ASME-IMECE meeting.

The selection committee is led by the Vice Chair of the Executive Committee of the Applied Mechanics Division of the ASME. Recent previous recipients include faculty at MIT, Harvard, UIUC, and Tsinghua University.



DR. MING LEU RECEIVES HONORS FOR HIS CONTRIBUTIONS IN MANUFACTURING RESEARCH

Dr. Ming Leu, the Keith and Pat Bailey Missouri Professor of Integrated Product Manufacturing, has been honored by the American Society of Mechanical Engineers (ASME) and the Society of Manufacturing Engineers (SME) for his role in advancing manufacturing research.

Recently, SME has announced that Dr. Leu, who also directs the Intelligent Systems Center at S&T, has been elected a Fellow and will be inducted into the SME College of Fellows. Those selected as fellows have 20 years or more of manufacturing experience and expertise. They have contributed notably to the social, technological and educational benefit of manufacturing and the engineering profession. Leu has also been named the winner of ASME's 2018 Milton C. Shaw Manufacturing Research Medal. The award was presented at the 2018 ASME Manufacturing Science and Engineering Conference in late June at Texas A&M University. The award recognizes significant fundamental contributions to the science and technology of manufacturing processes.

Leu was nominated by his colleague Dr. Robert G. Landers, Curators' Distinguished Professor of mechanical engineering.

"Dr. Leu has made exceptional contributions to the science, engineering and technology of additive manufacturing through his outstanding research, scholarship and creativity in this emerging technology area for 20 years," writes Landers in his nomination letter. "His research has created three novel additive manufacturing processes, generated the fundamental understanding of these processes, contributed to advancing and optimizing these and other AM processes, and developed innovative applications for these processes."

Leu has published over 400 refereed publications in technical journals and conference proceedings, one e-book and nine book chapters over his 36-year academic career while receiving four U.S. patents (plus two pending). He has delivered more than 300 technical presentations and his publications have received over 8,600 citations with an h-index of 45. Leu has also obtained more than $28 million in external grants since joining Missouri S&T. His technical interests are in the areas of additive manufacturing, virtual prototyping, computer-aided design and manufacturing, robotics and automation, machine dynamics and control, and cyber-physical systems.

Leu earned a bachelor of science degree in 1972 from the National Taiwan University, a master of science degree in 1977 from Pennsylvania State University, and a doctorate in 1981 from the University of California at Berkeley. All three degrees were in mechanical engineering.

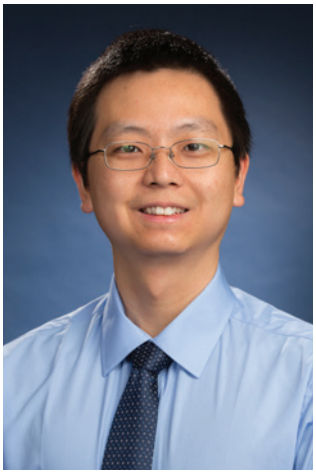
Leu has received several professional awards, including the University of Missouri President's Leadership Award in 2017, ASME's Blackall Machine Tool and Gage Award (2014), the Hideo Hanafusa Outstanding Investigator Award (2008), the Harlan J. Perlis Research Award from the New Jersey Institute of Technology, the NSF's Presidential Young Investigator Award, the Society of Automotive Engineers' Ralph R. Teetor Education Award and the Forest Products Research Society's Wood Paper Award. In addition, Leu was a member the New Jersey Institute of Technology team that received the University Lead Award from the Computer and Automated Systems Association of the Society of Manufacturing Engineers. He was elected as an ASME fellow in 1993 and a fellow of CIRP (International Institution for Production Engineering Research) in 2008. He is a member of the Sigma Xi, Tau Beta Pi and Phi Kappa Phi honor societies.

NEW FACULTY

DR. XIANGYANG DONG

Dr. Xiangyang Dong joined the MAE faculty in August of 2017 as an assistant professor in mechanical engineering. He conducted research in the Center for Laser-Based Manufacturing in the School of Mechanical Engineering at Purdue University, under the supervision of Professor Yung C. Shin. Prior to his Ph.D. studies, he received his bachelor of science degree in mechanical engineering at Xi'an Jiaotong University, Xi'an, China.

His research interests include the mechanics of advanced manufacturing processes, multiscale modeling of heterogeneous materials, and materials design of ceramics and composites. Through simulations and experiments, he aims at a better understanding of the relationships between the microstructure, properties, and processing of materials. His publication record includes articles in peer-reviewed journals such as Journal of the American Ceramic Society, The International Journal of Advanced Manufacturing Technology, and Journal of Manufacturing Science and Engineering. He has also co-authored a chapter of the book Comprehensive Materials Processing Technology.



DR. DAORU (FRANK) HAN

In August 2017, Dr. Daoru (Frank) Han joined the mechanical and aerospace faculty as an assistant professor. His research areas include plasma aerospace applications, space propulsion, plasma-material interactions, plasma physics and rarefied gas dynamics, high-performance computing. Dr. Han received his Ph.D. from the Department of Astronautical Engineering at the University of Southern California. His research focused on developing and applying first-principle-based plasma simulation models on supercomputers to resolve fundamental plasma physics phenomena arising from space explorations. He then became an assistant research professor of the aerospace engineering program at Worcester Polytechnic Institute (WPI).

Dr. Han was born in Zhoukou, Henan Province and in 2005, he attended the Nanjing University of Aeronautics and Astronautics at the city of Nanjing, Jiangsu Province. He graduated with a bachelor of engineering degree in power engineering of aircraft (aeronautical propulsion) in 2009, and moved to the United States to study at Missouri S&T, getting a master of science degree in aerospace engineering degree with a thesis focused on aerodynamics.

WELCOME KAREN WALBERG

Over the past year, we have had a new addition to the department staff. A vacancy was created when Michele Warren joined the Department of Mining Engineering, opening her previous position as the graduate program support coordinator.

Karen Walberg, joined MAE in May 2018 as graduate office support assistant IV. She brings an extensive background from factory supervisor, tax preparation, to accounting. Karen was previously employed with S&T in Procurement in 2002-2010, the Power Plant during the transition to the geothermal system and her latest role working at MKST-FM, the campus radio station from 2014-2017.

Karen also holds an associates degree in business and has several credit hours towards her bachelors in business management. In her spare time, she loves to read, do online mmorpg gaming. She also enjoys the outdoors, hunting, fishing, swimming, sewing and crafts.

ACADEMY OF MECHANICAL AND AEROSPACE ENGINEERS

SEVEN NEW MEMBERS WERE INDUCTED INTO THE ACADEMY

From left: Bradley Sexton, Vinisha Clark, Ronald Rosner, Dr. Robert Oetting, Daniel Jaspering, Dr. Nick Mehta and John Berger.

The Academy of Mechanical and Aerospace Engineers held its 22nd Annual Induction Dinner on Thursday, October 26, 2017 in the Missouri S&T Havener Center.

Six new members and one honorary member were inducted into the Academy of Mechanical and Aerospace Engineers at the academy dinner held in October. The evening was filled with fun and festivity as the academy celebrated the close of the departmental centennial celebration. The theme for the night was, "Gearing up for the next 100 years!" The Academy honored the past, present and future of Missouri S&T through their activities during the evening. Dr. Robert Oetting, who first came to campus as a student when it was MSM, was honored for 31 years of teaching and received a standing ovation; one of many talented professors who helped to shape yesterday's "future" that we live in today.

John M. Berger P.E. (BSME 1968): Owner - Energy Efficient Environmental Solutions, Fishers, Indiana

Vinisha Clark (BSME 1991, MS Eng Mgt 1993): VP - Enterprise Global Solutions - Client Solutions & Operations, AT&T

Daniel Jaspering (MSME 1984): Director Airborne Surveillance Programs (retired) Boeing Defense Space and Security

Nick C. Mehta (MSME 1962, Ph.D. ME 1967): Vice President of Engineering and Chief Technology Officer (retired), Zenith Electronics

Robert B. Oetting, honorary member: Emeritus Professor of mechanical and aerospace engineering, Missouri S&T

Ronald A. Rosner (BSAE 1989): Senior Managing Consultant, Ramboll

Bradley W. Sexton (BSAE 1987): Principal Engineer, Boeing Research & Technology, The Boeing Company

PASSING OF THE GAVEL...

Past President, Paul Niewald, receives a plaque, from president, Dale Pitt, honoring his service to the Academy.

Dale Pitt is the new president of the Academy for 2017-2018, with Paul Niewald serving the Academy as past president .

Dale graduated in 1972 with a degree in aerospace engineering. Following graduation, he was employed at the United States Army Aviation System Command in St. Louis. While there, he received his master and doctorate degrees. In 1980, Dale took a job at McDonnell Aircraft Company (now Boeing) as a research engineer. Dale has authored 39 technical papers that describe his research endeavors; smart structures, structural health monitoring, aeroelasticity, and unsteady aerodynamics. He has traveled internationally lecturing on Aeroelasticity and Smart Structures, and holds a patent for adaptive aircraft structures. Dale has also been an Adjunct Professor of Mechanical Engineering at Washington University in St. Louis, where he has taught both graduate and undergraduate engineering courses. Dale retired from Boeing this fall.

2017-2018 Scholarship and Graduate Teaching Award Recipients:

From left: Seth Jones, Jillian Anderson, Matthew Fogle, Katherine Allen—Past Presidents Scholarship Award, Theodore Ebbesmeyer, Nathan Henshaw, John Rodhouse, Mario Santos—Fall 2016 Graduate Teaching Award, Tyler Lamb—McGovern Scholarship Award, Delanie Degraeve, Brody Riemann, and Elsa Lopez

Not pictured: Joshua Giancola and John Daniel Peterson—Spring 2017 Graduate Teaching Award

ANOTHER WIN FOR AMAE AT THE ACADEMY OF ENGINEERING MANAGEMENT GOLF TOURNAMENT

For the Academy of Engineering Management Golf Tournament, the Academy of Mechanical and Aerospace Engineers were the first academy to be challenged last year and they returned to a rematch this year. Last year, the tournament proved to be a close match and the game was played through a rain shower. The teams were tied after regulation play and AMAE won after a scorecard playoff. This year, though no rain, it was much colder. AMAE also won the match by a larger margin and remained the tournament champion!

AMAE would like to recognize those who supported this event through sponsorship: Matthew Baebler, Craig Barnes, Mike Calandro, Jerry Canfield, Roger Dorf, D&S Car Wash (Jon Jansky), John Eash, Robert Hoffman, Dennis Jaggi, Andrew Johnson, Todd Martin, Steve Moss, Paul Niewald, Dale Pitt, and Lisa Sombart.

Steve Bugg, BSME '65, chips in a shot on the green during the 2018 Academy of Engineering Management Golf Tournament.

MECHANICAL & AEROSPACE ENGINEERING
400 W. 13th St.
194 Toomey Hall
Rolla, MO 65409-0050

THANK YOU TO EVERYONE WHO MADE CONTRIBUTIONS TO LAST YEAR'S PHONATHON. THE PHONATHON WILL BE HELD SEPTEMBER 4TH - 17TH. WHEN THE PHONE RINGS, PLEASE TAKE A MOMENT TO SPEAK WITH ONE OF OUR STUDENT REPRESENTATIVES. EVERY GIFT HELPS MAKE A DIFFERENCE AND SUPPORTS MAE'S MISSION OF ENHANCING STUDENT LEARNING. PLEASE HELP MAKE THIS YEAR'S FUNDRAISING THE BEST YET!

WE LOOK FORWARD TO SPEAKING WITH YOU SOON!