

2018-19



# Mechanical and Aerospace Engineering

WESTERN MICHIGAN UNIVERSITY

# Letter from the chair

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Welcome to this issue of the Mechanical and Aerospace Engineering Department (MAE) newsletter. We have had another great year. Our overall enrollment is still at an all-time high of 900 students. We continue to be the largest department in the College of Engineering and Applied Sciences (CEAS). Our faculty research continues to attract external funding at a great rate, and our graduates enjoy a very high rate of post-graduation employment at competitive salaries.

We welcome Dr. Zach Asher to our department. Dr. Asher's expertise is in the area of mathematical modeling for control and optimization of mechanical systems. He comes to us from Colorado State University, where he completed his Ph.D. in Mechanical Engineering (look for more about Dr. Asher in this issue).

In April 2018, Dr. Sharma retired from the MAE department after 37 years. We wish him a wonderful retirement. In June 2018, we received word that Drs. Hudson and Lemmer have received tenure and were promoted to the rank of Associate Professor. Congratulations to them both!

In August 2018, Pete Thannhauser, Senior Laboratory Supervisor, received the WMU 2018 Distinguished Service Award. During his nearly 35 years in the college, he has made significant contributions to our department and the College of Engineering and Applied Sciences. Congratulations Pete!

This summer, Amanda Hoger was promoted to the rank of Administrative Assistant II and took the place of Ann Mathis who departed WMU. Amanda has worked at WMU since 2010. She has experience in working at the WMU Unified Clinics, Industrial and Entrepreneurial Engineering and Engineering Management, Speech, Language and Hearing Sciences, and Electrical and Computer Engineering department offices. Karen Murphy was then hired to take Amanda's former position. Karen comes to us with 21 years of experience as an office coordinator, most recently at EPI Marketing Services and before that at the Kalamazoo County 8th District Court.

This fall, we awarded the department Alumni Excellence Award to Alex Porter, Global Director of Engineering at Intertek (B.S. Aircraft Engineering '89, M.S. Mechanical Engineering '92).

We hope that you will find the latest MAE news encouraging. Please visit our webpage at: <https://wmich.edu/mechanical-aerospace> and view our latest department video. If it's been a while since you visited us, please contact us and arrange to visit our department.



**Koorosh Naghshineh**, Chair,  
Department of Mechanical and Aerospace Engineering



# Introducing Dr. Zachary D. Asher

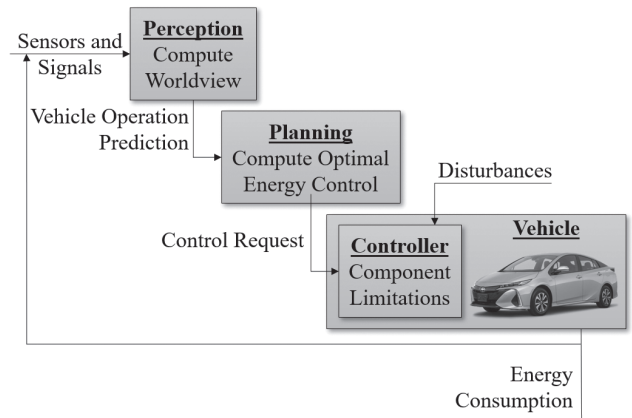


Dr. Zachary D. Asher joined Western Michigan University as an Assistant Professor of Mechanical and Aerospace Engineering in July 2018. He received his B.S. in Mechanical Engineering from Colorado State University in 2009, his M.S. in Mechanical and Aerospace Engineering from the University of Colorado, Colorado Springs in 2012, and his Ph.D. in Mechanical Engineering from Colorado State University in May 2018. He also worked full time in engineering industry from 2009 to 2015 and completed a short postdoctoral research position at the University of Michigan from May 2018 to August 2018. His master's degree research was focused on space debris removal using tether momentum exchange and his Ph.D. research was focused on the use of driverless vehicle technologies to improve vehicle fuel economy in addition to safety.

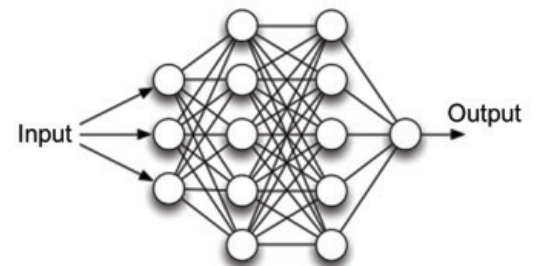
Dr. Asher's field of study is summarized as the mathematical modeling, control, and optimization of mechanical systems. To date, this expertise has been applied to hybrid electric vehicles to realize improved fuel economy, the transportation sustainability impacts from widespread infrastructure deployment of electric vehicle in-motion charging technology, development of driverless control of vehicles, and removal of space debris fields using a single spacecraft. Success in this field requires an in-depth understanding of the latest modeling, simulation, and mathematical optimization techniques, as well as creativity and vision for real world implementation. His current research is focused on the real world realization of hybrid electric vehicle fuel economy improvements through advanced control, big data fusion for transportation network fuel economy improvements, transportation sustainability analysis, development of robust driverless control strategies, and techniques for removal of space debris. He is actively pursuing research funding for each of these projects from the U.S. Department of Energy, the Michigan Department of Transportation, and various industry partners.

He is teaching ME 3580, Mechanism Analysis, in fall 2018 and spring 2019 and is updating the course to include relevant software skills for mechanical engineering industry positions. These analysis tools include Computer Aided Drafting (CAD) of mechanisms and the development of solver programs using numerical analysis tools such as Matlab. His future teaching interests include design of hybrid electric vehicle powertrains, advanced mechanical system analysis, driverless vehicle development, optimization, modeling with artificial neural networks, and astrodynamics. He is very active in the field of pedagogical research and looks forward to continually improving courses.

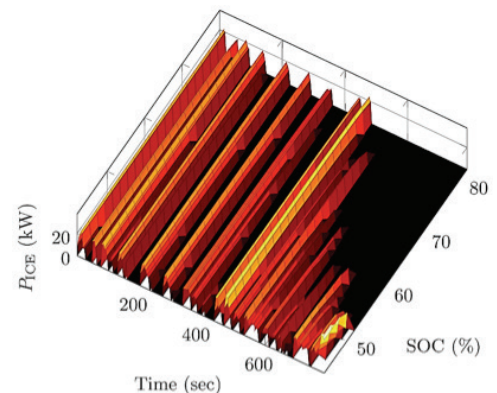
Dr. Asher is looking for graduate students who are interested in the new and emerging fields of electric vehicles, driverless vehicles, and advanced satellite control. Students interested in contributing to the ongoing research efforts are encouraged to contact him at [zach.asher@wmich.edu](mailto:zach.asher@wmich.edu) and to visit his website at <http://zachasher.wixsite.com/home>



Implementation of advanced vehicle control.



An artificial neural network is used for predictive modeling.



Optimal control matrix for maximum fuel economy where the x-axis is time, the y-axis is battery state of charge (SOC), and the z-axis is engine power (PICE).

# Department of Mechanical and Aerospace Engineering develops an engineering flight simulator

Dr. Kapseong Ro and his graduate student Cameron Segard, along with a senior design capstone project group, have recently completed initial development of the MAE Engineering Flight Simulator (MAE<sup>2</sup>FS).

Flight Simulators are extensively used for pilot training and as a R&D tool among the pilot training industry, aerospace manufacturers and government institutions. A training simulator is used to practice pilot skills and operational procedures of a specific airplane, and is thereby very inflexible. An engineering flight simulator, however, is highly capable of being tailored to meet various objectives and applications such as applied research and engineering education. Previously, the MAE department used a yoke and pedal with consumer grade flight simulation software for basic aircraft familiarization at the freshmen level. The MAE Engineering Flight Simulator will be used not only as an integrative tool for aeronautical engineering education but also as an effective tool to conduct advanced research such as next generation aircraft design, innovative control configured aircraft, safety and environmental benefits of advanced control laws, flying/handling qualities evaluation, etc. Integrating the simulator into the current aerospace curriculum will provide students the chance to physically experience changes in flight dynamics and control system.

The simulator consists of an out-the-window (OTW) display system made up of three 55" UHD-TVs providing a large field of view (160° horizontal and 30° vertical), primary flight instruments display and operator interface via two touch screen monitors, throttle and flap control unit, and a FAA Level D flight simulator certifiable three-axes primary control loading system (CLS). The computational and graphics power comes from a purpose-built high-performance workstation utilizing a 4.5 Ghz liquid cooled Intel i7-7740X processor, 32Gb DDR4 RAM, dual SLI Nvidia GTX 1070's, and 2.5Tb of hard drive memory. Flight dynamics and control system software are in the process of being developed on the MATLAB/SIMULINK platform, which is linked to Flight Gear's OTW image generation, for rapid prototyping and validation of research tasks. For initial curriculum applications, X-Plane 11 simulation software will be used as it seamlessly integrates with training industry grade and programmable Brunner CLS-P side stick and rudder pedal system. This allows accurate control forces representation to the user throughout the flight envelope repeatedly. Variations to the aircraft payload allow for users to become familiar with the nuances of flight dynamics in a controlled high-fidelity environment. Opportunities for future software development and hardware-in-the-loop-simulation(HILS) integration continue to grow as the simulator becomes fully utilized.

The MAE Engineering Flight Simulator was assembled in the UAV Lab with the support of the senior design team members, undergraduate students and family members. The MAE department interfaced with the project seamlessly providing logistic support and purchasing guidance as the project progressed as noted by the team. All the raw material and necessary equipment were selected, sourced and purchased by the team ahead of each phase of the assembly process, enabling an ambitious assembly schedule. All team members had the opportunity to collaboratively develop their own hands-on skills to contribute to the project. The lab lights were rarely off during the month of July and August as a flexible work schedule was utilized to accommodate each team member as availability times changed. The few remaining features to be installed are the finalized light control curtain and adjustable position pilot's seat being completed by the senior design team.

As news spread of the MAE<sup>2</sup>FS during the first few weeks of the semester, ideas and interest began to flourish among entering and current students about their future work to be carried out on the simulator. During our most recent lab open house on Passport Day during WMU's Fall Welcome, new engineering students had the opportunity to fly their choice of available aircraft and experience the immersive simulation. Many were excited to have an opportunity to be at the controls and test their piloting skills in various flight conditions. All appreciated the opportunity and left excited to return and use it again in their future course work. The future is bright for the contribution capabilities of the simulator as environmental and noise restriction regulations continue to increase. In time, those necessary sustainable aircraft configurations with modern propulsion systems will be analyzed and evaluated in real time on MAE<sup>2</sup>FS. This will provide invaluable access to undergraduate and graduate students for modern control system research on multi-input-multi-output nonlinear aero models. It's a good time to be a Bronco! Go Broncos! Go MAE!

*Cameron Segard worked as a flight control engineer at a major aircraft manufacturing company for several years after graduating from WMU with a bachelor's degree in aerospace engineering in 2014 and now is pursuing his master's degree in aerospace engineering. This project is supported by the Office of Sustainability and the Department of Mechanical and Aerospace Engineering at Western Michigan University.*



MAE Engineering Flight Simulator - as it nears completion



# Gear Sliding Loss Prediction

## Center for Advanced Vehicle Design and Simulation (CAViDS)



The prediction of traction coefficient and thus sliding losses in lubricated sliding-rolling contacts remains a challenging problem, especially for gear teeth applications. Under heavy loads and varying shear rates, the behavior of the shear stress, which determines the traction coefficient, with the shear rate is complex. For shear stresses below the threshold stress, in the Newtonian regime corresponding to stresses less than 1.1752 of the Eyring stress, shear stress increases linearly with the shear rate. In the non-Newtonian regime or the shear thinning viscoelastic region, the lubricant develops more elastic properties, behaving more like a glassy substance and releases stress as strain rate increases. This process continues until at very large Deborah numbers, the lubricant becomes completely elastic. Additional stress makes the lubricant reach its plastic limit, the yielding stress or the limiting shear stress.

Depending on the operating conditions of the gear teeth, the traction coefficient magnitude is most influenced by the condition of the lubricant and its viscosity, which varies with pressure and temperature within the contact. To evaluate the traction coefficient, the shear thinning of the non-Newtonian lubricant with increasing shear rate under low and high contact pressures must be considered. Finally, the limiting shear stress of the lubricant because of its viscoelastic behavior must be taken into account.



For extremely large loads, the contacting surfaces undergo elastic deformation. If the materials of the contact surfaces yield under these extreme pressures, the possibility of plastic deformation and failure of the gear tooth because of pitting and scoring exist. The gear teeth contacts mostly operate under the elastohydrodynamic condition. In this piezoviscous-elastic regime, the lubricant behaves like a viscoelastic material with high magnitudes of viscosity because of large Hertzian pressures. In addition, the lubricant viscosity changes with temperature as a result of the viscous shear heat losses in the contact. Thus, there is a strong coupling between the traction force and film temperature.

The objective of this research by Dr. Parviz Merati and John Bair, executive director of CAViDS, is to develop appropriate relationships for calculating gear sliding losses based on known gear geometry, lubrication properties, gear design, and gear manufacturing parameters.



# Ph.D. student receives the prestigious NASA Earth and Space Science Fellowship

Shawn Brueshaber is a Ph.D. candidate and part-time faculty in the Department of Mechanical and Aerospace Engineering. He has 21 years of experience in various aerospace and mechanical engineering positions including product design, stress analysis, and research and development. In 2016 he was awarded with a prestigious NASA Earth and Space Science Fellowship for his dissertation proposal titled, "Accumulation of Polar Vorticity, Towards a 3D Theory." Brueshaber's research is attempting to understand why the four giant planets of the solar system—Jupiter, Saturn, Uranus, and Neptune—have different configurations of polar vortices. Polar vortices are structures that are ubiquitous on planets with a substantial atmosphere, including Earth. Atmospheric vortices are locations where air spirals around a center of circulation, in which the pressure gradient force, centripetal acceleration, and/or the Coriolis forces are in balance. Planets such as Jupiter and Saturn, which otherwise have very similar dynamics in their equatorial regions and midlatitudes, depart radically from each other at the poles. Both planets' weather is largely thought to be controlled by moist convective processes including frequent thunderstorms. Such storms create turbulence and this turbulence self-organizes into a number of zonal (east-west) jet streams and/or vortices, with the vortices becoming more numerous in the high latitudes. Saturn features a single compact cyclonic vortex (rotating in the same direction as the planet) centered on each pole. Jupiter's north polar region features eight polar cyclones slowly precessing around another that itself is offset from the pole. Jupiter's south polar region features five cyclones precessing around another that is offset from the pole. Why Jupiter and Saturn have very different dynamics in their polar regions is an area of active research in planetary science.



Brueshaber's recently completed research uses a general circulation model solving the shallow-water equations, which are a simplification to the full Navier-Stokes equations. The weather layer, which includes the visible cloud decks of the four giant planets, is simulated as a single fluid layer on a Cartesian grid using a gamma-plane approximation to capture the latitudinally varying Coriolis force. Turbulence in the model is generated by randomly and continually injecting small-scale mass pulses ("storms") into the domain. Positive mass pulses mimic thunderstorms which inject mass into the weather layer from below, whereas negative mass pulses model upper-level convergence and subsidence of air. Small cyclones (anticyclones) emerge for negative (positive) storms. The motions and interactions of the storms ultimately result in large-scale

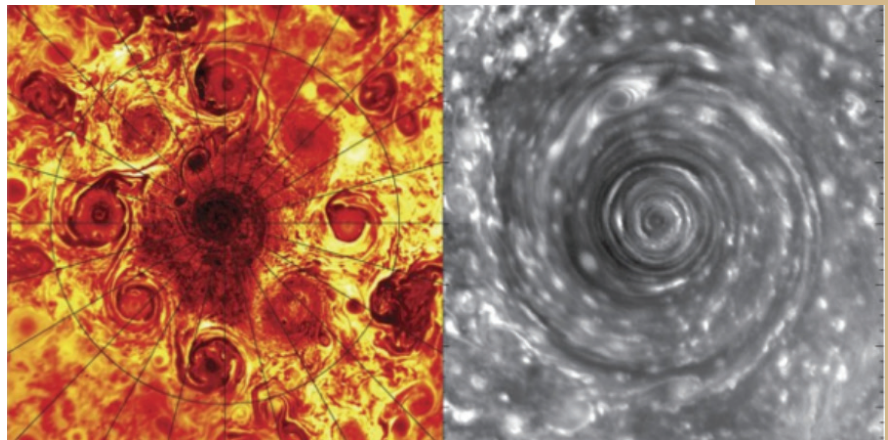


Figure 1: (Left) Jupiter's northern polar region. Image taken from the Juno spacecraft's JIRAM instrument at  $\lambda = 5\mu\text{m}$  M filter (Adriani et al. 2017). (Right) Saturn's northern polar region from the Cassini spacecraft's ISS instrument. Image taken with CB2 filter,  $\lambda = 750\text{ nm}$  (Sayanagi et al. 2017).

structures such as polar vortices and jet streams being formed. His research has shown that the configurations of polar vortices are substantially influenced by the non-dimensional Burger number, which is the ratio of the Rossby deformation radius to the planetary radius. The Rossby deformation radius is the characteristic length scale at which the planet's rotation has an effect approximately equal to the influence of buoyancy. On Earth's atmosphere this value is  $\sim 1,000\text{ km}$ , whereas in the oceans, it is  $\sim 15\text{ km}$ . Interestingly, the strength of randomly injected storms and their polarity (cyclonic or anticyclonic) do not appear to have substantial influence upon the configuration of the polar vortices or jet streams. For Saturn, Uranus, and Neptune, the Burger number is probably large, and Brueshaber's research demonstrates that a single compact cyclone will emerge from the turbulence. Jupiter, on the other hand, has a small Burger number and his simulations demonstrate multiple vortices should emerge. His results largely match the observations found by the Cassini spacecraft (orbited Saturn from 2004-2017), and the Juno spacecraft (orbiting Jupiter 2016-present). Brueshaber's current research is applying the results found from his simpler shallow-water modeling with the more complicated primitive equations model (seemingly oddly named), which allow a greater range of fluid dynamic behavior to be studied. He hopes to have his current battery of simulations completed by early spring and defend his dissertation in the fall of 2019. His Ph.D. dissertation committee is chaired by Dr. William W. Liou, professor of aerospace engineering in the department.

## NSF grant allows important materials research



Dr. Pnina Ari-Gur, Professor, Mechanical and Aerospace Engineering, is a co-principal investigator on the recent National Science Foundation (NSF) award. The grant of \$621,618, from the Major Research Instrumentation program, will fund the acquisition of Quantum Design Physics Properties Measurement System (PPMS). The award is the outcome of collaboration between the departments of Physics (team led by Dr. Clem Burns), Chemistry and Mechanical and Aerospace Engineering. The

system is a multipurpose instrument that enables studying materials at a broad range of temperatures (almost absolute zero to 400 K) and under magnetic fields up to strength of 14T. The PPMS system that has no equivalent at WMU or anywhere in the area will enable measurements of many of the most important properties of materials. It will support important research into alternative energy magnetic materials, batteries, semiconductors and superconductors. Ari-Gur is excited about the added research capability. In 2016, she was the principal investigator on an award from the same NSF program that funded the acquisition of a top-of-the-line X-ray diffraction system.



Pete Thannhauser, senior laboratory supervisor in the Department of Mechanical and Aerospace Engineering, is the recipient of the WMU 2018 Distinguished Service Award.

“This is a great and well-deserved honor,” said Dean Houssam Toutanji.

“Pete’s significant contribution to our college and WMU as a whole makes a huge difference in the lives of our students, faculty and staff. We are fortunate and delighted to have someone like Pete as a colleague.”

Thannhauser joined WMU in the Department of Mechanical Engineering in 1984. During his nearly 35 years in the college, he has contributed to the research efforts of many faculty members in several

departments, assisted many undergraduate students with their senior design projects, and worked with graduate students on projects, theses and dissertations. He was instrumental in upgrading the Applied Aerodynamics Lab, in particular, in wind tunnel control and instrumentation. In addition, Thannhauser has provided support for many registered student organizations. Outside of Western, he also has served as a devoted mentor to the national award-winning Stryke Force First Robotics team from 2014-2017, mentoring high school students from throughout the county from five different school systems.

Thannhauser was chosen from nominees across campus who have demonstrated exceptional service in areas that reflect innovative and effective programming, increase WMU’s stature or extend WMU’s impact and presence into the larger community.

He received a recognition plaque inscribed with his name and a check for \$2,000 at Fall Convocation on Friday, Sept. 14. A second plaque in his name will be added to the 2018 Distinguished Service Award recipient collection at the Bernhard Center.

## Student receives scholarship from gear industry

Mechanical engineering student Caleb Gurd is one of 10 students from the U.S. and Canada who has received a \$5,000 scholarship from the American Gear Manufacturers Association (AGMA). The awards typically go to students with experience in the gear industry.

“The Scholarship Program is one way in which the AGMA Foundation fulfills its mission to recruit, educate, and keep the power transmission industry current with emerging technology,” said Cindy Bennett, AGMA Foundation executive director. “This program successfully delivers engineers and trained personnel to our industry.”

Dr. Claudia Fajardo-Hansford, associate professor of mechanical engineering, said this is the second time a Western Michigan student working in research projects for the Center for Advanced Vehicle Design and Simulation (CAViDS) has received the AGMA scholarship. The investment in CAViDS from the government, foundations, and industry partners is used to develop basic simulation tools and customize the developed technologies to industry needs. For his senior design project, Gurd is designing, developing and validating a variable speed test bed capable of measuring gearbox efficiencies.

“Caleb is well deserving of this scholarship,” Fajardo said. “He demonstrated interest in vehicle research very early on as an undergraduate engineering student. His senior design project, focused in the area of power transmission and efficiency using gearboxes, will enhance research capability at the College of Engineering and Applied Sciences in support of industry-academia collaborative projects.”

Eighty-six percent of graduated AGMA scholarship recipients are employed in the gear/power transmission industry.

Companies and research institutions employing AGMA Foundation scholarship recipients include: Colorado State Engine & Energy Conversion Lab, DNV KEMA Renewables, Dynamic Motion Control, Gardner Denver Nash LLC, Hirschvogel, Koepfer Amercia, Ontario Drive & Gear, Tawas Tool, Toyota Performance Gear Systems and The University of North Carolina.



# SAVE THE DATE

Help MAE keep  
this trophy  
and steal the other!

## 3.14 2019



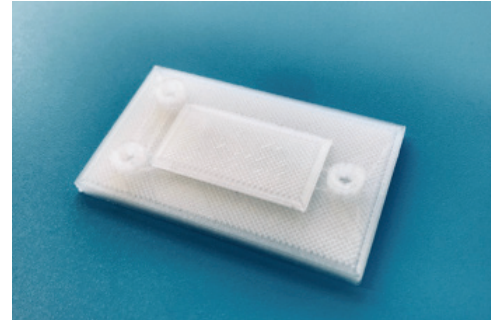
The College of Engineering  
and Applied Sciences'  
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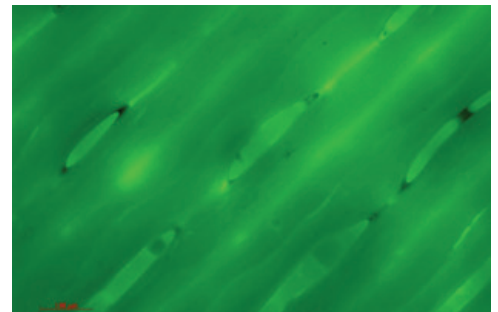
## Development of low cost/high volume micro/nano sensors and actuators



Dr. Muralidhar Ghantasala's group has been actively working on micro/nano sensors and actuators. Development of low cost/high volume sensor technologies has been the focus of his current research. Recently his group has received funding from the Michigan Economic Development Corp. (MEDC) ADVANCE Grant program for the development of low cost torque sensors. These grants are awarded to faculty from Michigan public universities to develop devices to proof of concept stage and help move the inventions from early stage technology to commercialization. The grants are awarded and managed by Michigan State University. The goal of this research is to produce torque sensors at a cost of less than \$50-\$75. This work is being performed in association with WMU's Center for Advanced Vehicle Design and Simulation (CAViDS). Another project that the group is currently working on is the simulation and testing of microfluidics based lab-on-chip devices and technologies (e.g. nano drug delivery systems, in-vitro lab on chip technologies). Dr. Ghantasala has an ongoing project in collaboration with the Center for Nanoscale Materials at Argonne National Laboratory on nano particle drug delivery simulation and in-vitro testing by lab-on-chip devices, which is also funded by Western Michigan University.



3-D printed lab-on-chip



Fluorescence image of protein attached on a Ultra-violet ozone (UVO) treated 3-D printed lab-on-chip Poly Lactic Acid (PLA) surfaces



Soaring high this summer was aerospace engineering sophomore Ashleigh Heath who performed at the EAA AirVenture event in Oshkosh, Wisc. -- the largest annual gathering of aviation enthusiasts in the country, with more than 600,000 attending. She flew three demonstration flights with a giant scale radio-controlled airplane as part of twilight and nighttime air shows, alongside many professional aerobatic pilots.

More than 10,000 aircraft were at the event, including homebuilt aircraft, vintage planes, warbirds, seaplanes and aerobatic aircraft, among others.

## Liou receives \$204,000 NSF grant for neurological research

Dr. William Liou has received a \$204,000 grant from the National Science Foundation (NSF) for research designed to help improve the medical diagnosis and treatment of patients with neurological diseases related to cerebrospinal fluid flow in the brain. Using a multidisciplinary approach, Liou, professor in WMU's Department of Mechanical and Aerospace Engineering, is collaborating with Dr. Shinya Yamada, chief of neurosurgery and chief of the Hydrocephalus and Cerebrospinal Fluid Research Center at the Toshiba Rinkan Hospital in Japan.

The research, "Turbulent Cerebrospinal Fluid Flow Dynamics in Physiological and Pathological Conditions," will look at abnormalities in cerebrospinal fluid – which surrounds the brain and spinal cord – and how they affect health.

"Cerebrospinal fluid is believed to circulate in the central nervous system, protecting the brain from trauma by providing buoyancy and transporting nutrients," Liou said. "Abnormalities in the fluid, its containment space, and its circulation have been related to several diseases, such as hydrocephalus, Alzheimer's disease, schizophrenia and multiple sclerosis."

The project will use state-of-the-art brain imaging and computational science equipment to study how the cerebrospinal fluid flow impacts the brain. "This research is unique because we are looking at the dynamics of the cerebrospinal fluid and the blood flow systems in the brain and using computer modeling to get an advanced understanding of its impact on health," Liou said. "We are hoping that by studying the physics of the bio-turbulent flow of cerebrospinal fluid, we can learn how to help patients with some of the associated diseases."



## Alexander Porter inducted into the Alumni Excellence Academy

B.S. Aircraft Engineering '89, M.S. Mechanical Engineering '92

Alex Porter is the Global Director of Engineering at Intertek. He has been with the company since 1992, holding additional positions in materials testing, finite element analysis, sales and engineering development.

Starting in 1996, Alex began working with automotive, furniture, industrial and appliance manufacturers to develop accelerated test methods that could quickly identify design inherent failure modes and reduce development time. He has three patents related to accelerated testing equipment, and is the author of Accelerated Testing and Validation as well as more than 40 articles and technical papers on accelerated testing.

In his current role, Alex serves as principal architect for Intertek's current global qualification system that tracks engineering qualifications across three continents. He also has deployed a global system for tracking non-standard and benchmark testing. Alex has personally tested everything from robotic babies, kitchen sinks and parts of the International Space Station.

Alex is a member of the Society of Automotive Engineers (SAE) and is a Professional Engineer in the state of Michigan.



**Favorite Bronco Memory:** Flying with Art Hoadley in the experimental Cessna 182 doing zero g parabolic flights to test the liquid cooling capability of a data acquisition system being developed for NASA for high angle of attack airflow study on the F/A-18.



FSAE RACE CAR



BRONCO BAJA CAR



"GIVE A SLICE" MOST DONORS TROPHY



GEAS BACK TO SCHOOL PICNIC

ASHLEY HEATH IN OSHKOSH, WI



FLIGHT SIMULATOR



DR. GUSTAFSON IN OSHKOSH, WI



INTERNATIONAL GRADUATE STUDENT ORIENTATION



ANECHOIC CHAMBER

# THE YEAR IN PHOTOS

# MAE Faculty

Most faculty members hold terminal degrees in mechanical engineering, aerospace engineering or closely related fields. Their areas of research include but are not limited to mechanical system, structural dynamics, system design and controls, advanced materials, experimental stress analysis, vehicle dynamics, electric propulsion, experimental and computational fluid dynamics, thermal and power systems, fuel cells, noise and vibrations, finite element analysis, and micro and nano-technology.

## **Koorosh Naghshineh, P.E. (Chair)**

Ph.D., Mechanical Engineering, Pennsylvania State University  
Areas of expertise: acoustics, structural vibrations, noise and vibration control  
Phone: 269 276-3292

## **ME Graduate Programs Director**

### **Muralidhar K. Ghantasala**

Ph. D., Instrumentation Engineering, Indian Institute of Science, Bangalore, India.  
Areas of expertise: micro/nano sensors and actuators, micro/nano fabrication technologies, high efficiency hybrid micro actuators

## **AE Graduate Program Director**

### **Peter Gustafson**

Ph. D., Aerospace Engineering, University of Michigan.  
Areas of expertise: composite materials, finite element modeling, orthopaedic biomechanics

## **Other Faculty**

### **Judah Ari-Gur**

D.Sc., Aeronautical Engineering, Technion (Israel)  
Areas of expertise: structural dynamics, blast response of shells, structural stability, composite material structures, finite-element modeling

### **Pnina Ari-Gur**

D.Sc., Materials Engineering, Technion (Israel)  
Areas of expertise: nano-structured materials development and characterization, smart materials, bio-materials, virtual reality laboratory, x-ray and neutron scattering and electron microscopy

### **Zachary D. Asher**

Ph. D., Mechanical Engineering, Colorado State University  
Areas of expertise: mathematical modeling for control and optimization of mechanical systems

### **Christopher Cho, P.E.**

Ph.D., Mechanical Engineering, State University of New York at Stony Brook  
Areas of expertise: heat transfer, two-phase flow, thermal-fluid measurement

### **Claudia Fajardo**

Ph.D., Mechanical Engineering, University of Michigan  
Areas of expertise: experimental fluid mechanics and combustion, optical diagnostics, internal combustion engines

### **Jennifer Hudson**

Ph. D., Aerospace Engineering, University of Michigan  
Areas of expertise: space flight dynamics and control, orbital mechanics, optimal control theory

### **Daniel Kujawski**

D.Sc., Mechanics of Solids, Warsaw University of Technology;  
Ph.D., Mechanics of Solids, Polish Academy of Sciences  
Areas of expertise: fatigue and fracture, life prediction, and mechanical testing

### **Jinseok Kim**

Ph. D., Mechanical Engineering, Texas A&M University;  
Areas of expertise: solid mechanics, computational mechanics, finite element method, plate and shell theories, non-local theories, functionally graded materials, and piezoelectric materials

### **Ho Sung Lee**

Ph. D., Mechanical Engineering, University of Michigan  
Areas of expertise: heat transfer, thermal design, boiling in microgravity, and engine cooling systems

### **Kristina Lemmer**

Ph. D., Aerospace Engineering, University of Michigan  
Areas of expertise: plasma diagnostic development, optical erosion spectroscopy, experimental plasma discharges and hypersonic plasma interactions

### **William W. Liou**

Ph.D., Aerospace Engineering, Pennsylvania State University  
Areas of expertise: continuum and discrete fluid flow computation, multi-physics engineering simulation, microfluid flow, transition and turbulence, aerodynamics, propulsion

### **Tianshu Liu**

Ph.D., Aeronautics and Astronautics, Purdue University  
Areas of expertise: experimental aerodynamics, applied aerodynamics, fluid mechanics, heat transfer

### **Parviz Merati, P.E.**

Ph.D., Theoretical and Applied Mechanics, University of Illinois at Urbana-Champaign  
Areas of expertise: experimental and computational fluid mechanics and heat transfer, compressible fluid flow, tribology

### **Richard T. Meyer, P.E.**

Ph.D. Mechanical Engineering, Purdue University  
Areas of expertise: hybrid power systems, control, modeling and simulation, numerical methods

### **Javier Montefort**

Ph.D. Mechanical Engineering, Western Michigan University  
Areas of expertise: experimental fluid mechanics and heat transfer

### **Kapseong Ro**

Ph. D., Aerospace Engineering, University of Maryland at College Park  
Areas of expertise: aircraft flight dynamics and control, flight simulation, unmanned aerial vehicle

### **Bade Shrestha, P.Eng.**

Ph. D., Mechanical Engineering, University of Calgary  
Areas of expertise: alternative fuel combustion, advance internal combustion engines, fuel cells, and renewable and sustainable energy development

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