



WESTERN MICHIGAN UNIVERSITY
College of Engineering
and Applied Sciences



Mechanical and Aerospace Engineering • 2015-2016

Letter from the Department Chair



This is our inaugural newsletter, a symbolic manifestation of the changes and progress that we are witnessing in our department. I am the new dean of the College of Engineering and Applied Sciences and also currently the interim chair of the Department of Mechanical and Aerospace Engineering. I would like to thank Dr. Parviz Merati, who served as the department chair for more than 20 years. He has returned to the faculty and we are now searching for a new chair.

We have recently added a new master's program in aerospace engineering, and we now have undergraduate and master's programs in both mechanical engineering and aerospace engineering as well as a Ph.D. program in mechanical engineering. We are by far the biggest department in the College of Engineering and Applied Sciences, with close to 900 enrolled students. Both of our undergraduate programs are fully accredited and thriving.

Two of our long-serving faculty members, Dr. Dennis VandenBrink and Dr. Roman Rabiej, have retired. We have hired a new faculty member, Dr. Richard Meyer, who joined us at the beginning of the academic year. A description of his experience and expertise is included in this newsletter. In our department office, Heather Martin joined us to replace Erin Baker who was promoted to a position in another department.

In future newsletters we would like to also include information about our alumni. We encourage you all to keep in touch and inform us about your lives and careers.

New Faculty



Richard T. Meyer received his Ph.D. in Mechanical Engineering from Purdue University where he was a recipient of the National Defense Science and Engineering Graduate Fellowship. His research interests include power management, hybrid systems, and model predictive control. Investigations include simulation and optimal control of fuel cell-battery hybrid vehicles, battery-supercapacitor electric vehicles, internal combustion engine-battery hybrid vehicles, and future naval ship power systems. Furthermore, he has created a new terrestrial gas turbine engine model explicitly for power plant control. Additionally, he has studied a powered wheelchair for persons with hand tremor, which has onboard intelligence that shares control with the user to ensure safe operation. Previously, he received his BS from the University of Missouri-Rolla (Missouri University of Science and Technology) in Mechanical Engineering. Afterwards, he received a National Science Foundation Fellowship to obtain his MS in Mechanical Engineering at the University of Missouri-Rolla. He then joined Ford Motor Company in Dearborn, Michigan where he worked in advanced transmission control system design. Following that, he joined DeLaval Inc. in Kansas City, Missouri to develop control solutions for the dairy industry.

Student Success



Nicolas Theoret, a senior in mechanical engineering, was a finalist in the 2016 Magna Innovation Challenge (see: <http://www.magna.com/studentinnovationchallenge>). After the initial applications (from the U.S., Canada and Mexico) were screened, he was invited to the Consumers Electronics Show in Las Vegas to participate in the design competition, sponsored by Magna. The challenge was to come up with a capability or feature of the car of 2030. He was teamed up with two students from other schools for three grueling days of work to come up with a business plan for their design, which was then presented in front of a panel of judges. Their team won the second place award. Nicolas says that "the entire experience was truly inspiring and I encourage more WMU students to apply for the 2017 student competition".





**Kristina
Lemmer**



**Jennifer
Hudson**

University NanoSatellite Program P-Spec Mission

The University Nanosatellite Program (UNP) is sponsored by the Air Force Office of Scientific Research and the Air Force Research Laboratory (AFRL). It is a two year grant that allows universities to design and build a small satellite while going through a rigorous design review process by AFRL. Dr. Lemmer and Dr. Hudson received one of these prestigious grants so that the student organization, Western Aerospace Launch Alliance (WALI), can design and build two models of satellites that will determine whether plasma properties can be reliably measured using optical emission spectroscopy (OES) from a small satellite platform. The goal of the research is to develop a small satellite for on-orbit analysis of plasma plumes. The research will investigate mission feasibility, develop enabling technology, and demonstrate benefits to the United States Air Force (USAF). The project will also serve as an intensive, hands-on learning experience for engineering students at WMU, and it will enhance the state-of-the-art CubeSat technologies. If successful, the satellite design and prototype models will proceed to the second phase of UNP where the satellite is built, tested, and eventually launched into space.

The research goals will be achieved through a mission demonstration of on-orbit OES of a plasma discharge. The Plasma Spectroscopy CubeSat (P-Spec) consists of a pair of satellites that launch as an integrated unit and separate after deployment. The two satellites will operate in mother-daughter configuration. The OES system on P-Spec1 (2U CubeSat) will analyze a plasma source light emission from P-Spec2 (1U CubeSat). Initially, the two satellites will operate in close proximity, but as they drift apart, the distance limits on plasma analysis using OES on orbit will be determined. Furthermore, P-Spec1 will employ active attitude control to point the spectrometer at the plasma source on P-Spec2. By adjusting the attitude rate of P-Spec1, the stability of the OES system necessary to measure emission data for plasma plume analysis will be determined.

The proposed project involves several engineering challenges. The plasma source onboard P-Spec2 will be a plasma tube or a hollow cathode. Experiments will determine the optimum plasma source for the mission within the constraints of a 1U CubeSat. Similarly, the optimum OES system will be determined based on power availability, vibration sensitivity, and thermal requirements on a 2U CubeSat.

Recent advances in CubeSat technology have resulted in increased interest in using micro electric propulsion (EP) thrusters for orbit maneuvering. By using a hollow cathode for the P-Spec mission, several technologies required for EP thrusters will be tested, including propellant feed and storage systems, power processing units, and a pressure monitoring system.

The ability to characterize the plasma plume of an EP device onboard a satellite is directly applicable to USAF needs in Space Situational Awareness. This diagnostic capability can be used to diagnose a malfunctioning EP system or to identify an unknown spacecraft operating with EP. The P-Spec mission represents the first of three planned WMU missions to develop and demonstrate a propulsion-enabled CubeSat for on-orbit plasma diagnostics.

The proposed mission will also significantly impact the education of WMU students. The infrastructure that is developed as a result of the research and protoflight satellite development will enrich the student small satellite group, the Western Aerospace Launch Initiative (WALI), by providing equipment for ADACS testing, a ground station, OES instrumentation, and satellite subsystem components such as solar panels, batteries, an onboard CPU, and communications transceivers. The students will develop systems engineering skills, build and integrate satellite subsystems, and manage projects. They will implement protocols for designing future missions using experiences from the P-Spec mission.

For more information about the student group WALI, and to help support WALI's efforts, please visit the following website:

bit.ly/FundWali or www.mywmu.com/WALI



WALI Student Opportunities

This summer, WALI students are in store for two exceptional hands-on learning opportunities. The first is associated with University Nanosatellite Program (UNP). Four students have the opportunity to attend a satellite building workshop at Kirtland Air Force Base in Albuquerque, NM. At the two day Sat Fab 101 workshop, students will learn necessary basics for building a satellite including soldering, harnessing, mechanical assembly, electrostatic discharge, and cleanliness training.



The second is a workshop presented by NASA's Wallops Flight Center near Norfolk, VA. During the RockOn workshop, teams of three learn through hands-on activities how to build a sounding rocket payload or RocketSat. Three WALI students will build their RocketSat from a kit in four days and launch it on sounding rocket to ~73 miles on the sixth day. The hardware in the kit could possibly be used on CubeSat flights. Wallops provides the rocket and launch operations for the workshop. While there, the students will also receive a tour of the facilities and briefings on sounding rocket environments for future flights.

If you would like to support student efforts to gain hands-on experiences, and help more students to attend workshops such as these, please contribute at: bit.ly/FundWali or www.mywmu.com/WALI



Claudia Fajardo-Hansford

Denso North America Foundation has invested \$50,000 in engineering student projects with automotive focus. The grant supports WMU's Sunseeker, Formula SAE and Baja SAE student projects. The teams are working on the design, fabrication and testing of their vehicles for the 2016 competition year. Faculty members working with the student teams include Drs. Claudia Fajardo-Hansford (MAE), Jennifer Hudson (MAE), Brad Bazuin (ECE), and Andrew Kline (CPE).

Link: <https://wmich.edu/news/2015/09/26445>

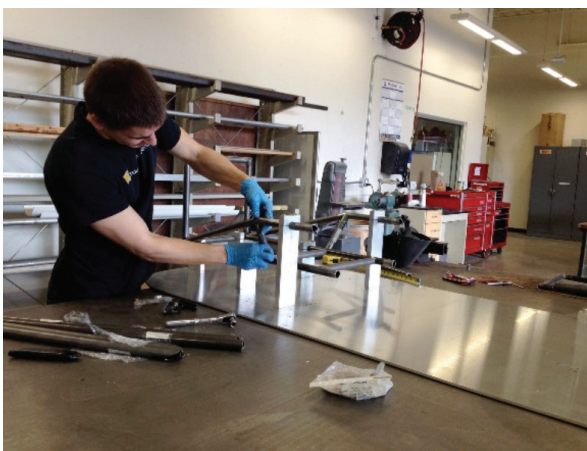
and built Formula SAE and Baja vehicles were on display at DeVos place during the event. Mechanical Engineering student, Ramin Mirshab (FSAE engine team leader) was interviewed in a news story on WOTV4. The teams are gearing up for mid-June competitions this year: the Formula SAE Lincoln, NE,



event and the Baja SAE national competition in Rochester, NY. At these events, attended by teams from all over the world, the design and performance of the student-designed vehicles are evaluated by industry experts. The events, sanctioned by SAE International as part of the Collegiate Design Series, provide excellent opportunities for students to learn, network, and have fun, while showcasing WMU engineering programs.

The SAE teams are thankful to all who make these projects possible through monetary or in-kind donations. If you would like to become a team sponsor please visit www.mywmu.com or contact Claudia.fajardo@wmich.edu (FSAE Team Faculty Advisor).

Link: <https://wmich.edu/engineer/autoshow>



Mechanical engineering student and Formula SAE team member Conner Knepley participated in the Frankfurt Auto Show to showcase a lightweight prototype wheel he has designed as an intern at Maxion Wheels. Conner plans to earn his mechanical engineering degree from WMU in Fall 2017 and work in automotive research and development.

Link: <https://wmich.edu/news/2015/11/28063>

The Center for Advanced Vehicle Design and Simulation (CAViDS) is an interdisciplinary CEAS research center, dedicated to providing breakthrough applied computer simulation technology and knowledge to the vehicle industry in the area of vehicle design and analysis. CAViDS relies on synergistic academic-industry collaboration to address current automotive challenges. Current industry partners include Eaton Corp., Caterpillar Inc., Lubrizol, and Dana Holding Corp. Government lab affiliates include TARDEC and Oak Ridge National Laboratory. Additional information can be found at <http://wmich.edu/vehicledesign/index.php> or by contacting Dr. Claudia Fajardo-Hansford, CAViDS Director.

Dr. Naghshineh is the Director of the Noise and Vibration Laboratory (NVL) which is located in room F-108 of Floyd Hall, of Western Michigan University. The lab is equipped with the state-of-the-art instrumentation required for measurement, analysis, and control of undesired motion and noise of structures and machinery. This laboratory is available on a contract basis. In addition, short courses can be designed in the field of noise and vibration control to meet the needs of industry. The most recent research projects using the resources of this laboratory are listed below.

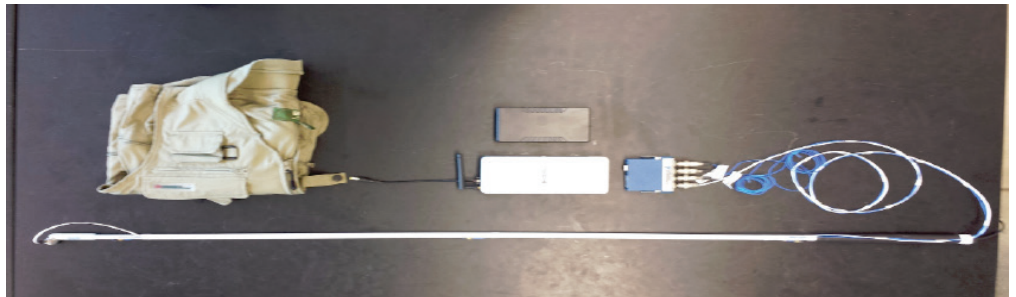


Koorosh Naghshineh

Study of Blind Cane Vibration



Dr. Naghshineh and MS-ME graduate student, Aaron Dean, are collaborating with Drs. Dae Kim and Robert Wall Emerson in the WMU Department of Blindness and Low Vision Studies, to study the relation between blind cane vibration characteristics and obstacle or drop-off detection. In this study, which is funded by the National Institute of Health (NIH), the vibration properties of canes with different mass and stiffness will be measured, then given to blind users who will test their ability to notice a drop-off in their path. Several instrumented canes have also been fabricated in order to measure cane vibration while it is in use for navigation. Identifying the cane characteristics that are most helpful to the user will allow the design of a safer, more reliable blind cane.



Study of Anthropogenic Noise on Songbird Behavior



In a multi-disciplinary project, funded by the National Science Foundation (NSF), Drs. Naghshineh and Sharon Gill (Department of Biological Sciences) will study how anthropogenic noise affects the habitual behavior of multiple species of songbirds. This work is conducted throughout the Kalamazoo area. Research assistants and employees of the Noise and Vibration Lab, Dr. Kyle Myers and Steve Beuerle, have helped in providing program support in the form of data collection, sound file analysis, and equipment calibration for this project.



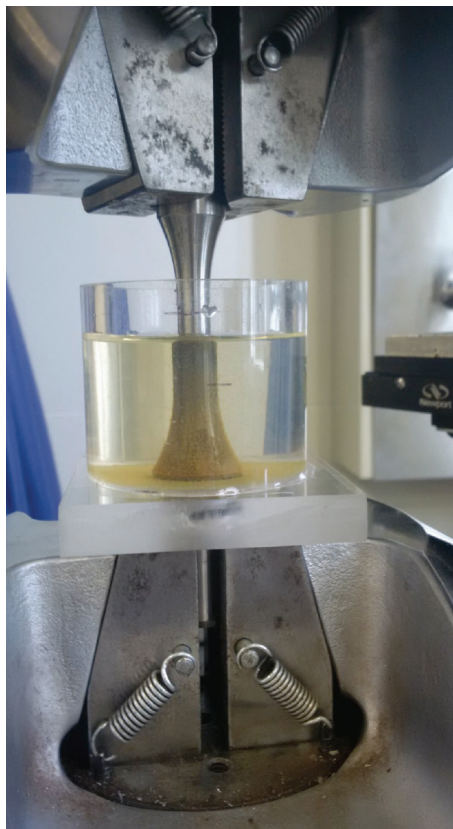
Wildlife Acoustic's Song Meter 2 is the principal piece of equipment used for recording the songbirds' activity. Using MATLAB, many different programs are written to aid calibration of these units and analysis of sound files from these units.

This ongoing study has resulted in multiple publications thus far. The study is continuing using different species of songbirds, and different habitats associated with each species. Variations of species, habitat, and song-activity have been studied in hopes of scientifically connecting the presence of anthropogenic noise to the behavior of these songbirds.



Dr. D. Kujawski

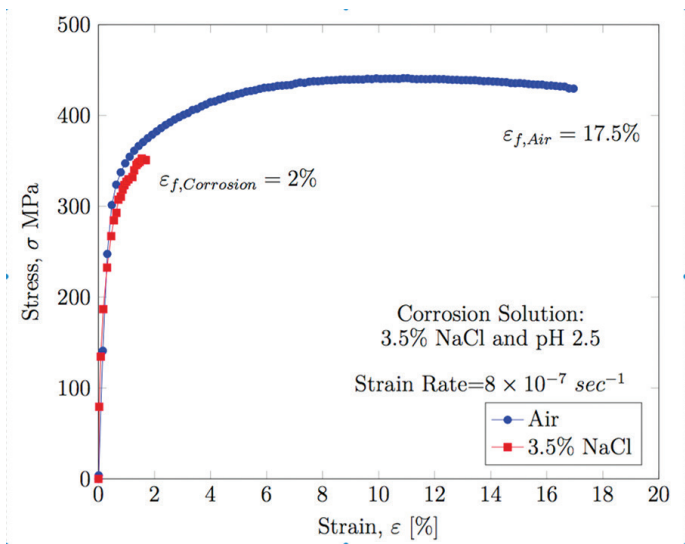
Dr. Daniel Kujawski is the director of Fatigue and Fracture Laboratory which conducts research in the fields of inelastic material behavior, fatigue, fracture, and stress analysis at notches. Investigations address experimental, theoretical, and applied problems concerned with macro- and micro-damage mechanisms, fatigue sensors, crack growth, and life prediction for metals and advanced composites. The overall objective is to develop tools for predicting long-term strength of industrial materials and components, and to contribute towards damage tolerant design concept. Current research on corrosion fatigue and stress corrosion cracking has been continuously funded since 2010 by the Office of Naval Research. The overall goal of this research is to develop a consistent two-parameter approach to both fatigue crack initiation and propagation. It is well-recognized that fatigue crack initiation and propagation are affected by a number of variables such as applied stress and strain, geometry or stress concentration, and environment. The final objective is to implement the proposed modeling into UNIGROW software for fatigue life prediction in navy applications.



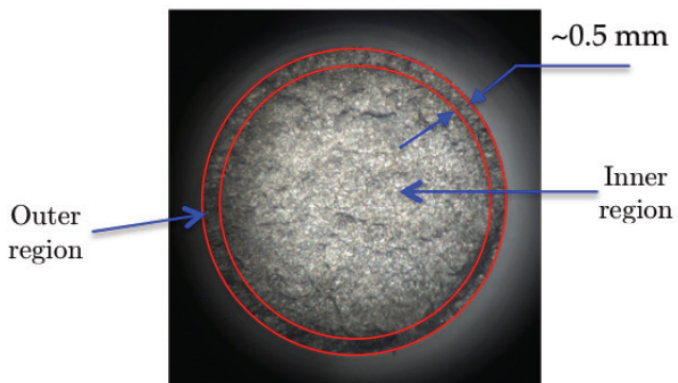
Experimental setup of specimen in testing machine with corrosive chamber at Fatigue and Fracture Laboratory.

In May 2015 Dr. Kujawski received an award from the WMU Faculty Research and Creative Activities Award (FRACAA) for a project titled “An Interactive Web-Based Fatigue Analysis Tool”. The aim of this project is to develop an interactive web-based fatigue analysis tool, which may be easily accessed by means of multiple platforms, such as desktop and laptop computers, tablets and/or smart-phones. A self-explanatory, web-based educational version will allow the users to learn the fatigue fundamentals as well as to expand and master their knowledge on modern fatigue analysis methods. It will benefit engineering students in their design courses and the capstone senior design projects. Graduate students will expand their fatigue knowledge by using this tool for verification and benchmarking of their own and others’ approaches.

During May and June 2015 Dr. Kujawski and his graduate student Joshua Teo participated in the WMU Innovation Corps (I-Corps) program. During this program a strong industrial demand for an interactive web-based fatigue analysis tool has been identified. Such tool can bridge the existing gap between universities and the needs of design and test engineers in small, medium and large size companies.



Slow strain rate test results of 7075-T651 Al alloy in air and 3.5% NaCl solution.



Microscopic view of fracture surface of 7075-T651 Al alloy specimen tested in 3.5% NaCl solution.



Dr. Pnina Ari-Gur's research is in the field of smart and advanced materials. One of her research projects in this area, which was funded by grants from NSF and CRDF Global, is focused on developing advanced new alloys that will help achieve

an environmentally-friendly high-efficiency refrigeration and energy-saving technology. Freon, which has been used for many years as a liquid refrigerant, is being phased out because of its contribution to the depletion of the ozone layer. A combined theoretical and experimental approach is used in the framework of the project to develop new alloys that will produce no emissions and operate quietly and efficiently. She collaborates on this project with scientists from the Russian Academy of Sciences. Other related research projects include developing nanostructured NiTiCu for nano-tweezers and other applications. At WMU, she supervises a Ph.D. student from the physics department and various CEAS undergraduates. For example, Zachary Reinke (ME), Magreth W Haji (AE), Eric Allen Pietrowicz (ECE) and David Chukwuemeka Ajoku (AE) are recipients of the undergraduate research award who work with her on advanced materials research in this academic year. Carlos Soto (ME), who has participated in the magnesium alloy research, was the 2nd runner up in the MSC Ground Vehicles and Heavy Machinery Users Conference Poster Session in September 2015 and also presented the research at the 2016 LSAMP Research Symposium Poster Session in National Harbor, Maryland.

In an entirely different research area, Dr. Ari Gur has an NSF grant for developing computer-game style 3D virtual laboratories. The laboratories have been in high demand and about 100 institutions around the world have requested and received them. Two students, Eric A. Pietrowicz and Tyler W. Bayne (ECE), who are working with her on this NSF grant, presented at the 21st International Cultural and Academic Meeting of Engineering Students (ICAMES) in Turkey a paper on a computer-game style 3-D virtual scanning electron microscope (SEM) that is fully interactive. The presentation was very well received by audience and referees alike, and the team won the 1st place award.

<https://www.wmich.edu/sites/default/files/attachments/u593/2015/CEAS%20e%20news%20June15.pdf>



Dr. Pnina Ari-Gur



Eric delivers the talk

The computational engineering physics research in Dr. William W. Liou's group includes the following topics in the last two years.

(1) Computational modeling of reverse shoulder arthroplasty. In collaboration with Wayne State University Medical School and with funding support from ExacTech Inc., Dr. Liou's group conducted physics-based computations of the muscle strength and joint forces associated with reverse shoulder arthroplasty (RSA). RSA's indications include many complex etiologies and the operation has become increasingly common in shoulder implants. Dr. Liou used human musculoskeletal models to simulate the effects of RSA shoulder implant on muscle forces and joint reaction forces during motions of arms. The shoulder muscle groups and bones are modeled using a finite element method.

(2) Computational simulation of heart health using hemodynamics models. It is widely known that chronic high sodium intake contributes to the development of hypertension and left ventricular hypertrophy. A system-level computer model that included cardiovascular hemodynamics and kidney function were developed to simulate the long-term effects of increased sodium intake on the left ventricular mechanical functions and the body-fluid homeostasis. The results may be used to provide information on how much salt is too much for an individual. Dr. Liou's group also studied the cardiovascular health by simulating the short- and long-term responses of, for example, blood pressure, heart rate, hormonal concentrations, and cardiac structural changes to fluid overload. The efforts were partially supported by Borgess Medical Center and Western Michigan University Office of Vice President for Research.

(3) Fluid flow and flexible structure interactions. The interaction between fluid medium and the solid affects the performance of components of ground vehicle systems, such as fan drives, hydraulic fluid lines, fluid mixing chambers, and cooling fan. Computational fluid dynamics (CFD) and finite element computational structure dynamics (CSD) methods are coupled. Supported by the CAViDS Consortium at the College of Engineering and Applied Sciences at WMU, multiple commercial CFD and CSD software were applied to identify approaches that are likely to be developed to form best practices in production vehicle applications. Research was also performed in the areas of flexible wing drag reduction, wing surface roughness simulations, and conjugate heat transfer in engine exhaust and arterial atherosclerotic plaques.



Dr. William Liou

Research results and publications can be found at the homepage of Dr. William W. Liou. <http://homepages.wmich.edu/~liou/>

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Hello Alumni!

We would love to hear from you and how you are doing! Please mail the information below to our address above or send it to mae-info@wmich.edu.

Name:

Graduation year:

Current professional position:

Time at this position:

Personal updates:

