

ME Connections

A publication of UNM's Department of Mechanical Engineering

Fall 2017

From the Chair

With this communication, the Department of Mechanical Engineering (ME) at The University of New Mexico (UNM) is reaching out to you to showcase some of our recent accomplishments and draw your attention to our future development.



Since its inception, the ME Department at UNM has been at the forefront of engineering education. The Department commenced its operation in 1931, and awarded its first B.S. degrees in 1933, its first M.S. degrees in 1948, and its first Ph.D. degrees in 1965. Today our annual

degree production reaches about 90 B.S., 18 M.S. and 4 Ph.D. degrees. Graduates at all levels built their careers around the State of New Mexico, the nation, and many

parts of the world. Annual research expenditures by our faculty amount to around \$3 million, which in turn results in a steady stream of scholarly publications and invention disclosures.

ME is a student-centered, discovery-driven, and globally-engaged academic department. This newsletter provides a sampling of our cutting-edge research, student activities, and community engagement. Special thanks go to Christos Christodoulou, dean of the School of Engineering, for his strong support of the ME Department, and to Kim Delker, School of Engineering marketing manager, for her invaluable help in preparing this publication.

Yu-Lin Shen

on behalf of the entire ME family

Lee receives ORAU award for research



Assistant Professor Sang Lee has been awarded the Oak Ridge Associate Universities (ORAU) 2017 Ralph E. Powe Junior Faculty Enhancement Award for his research in simulations of offshore high-altitude wind energy.

His selection is especially significant because there were 125 applicants nationwide from which 37 awardees were chosen. Recipients of this award are faculty who are within the first two years of their tenure-track position.

This is a national award that recognizes the quality and promise of young faculty researchers. UNM Vice President for Research Gabriel Lopez proclaimed that "This is a great achievement for Dr. Lee and UNM is proud of his commitment to research excellence."

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\$1.6 million NSF grant to benefit microsystems education

UNM has been awarded \$1.6 million from the National Science Foundation to continue a successful program to provide educational materials and services to industry trainers and educators on the growing science and technology of microsystems.

The four-year grant, which began July 1, will fund the creation and maintenance of a wide variety of microsystems educational materials used by colleges, educators, and industry members across the nation. This is a continuation of previous NSF grants for the initiative, called the Southwest Center for Microsystems Education.

For nearly a decade, UNM has been working under NSF grants to develop technical training materials and develop outreach modules. This latest grant will focus specifically on converting those materials into an online format,



creating a support center for those in the microsystems industry. Mechanical engineering faculty play a central role in this endeavor. Matthias Pleil, research professor, is the principal investigator, and John Wood, professor and director of the Manufacturing Engineering Program, is a co-PI.

New online master's degree coming soon

Preparation is underway to launch a master of science degree program with a space systems engineering concentration. The Department of Mechanical Engineering is partnering with the Department of Electrical and Computer Engineering to develop this fully-online program. After completing a set of space-related coursework and the graduate core courses in the respective departments, students will receive the M.S. degree in either mechanical engineering or electrical engineering with the space systems engineering concentration. The program was initiated by Professor Chris Hall, with a planned start in the 2018-2019 academic year. The initial set of space related courses include Orbital Mechanics, Spacecraft Attitude Dynamics and Control, Spacecraft Design, Space Situation Awareness, Space Weather, Remote Sensing, and Current Issues in Space.

Vorobieff, Truman speak at conference

The 9th International Conference on Computational and Experimental Methods in Multiphase and Complex Flow took place in Tallinn, Estonia, in June. The meeting was organized by the Wessex Institute and UNM, represented respectively by professors Carlos Brebbia and Peter Vorobieff. The meeting included several invited lectures by well-known researchers, two of whom are from the UNM ME Department: "Instabilities in a shock interaction with a perturbed curtain of particles" by Vorobieff, and "Mixing-model sensitivity to input parameter variation" by Randy Truman.

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Solar Splash team takes a top award at competition

The UNM Solar Splash team participated in the national competition in Springfield, Ohio, in June and was awarded the Outstanding Solar System Design Award.

The team also placed second in qualifying and second in visual display and took seventh place in overall finish. The team was led by mechanical engineering Professor Peter Vorobieff, with Professor Jane Lehr of electrical and computer engineering guiding the electrical part of the team. Nine mechanical engineering students and 12 electrical and computer engineering students were on the team, led by mechanical engineering students Michael Anselmi and Daniel Taylor, and Joshua Stewart on the electrical engineering side.

Vorobieff said invaluable technical assistance was provided by individuals at two local companies — Steve Taylor from Taylor Marine and Alex Stavrides at SolAero Technologies.

Both the departments of Mechanical Engineering and Electrical and Computer Engineering provided generous support to the effort. Preparation of the 2018 competition is already underway.

To donate to the 2018 Solar Splash team, go to <https://www.unmfund.org/fund/solar-splash/>

Fast *Forward*



FSAE looks toward the future with new staff, space

The University of New Mexico Formula SAE team has nearly two decades of design, build, and racing experience under its belt. Under the direction of John Russell, professor of mechanical engineering, the team has grown and evolved, and also has had some great results, including being ranked as high as fifth best out of 125 in the United States and 18th best out of 500 in the world.

Although the team has done well with the resources it has, better-financed teams from other universities with newer equipment, facilities, and more specialized expertise have stolen the spotlight in recent international competitions.

Mike Arnold, a veteran of the Indy Car circuit, recently joined the endeavor as lab manager. Arnold has experience in the building, design, and fabrication of racecars. He has since been working with the program to provide expertise on the build of the car and organization of the shop.

Russell said even small changes implemented by Arnold, like being there to answer questions, have greatly helped the team. Bringing Arnold onboard to manage the shop is the first step in a new five-year plan called the Venture for Racing Excellence to raise funds to revamp the FSAE program — which includes acquiring all-new equipment

and a larger design and build space — in an effort to not just improve competition results, but also to enhance the learning experience for students and raise the profile of the program, the School of Engineering, and UNM.

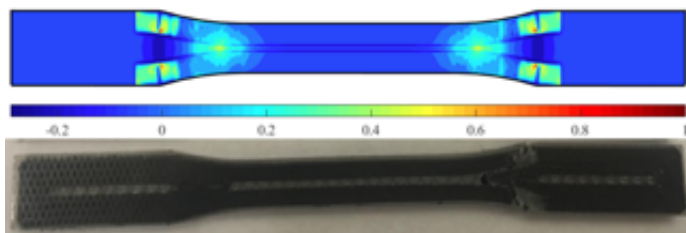
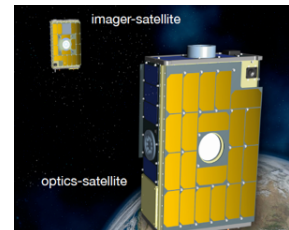
The LOBO Motorsports FSAE program is a problem-based, hands-on senior design program where over the course of three semesters, students design, build, and race a small Formula-type racecar for international competition. The project includes every aspect of systems engineering, project management, and teamwork seen in a government or industrial engineering development program. In a little over a year, the team takes a system from conception to operation. The program is interdisciplinary and has about 45 students on each year's team. It is one of the few programs in the country that doesn't operate as a club. Instead, FSAE is a for-credit alternative to a senior design project.

To donate to the Venture for Racing Excellence, contact Kara Clem at (505) 277-2051 or kara.clem@unmfund.org

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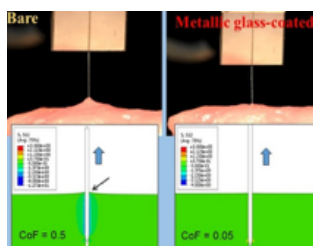
Research Roundup

Asal Naseri, a senior lecturer, is currently working on a NASA-funded project called “The Virtual Telescope for X-ray Observations.” The VT XO is a formation flying mission, where two 6U-CubeSats, one carrying a Phased Fresnel Lens and the other carrying an imager, will act as a virtual telescope. Naseri and her graduate students are developing the guidance, navigation, and control algorithms that are needed for the autonomous astrometric alignment of the two CubeSats.



With the recent advent of composite 3D printing technologies, new design paradigms for structures have emerged. Assistant professor **Mehran Tehrani** and his team are investigating the effects of topology and fiber orientation on structural performance and weight of 3D printed composite parts. By doing so, they will be able to achieve mechanical performances that are not otherwise possible.

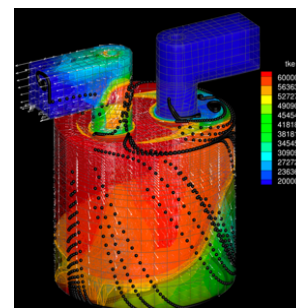
Assistant professor **Francesco Sorrentino** partners with postdoctoral researcher Karen Blaha and CHTM professor Mani Hossein-Zadeh to study interactions between different kinds of oscillatory systems. With their recently awarded grant from National Science Foundation, they will examine the behavior that arises from the interactions of oscillating systems with fundamentally different underlying physical principles (opto-mechanical, opto-electronic, and electro-mechanical). The oscillators have different natural rates, wave shapes, and spatial dynamics. The work asks how collective behavior is sensitive to changes in the oscillators and the communications between oscillators.



Professor **Yu-Lin Shen** and his multinational research collaborators recently developed non-stick medical syringe needles which can reduce pain during injection. It was demonstrated that stainless steel syringe needles, when coated with a nanometer-scale zirconium-based metallic-glass thin film, showed exceptionally low friction and enhanced durability. Their finding was published in *Scientific Reports* (Nature Publishing Group). When tested on muscle tissue from pigs and on rubber, the coated needles displayed significantly reduced forces during insertion and retraction. This study is expected to directly benefit the medical

community in areas such as transdermal delivery of drugs, plastic surgical procedures, and sewing of skin.

A new research collaboration has been started between the groups of associate professor **Svetlana Poroseva** (UNM) and David Carrington (LANL) in the area of modeling turbulent reactive flows in internal combustion engines. As the first step of the project, the ME graduate student Brad Philipbar works on enhancing the LANL’s KIVA codes with a capability of fast generation of high-quality numerical grids using GridPro®. This will significantly reduce time of the new engines analysis.



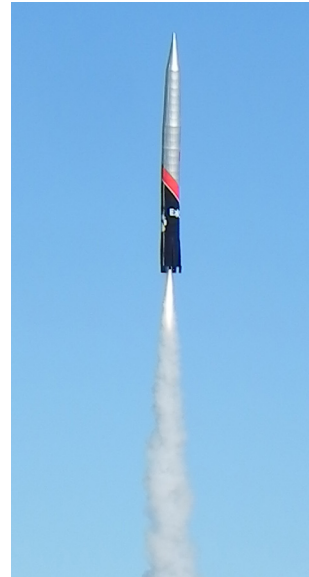
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Lobo Launch makes its maiden voyage

In the spring semester of 2017, a group of mechanical engineering students built and launched the world's largest amateur rocket as part of a first-of-its-kind senior design project.

Professor and former department chair Chris Hall worked to initiate the project, and the two-semester courses were taught by Fernando (Doc) Aguilar, an adjunct professor. The new class is designed as a way for mechanical engineering majors to get hands-on experience in an aerospace project while finishing up their degrees. Students were separated into four different areas (structures, launch rail/pad, systems and propulsion) and were responsible for nearly every aspect of the rocket build.

The finished product stands roughly 47 feet tall, weighs more than 200 pounds and was capable of traveling upwards of 200 mph. The rocket, with a semi-monocoque design, features a solid-rocket-fuel motor. It was supposed to soar somewhere in the range 3,000 feet into the sky, releasing a UNM-developed cube satellite (supervised by mechanical engineering senior lecturer Asal Naseri) before safely returning to earth.



Liftoff took place on May 27 near Rio Rancho. The rocket exploded at about 200 feet. The broken craft left a corkscrew-shaped plume of smoke in its wake as it flew into the sky before parachutes deployed and brought what was left of the project back to earth. The event was spectacular, as was the experience gained by the students throughout the project.

Aguilar said he will analyze the debris to try to determine what happened to help the next class. This "Lobo Launch" program is partially funded through a generous donation from a Mechanical Engineering alumnus, Roger Koerner. The students are also receiving support from the Air Force Research Laboratory and Quelab.

Supporting ME

The department is launching a three-year drive to fundraise \$300,000 in donations to create a new permanent endowment in perpetuity for mechanical engineering students (to be named "The ME Permanent Scholarship Fund").

As you may be aware, the tuition and fees on students have been going up in the last few years. To help reduce the burden on current and future students, we are asking your help in creating this endowment. Any alumni capable of helping with this drive to donate only \$300 each will have their name on a new banner to be placed in the ME building atrium (this is the minimum amount needed to get a banner made and installed). If we work collectively as a

team (something the ME department teaches as part of its curriculum), we can reach this fundraising goal by doing our small part. If you, as a supporter/alumni would like to donate more than \$300, you are welcome to do so. It only takes about 300 donors at \$1,000 each to reach this goal.

How to give

To donate, go to <https://www.unmfund.org/fund/mepsf/> or send a check made out to "ME Permanent Scholarship Fund" to

The University of New Mexico
School of Engineering
MSC01 1140
Attn: Courtney Holmes
Albuquerque, NM 87131

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Mammoli speaks at TEDxABQ

On Sept. 9, Professor Andrea Mammoli delivered a talk titled “The Future of the Electrical Grid” at the TEDxABQ annual main event.

The talk’s premise was the potential for a long-term major failure of the electricity grid in New Mexico — no electricity, heat, running water, sewage, traffic control, or food for days or even weeks. If communities, utilities, and government cooperate, we can combine new technology, fast arriving, with existing power distribution infrastructure to build a more resilient system, based on community-scale microgrids powered by solar energy, with battery storage and robust control of demand.

When given a possibility of delivering a TEDx talk, Mammoli took to it with enthusiasm, with the main goal of popularizing a potentially disruptive technology, making a wide audience aware of the issues involved, and perhaps making it possible for things to happen a little faster.

Mammoli’s research revolves around the integration of distributed resources on distribution infrastructure. These resources could be, for example, rooftop PV on customers’ houses, on the top of big box stores, or simply ground-



mounted. Storage could be in the form of stationary batteries, as well as electric vehicles. The challenge in making all of this work is combining new technologies with existing infrastructure, in a way that the system is more than the sum of its parts. Mammoli’s work is supported by grants from the National Science Foundation and from Japan’s Mitsubishi Research Institute. He runs a 350 kW building-scale microgrid, connected to the Aperture Center at Mesa del Sol, and is working on expanding the concept to encompass the entire Studio 14 distribution feeder, which currently provides power to the Albuquerque studios, several commercial buildings and approximately 200 houses.

New Faculty



Nathan Jackson recently joined the Department of Mechanical Engineering as an assistant professor. His research group focuses on developing microfabricated Smart Materials and Micro-Electro-Mechanical Systems (MEMS). He has a particular interest in piezoelectric

MEMS devices for biomedical applications.

After receiving his doctorate degree in bioengineering

from Arizona State University, in 2009, he moved to Ireland to work at the Tyndall National Institute. He became the team leader of the PiezoMEMS group, which was focused on developing devices for various applied research applications.

At UNM, Jackson plans to continue his research on PiezoMEMS for a range of applications including energy harvesting, biosensor, atomizers, ultrasound transducers, acoustic resonators, and flexible/stretchable electronics. He is a senior IEEE member and technical committee member for the IEEE MEMS conference.



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Khraishi leading two innovative STEM educational programs

Professor Tariq Khraishi has been leading two nationally-successful National Science Foundation (NSF) programs for several years: Science, Technology, Engineering, and Mathematics Talent Expansion Program (STEP) and the Science, Technology, Engineering, and Mathematics (S-STEM) Program. The STEP Program is hailed as a

national model for other universities and states to follow with its success in placing interns in companies and agencies as well as for engaging early career students in professional conferences. The S-STEM Program has been chosen by NSF as a case study for its success in retaining and graduating its participants.

Cheers to our super ME staff!



(Left to right) Shannon Siderius (department administrator), JJ Conn (advisement), Jason Church (machine shop), Cindi Sanchez (administrative), Tammy Arkie (accounting), Ron McKinstry (lab technician), Anna Mae Apodaca (advisement).
Not pictured: Diana Sargent (accounting).