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Mechanical & Aerospace Engineering
Undergraduate News

2014

THE OHIO STATE UNIVERSITY

A Message from the Associate Chair

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Department of Mechanical
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Chair, Mechanical Engineering
Undergraduate Studies Committee

The requirements of senior-level capstone courses and the rigor of undergraduate honors research test the wherewithal and passion of our students as they move closer to their professional careers. Through these experiences, a student's work ethic, the originality of their project, and their search for new processes or techniques are evaluated in accordance with the high standards we have set for individuals earning mechanical engineering and aerospace engineering degrees. We are thrilled to have a great track record of students earning top honors at Ohio State's annual Denman Undergraduate Research Forum and at the College's Capstone Showcase. Year in and year out, our students have brought home top prizes and demonstrated that they understand what it takes to commit themselves to academic excellence which eventually earns them coveted jobs alongside other esteemed engineers at some of the world's most respected corporations and organizations.

One outcome of their success is the additional professional development we acquire as educators. While we pass along knowledge of engineering to our students, they enrich our experience as academics by keeping us engaged in the future avenues of engineering. As ever more brilliant minds pass through our classrooms and research facilities, our circle of engineering acquaintances and collaborators expands into another generation of engineers. Thus, we take seriously the role of educator as mentor.

This year, Assistant Professor Shaurya Prakash, who directs the Microsystems and Nanosystems Laboratory within the Department of Mechanical and Aerospace Engineering, was presented a Distinguished Undergraduate Research Mentor award at Ohio State's 18th annual Denman Undergraduate Research Forum. From a field of eighty nominees, he was among five individuals who received a mentor award. In acknowledging the honor Prakash commented, "the award is a reflection of the wonderful students each one of us has a chance to work with and mentor." In addition to the recognition for Prakash, four other members of our faculty were also nominated for the award. I am so proud of each of them and their devotion to undergraduate research.

Likewise, the faculty who guide our seniors through their capstone experience strive continuously to impart the critical thinking; the essential aspects of the design, build, test process; and other key project management skils into the experiential learning that takes place prior to commencement. Equipping our students with these indispensable skills makes them highly regarded and sought after by organizations searching for exceptional engineers.

Isakowitz Visits Ohio State

Virgin Galactic President Steve Isakowitz

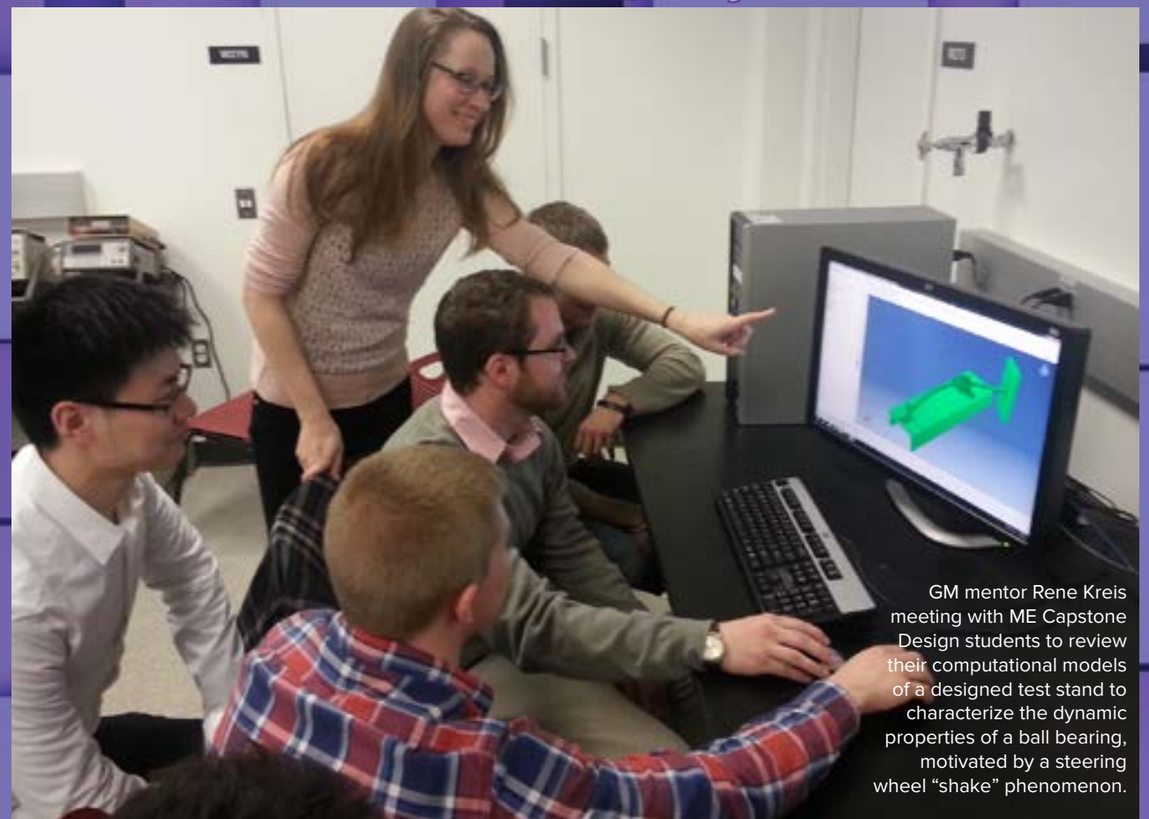
The president of the company that aims to offer the first suborbital spaceflights to space tourists paid a visit to Ohio State's main campus earlier this year. During his February visit, engineering students as well as other university faculty and staff got to hear Virgin Galactic President Steve Isakowitz discuss a range of science and technology topics related to commercial space travel. In addition to his scheduled public appearance, Isakowitz took time to speak with Clinical Assistant Professor Carl Hartsfield's Advanced Rocket Propulsion class. He not only offered the aerospace engineering students some insight about the status of Virgin Galactic's foray into space, he also gave them some sensible career advice. He offered that they not be afraid of changing jobs, and noted that he had moved several times between government and industry, emphasizing that there is still lots of opportunity to make very real contributions in human space flight.

Kit Plane to be Test Bed for Student-Built Electric Aircraft

Associate Professor Jim Gregory is dreaming of the day when the phrase "wheels up" can be uttered to mark an important milestone for a student-built aircraft that he and aerospace engineering students at Ohio State would use as a flying test bed for research in aerodynamic flow control and battery and power electronics. Later this summer, he expects to purchase a kit plane (with an internal combustion engine) with the long-term goal in mind of building expertise in aircraft construction – specifically construction of an electric aircraft that might one day be entered in a student competition.

Gregory sees plenty of blue sky ahead when it comes to feasibly providing students with an additional method for connecting theory with practice in aerospace engineering. He notes that the future of light aircraft looks more and more robust as low cost, low emissions, and low noise become important factors that favor electric aircraft. He expects to leverage not only Ohio State's Aerospace Research Center and the university's airport in the process of creating an electric aircraft, but also the leadership that Ohio State has already established in creating some outstanding student teams responsible for the Buckeye Bullet race-car, the Buckeye Current motorcycle, and its EcoCAR competition entries.

An Innovative Capstone Design Experience Based on Simulation Pilot Program Made Possible by GM Foundation



GM mentor Rene Kreis meeting with ME Capstone Design students to review their computational models of a designed test stand to characterize the dynamic properties of a ball bearing, motivated by a steering wheel “shake” phenomenon.

During the 2013-14 academic year, a new Mechanical Engineering Capstone Design (ME 4903) section was piloted with the goal to create a culture of simulation methods to solve noise, vibration, and harshness (NVH) problems while improving the skills of Ohio State undergraduate students to solve industry-defined problems. This initiative program was funded by the General Motors (GM) Foundation, and the project was conceived by Professor Rajendra Singh and Karen Morely of GM. The piloted section included 18 students grouped under four project teams, under the supervision of Dr. Jason Dreyer and Dr. Scott Noll. Two GM industry mentors, Dr. Steven Shi and Rene Kreis, met regularly with the teams and provided technical feedback as well as a perspective into the relevance of project coursework to current real-world vehicle issues.

The project topics included the analysis of front and rear brake system dynamics from the brake squeal perspective, steering wheel system dynamics and vibration, and dynamic characterization of a ball bearing with an application to steering wheel “shake” phenomenon. In their projects, the student teams utilized a combination of analytical, computational, and experimental tools. Dr. Steven Shi, a project mentor and engineer from the GM Technical Center, remarked, “From the ME undergrads capstone, I can easily see the time, effort, and energy they put into the project, and amount of knowledge they learned by doing it hands-on. I am amazed to see how efficiently they could do the testing and create finite element models with measurements. The technical experience as well as teamwork and communication skills they learned from the capstone project will be invaluable to their future careers.”

Through this novel program, students gained valuable experience in the experimental and computational aspects of NVH while studying industry-relevant problems and design practices. Students learned new and life-long skills, while working on real-world problems with meaningful design constraints. Rich Eckenrode, a graduating senior in the course, noted, “The project we worked on is a great real-world problem that is studied during automotive design, and the process we went through allowed us to accurately identify where NVH issues would arise in the steering wheel column. The design and finite element analysis experience that I gained through the ME 4903 Capstone project was a major talking point during my interview with Ford and ultimately led to a job offer from them.”

The students successfully presented their final reports to the GM team and then exhibited their work at Ohio State's Capstone Design Showcase, held this past spring. External industry visitors to the showcase liked the course outline and goals, often remarking that this type of coursework truly simulates their daily engineering design experience. Based on this pilot, a new ME Capstone Design on “Simulation Based Capstone Design for High Performance” will be offered in 2014-2015 under a permanent section.

Examining How an Ant Supports its Payload Pays Off for Undergraduate Researcher

When mechanical engineering student Hiromi Tsuda was first searching for a topic for her undergraduate honors research thesis, she didn't anticipate that working with the university insectary and learning how to care for specimens of *formica exsectoides* (Allegheny Mound Ants) would be requirements of her research study.

But after learning more about the research conducted by a former graduate student in the department, she knew that while the subject of her study might be small in size there could certainly be a sizable payoff in terms of lessons learned and knowledge gained.

To start, her research advisor Assistant Professor Carlos Castro provided an overview of the work that his former student, Vienny Nguyen (BS '10/MS '12), had begun on the tensile strength of the neck joint of the ant. Nguyen was interested in understanding how such a small insect could hoist loads that were several hundred times their own body weight. Prior to Tsuda's involvement, the work of Nguyen, Castro and Associate Professor Blaine Lilly had been submitted for publication to the *Journal of Biomechanics.* That report, which was published earlier this year (volume 47, issue 2), detailed how the tensile loading behavior of an ant neck joint (along with its exoskelatal structure) affects its ability to lift and carry heavy loads relative to the ant's body mass.

According to Castro, "One of the critical findings from that work was to identify the transition between the soft material of the neck joint and the hard exoskeleton material of the head as a critical region where failure occurs." He noted that generally transitions between dissimilar materials result in stress concentrations. One of the major questions that he and his team had after their initial study was "how is that soft-to-hard transition designed in the ant neck to optimize mechanical function?" Tsuda focused on trying to answer that question.

After Tsuda obtained the specimens needed for further research, Castro sent her off to Ohio State's Center for Electron Microscopy and Analysis to learn to use the facility's scanning electron microscope (an FEI Quanta 200 SEM). The next steps in her research required that she overcome any squeamishness she might encounter in dissecting the insect in order to obtain a clean cross-sectional image of the ant's neck. After some trial and error in learning how to best achieve the cleanest cut, Tsuda was able to obtain some extraordinary images.

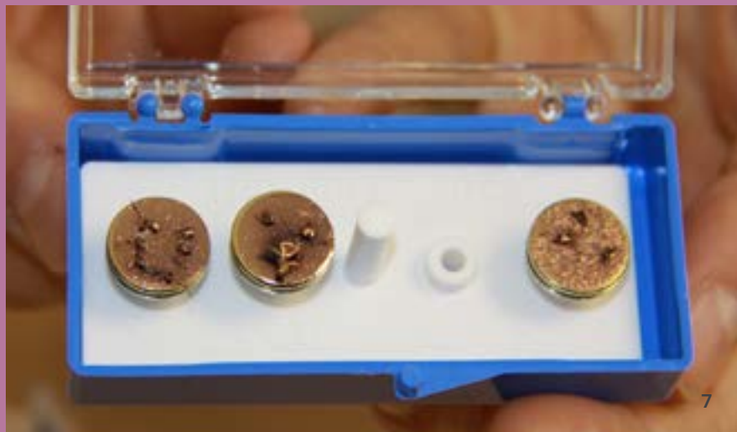
Left, sagittal view of ant neck taken by a scanning electron microscope (SEM) .
SEM images were captured using the Quanta 200 SEM located at Ohio State's Center for Electron Microscopy and Analysis.

Tsuda's results confirmed some of Nguyen's initial work and revealed additional details of a stepped interface that Castro believes plays a very important role in minimizing stress concentrations. When Tsuda returns to campus this fall she will continue her imaging work, hoping to identify the local microstructure of the neck joint material near the interface. Ultimately, Castro wants to learn more about the principles of how nature forms these interfaces in order to mimic its design in new material or robotic systems.

"Ants are impressive mechanical systems. Before beginning our research we conservatively estimated that an ant might withstand 1,000 times their weight, and it turned out to be much more," Castro said. In fact, the research published in the journal article stated that the neck joint of the ant could withstand pressures up to 5,000 times its weight.

For her part, Tsuda admitted, "I was shocked at how something so small and microscopic could be easily displayed and photographed. I had also never really taken particular interest in ants before, but upon starting this research project, I have found them to be more and more fascinating creatures." Having seen the results of her research and having been exposed to the field of biomimetics, she's confident she selected the perfect research thesis. Of course, it may have also helped that she could always amuse herself with the lyrics of "High Hopes" anytime she wondered if the findings would be worth the hours invested in learning more about "that little old ant."

Above, ME student Hiromi Tsuda holds a specimen of the Allegheny Mound Ant used in her research. Pictured below are samples that received a sputter coating of gold before being scanned by electron microscopy.



Utilizing the department's instructional wind tunnel are team members (clockwise from top left) of the Frisbee® Drag Reduction team; Serpentine Inlet Flow Control team; and the Aeroelastic Composite Wing Design for Race Car Spoiler team.

Aerospace Engineering Seniors Appreciate Updates to Experimental Projects Course

A new two-semester Experimental Projects course, designed for senior-level undergraduates, was "beta-tested" over the course of the past two years to better address the popular Conceive, Design, Implement, Operate (CDIO) initiatives that are beginning to serve as the educational framework for the next generation of aerospace engineers. Through improved hands-on exercises, this capstone course has moved away from lab demonstrations and the analysis of legacy data and now positions seniors to have more relevant "project team" experience to reference during job interviews. Ohio State's aerospace engineering students now consider the combination of computational and experimental techniques a step forward in helping them master the relevant methods, processes, and techniques necessary for CDIO and for documenting research projects that address the investigation of a hypothesis.

By taking students beyond the classroom and beyond the textbook, they are now challenged, as teams, to:

- Formulate the overall objectives and success criteria for an experimental/computational assessment of a hypothesis about the natural world.
- Develop strategy and tactics for design of a research plan to achieve these objectives.
- Implement the detailed research plan.
- Evaluate the results to determine if the hypothesis was indeed valid.
- Effectively communicate (orally and in writing) the key aspects of the project, from concept to end goal.

Brach Polen, who completed the course this past academic year and was hired by GE Aviation after graduation, had high praise for the course. He informed Professor Jeffrey Bons, one of the architects of the new course, that he referred to the course more than any other when, during the course of job interviews, he was asked questions about group work, leadership, hands-on experiences, etc. He was additionally happy to have been given the opportunity to utilize the instructional wind tunnel that was aquired to elevate the active learning component of the aerospace engineering curriculum.

In the past academic year, 15 student teams completed the Experimental Projects course. Six of those teams received financial support from the U.S. Air Force, Orbital Research, Competitive Swim Products, and Boeing. In addition, the Air Force Institute of Technology and GE were in-kind sponsors.

Not only has the course given students the freedom to be creative in selecting their CDIO project, it has given them greater exposure to ANSYS/FLUENT and XFLR exercises, and provided more time in the student machine shop, where they are able to construct any required apparatus or necessary parts for their projects.

A small sample of the 2013-14 projects included:

- Frisbee® Drag Reduction
- Aeroelastic Composite Wing Design for Race Car Spoiler
- Swim Lane Divider Characterization and Design
- Serpentine Inlet Flow Control

ME Studentpreneur Earns *Inc.'s* 2014 Title for "Coolest College Startup"

Compiled by Candi Clevenger for the College of Engineering, and Nancy Speicher

One current Ohio State mechanical engineering student, Keith Shields, and one former student, Josh Tucker, know a lot about rising to a challenge. Together they launched Applits, the first company to bring the power of crowdsourcing to mobile application development. Their effort to succeed in the interactive community has been aided by the fact that they were voted "Coolest College Startup" in the final round of *Inc.'s* 2014 competition for college entrepreneurs. The 4,715 votes cast in their favor in the March Madness-like matchup, placed them at the top of the 16 college startups vying for bragging rights as this year's top young innovators.

The Applits concept was born out of the duo's desire to make app creation accessible to all. To achieve that goal, they created an online platform that enables anyone to submit app ideas for the chance to earn free development services and a share in the profits after costs to design, develop, market and support it are covered. The Applits.com community is a key partner in the process; each month they vote to narrow down submitted ideas to the top five. From there, an Applits team selects a winner based on criteria such as technical feasibility and marketability.

"Apps are very expensive and time consuming to code, you're looking at $10,000 to $20,000 to put even the most basic app out into the market," said Shields. "We wanted to make this platform to bring everyday people into this cool industry."

The two former high school classmates from Marcellus, New York, dreamed up Applits while brainstorming possible entrepreneurship opportunities. The booming, multi-billion dollar mobile app development industry seemed to be a good fit and Applits launched in the summer of 2012 with a $70,000 investment from family, friends and angel investors.

The company is also a mechanism for the duo to share their love of entrepreneurship, Tucker explained. "Basically it lets people build a business without even having to run it. We take care of all the operations, stuff that normal people don't have the time, knowledge or expertise to do ... and they benefit from it."

They admit that juggling the many tasks needed to run an app development company while being students hasn't been easy. Shields expects to graduate next spring, while Tucker is now taking a break from classes to focus on Applits full-time. Together, the pair has enough time to run their business, but just barely.

"It would also be impossible for us to run this if we coded all these apps ourselves, so we outsource all the development, graphic design and project management work," said Shields. "We're more focused on the management of the whole platform, the site and the community building aspect of it."

A second branch of the company, Designli, offers paid app development services for clients who have an idea, but not the technical know-how to implement it. It provides vital revenue for the company, Shields and Tucker explained.

The Applits concept seems to be catching on, with more than 2,200 ideas submitted so far. Each month during public-voting week, a couple thousand visitors vote on which ideas should be developed. Nine apps are currently for sale, while ten more are in development.

"That's the fun part about this, nothing ever gets stagnant," said Shields. "You have a new product coming out every single month."

Occasionally, the public voting aspect means ideas the founders really like aren't chosen as finalists. Sometimes, they offer those submissions the same terms monthly winners get. "A good example of a staff pick is FaceCap. Someone submitted this idea for a custom emoji creator and we loved it," said Shields. "It didn't happen to win, and we were like, 'We have to make this.' So we did and it's doing well on the App Store right now."

In addition to selecting the top app ideas, community members can now follow each stage of development, from naming and slogan creation to icon and graphic design. "We're trying to involve users even more," explained Shields.

While building a business involves a lot of trial and error, the Buckeye engineers also credit the helpfulness of the many Ohio State resources available to budding studentpreneurs. These include being able to work out of the Ohio Union's Keith B. Key Center for Student Leadership and Service, and the many learning and networking opportunities available via extracurricular clubs, such as the Business Builders Club.

Applits also receives free public relations and marketing assistance from the PRactice, a student-run public relations firm at Ohio State.

"Now we have this system for ideating, creating and launching apps, but how do you market all of these individual apps?" said Shields. "We're working with the PRactice and have a team of seven communications and marketing students who are trying to market our products."

After realizing their passions lie in being entrepreneurs, Shields and Tucker look forward to being able to do a little less juggling and focus on Applits full-time after completing their studies. With their commitment and creativity, the future looks bright indeed for these Buckeye studentpreneurs!

Josh Tucker (left) and Keith Shields (right) launched Applits, the first company to bring the power of crowdsourcing to mobile application development.

From Creating Controls for an Electric Vehicle to Battling Deadly Forms of Malaria, Undergraduate Honors Research Makes an Impact

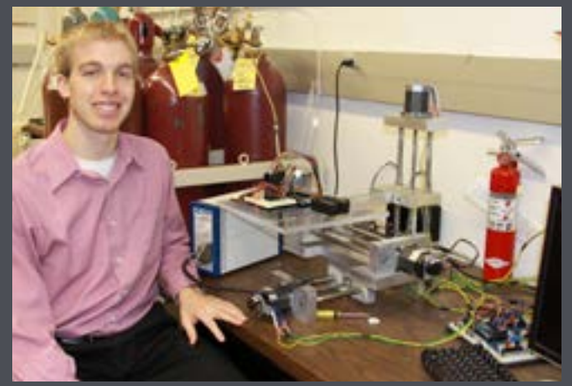
ME students who take on the challenge of writing an undergraduate honors research thesis are not easily intimidated by weighty issues as evidenced by some of the more recent research topics selected. A sampling of three students who completed their thesis prove that some remarkable critical-thinking skills are being developed ahead of full-time employment or admission into graduate school.

MJ Yatsko, who is a BS/MS student and a four-year member of Ohio State's EcoCAR team, was intent on improving her communications capabilities and found her research project offered plenty of opportunity to perfect her presentation skills. By using a popular control modeling program (*Simulink®*), she was able to develop an algorithm that led to the controls strategy for Ohio State's entry in the EcoCAR2 competition. Combining important lessons learned, she created the team's judged presentation about "Controls" at the EcoCAR2 Year Three Final Competition in June.

Brad Smith, who will begin his engineering career at ExxonMobil this summer, elected to research a non-invasive and inexpensive method for detecting a form of malaria. His research provided greater understanding of the effort required to plan, prepare and conduct experiments and greater insight in how to best collect and analyze the data associated with the micron-sized iron oxide particles produced by the parasite that causes malaria in humans.

Ryan Snodgrass, who will enter Cornell's graduate school this fall, looked at the surgical margin (healthy tissue) surrounding tumor tissue that is removed during a tumor resection. He found a great deal of satisfaction in helping to design a tool that was fast, precise, and portable (to surgery room) to aid in the imaging of tissue and verification of the surgical margin. He hopes that one day the deivce could lead to more successful surgeries and better survival rates of cancer patients.

Left, MJ Yatsko at EcoCAR2 competition.
Above, Brad Smith with the detection device used in his study of non-invasive methods for detecting a deadly form of Malaria.
Below, Ryan Snodgrass with components of the tool he helped design to measure surgical margins.



Siston Presented Alumni Award for Distinguished Teaching

Robert (Rob) Siston, associate professor in the Department of Mechanical and Aerospace Engineering, was presented one of the University's 2014 Alumni Awards for Distinguished Teaching. Siston, who joined Ohio State's faculty in 2007, most recently taught the department's machine elements course and a neuromuscular biomechanics course. Siston was also the original developer and teacher of the popular assistive devices for the mechanical engineering capstone design course and was instrumental in "flipping" the ME 3671 machine elements course.

Siston's excellent reputation as an educator has been previously recognized by Ohio State's College of Engineering and the ME External Advisory Board. In 2010, he participated in the Frontiers of Engineering Education Symposium. As a recipient of the Alumni Award for Distinguished Teaching, he will be inducted into Ohio State's Academy of Teaching, which provides leadership for the improvement of teaching.

Student Teams Accelerate Pace of Outstanding Performance

Perhaps nothing gets the motors of ME students running faster than some healthy competition. This year, Ohio State's student motorsports teams were challenged to "up their game" in order to bring home top prizes in the **EcoCAR2** competition and an international competition for electric motorcycles.

From June 1 - 12, Ohio State's EcoCar2 team competed, first in Milford, MI and then in Washington, D.C., to secure its Year 3 first place finish. For the past three years, 15 university teams have each "reworked" a 2013 Chevrolet Malibu in an effort to improve its fuel efficiency and reduce emissions while retaining the car's performance and consumer appeal. The advanced vehicle technology competition is sponsored by GM and the U.S. Department of Energy. With no time to rest on their laurels, a team of Ohio State students has already been selected to participate in the four-year EcoCAR3 challenge that spans the 2014-2018 timeframe.

Also in early June, the **Buckeye Current Electric Motorcycle** team defended their 2013 podium finish at the 2014 Isle of Man Tourist Trophy Zero race. The student-built motorcycle set a new collegiate record with an average speed of 93.531 mph and again earned a third place finish.

Later this year, the **Venturi Buckeye Bullet 3** team hopes to set a new international speed record at Utah's Bonneville Salt Flats. Originally slated to make a run at breaking the 400-mph barrier last summer, the vehicle, with its electric-powertrain, remained untested when heavier than normal rainfall flooded the Salt Flats.

Student Interns Introduced to U.S. Ambassador to the Republic of Poland in Warsaw

From left to right: Ohio State students Dylan DeSantis and Dan Arch, U.S. Ambassador to Poland Stephen D. Mull, and Ohio State students Jeff Kremer and Amanda McLaughlin met in Warsaw on February 12, 2014.

Four mechanical engineering undergraduate students met the U.S. Ambassador to the Republic of Poland, Stephen D. Mull, during a meeting hosted by the Institute of Aviation in Warsaw, Poland earlier this year.

The students participated in an internship abroad program that began in January and concluded at the end of March. The students were Dylan DeSantis, Dan Arch, Jeff Kremer, and Amanda McLaughlin.

While in Poland, the students lived in dormitories at the Warsaw Technical University (WTU), which has a research partnership with The Institute of Aviation (IofA).

They each worked on a research subject with Engineering Professor Piotr Wolanski, who is affiliated with both WTU and the IofA. The internship paid each of the students a monthly stipend during their three-month stay. While in Poland, they could elect to participate in research underway at either WTU or the IofA. Research subjects varied from the development of a rotating detonation engine (both for rocket and gas turbine application), theoretical and experimental studies of ablative and regenerative cooling (protection) of a rocket's engine combustion chamber and nozzle, and applications for electrical capacitance tomography among other optional topics.

Fishing for the Right Idea

When seniors begin fishing around for the ideal capstone design project, they don't generally settle upon the redesign of equipment used in the sport of fishing. But senior Kara Kenzora and her capstone teammates Aaron Szabo, Adam Meyer, and Jared Neidhard landed a great idea when they decided to focus on improving the safety of bobbers, lures, reels, and the storage of fishing hooks. Nearly everyone knows someone who was once snagged by a hook that went astray, including Kenzora and her teammates. Their designs, if developed commercially, could make the fun pastime a fundamentally safer activity. A few of their design improvements include: making the direction to turn the handle when reeling in fishing line more obvious; hiding the hooks of lures and bobbers while casting those objects into water; creating a hook storage device that aids in tying the hook to the fishing line; and creating a handle for the hook that acts as a grip to further control the hook when baiting the hook or removing fish. The group created their new fishing tackle with intent of making fishing safer for all ages, but especially for children under 14.

Jillian Yuricich Becomes First Buckeye to Earn Prestigious Astronaut Scholarship

Jillian Yuricich, an Ohio State junior majoring in aerospace engineering, has been awarded an Astronaut Scholarship for the 2014-15 academic year. Yuricich is the first Ohio State student to be awarded a scholarship by the Astronaut Scholarship Foundation, which was created by the Mercury 7 astronauts.

The Foundation annually presents $10,000 scholarships to outstanding juniors or seniors who are majoring in a science, technology, engineering or mathematics undergraduate program. Candidates for the scholarship must be nominated by their professors and must exhibit leadership, imagination and exceptional performance in their field of study. Aerospace Engineering Professor Mei Zhuang submitted the nomination for Yuricich's scholarship.

Last fall, Yuricich completed an internship at NASA Ames Research Center in Mountain View, CA. While there she worked in the Rotorcraft Aeromechanics Branch doing research in the world's largest wind tunnel identifying turbulence levels at the wind tunnel's inlet due to upwind blockages. Supporting her scholarship nomination was Dr. Alan J. Wadcock, an aerospace engineer at NASA Ames Research Center. This summer, Yuricich will be an intern at the Naval Air Warfare Center in the Advanced Aircraft Design Branch, Fighters/Bombers division located at the Patuxent River Naval Air Station, Maryland.

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