University of Idaho
College of Engineering

Fall 2022

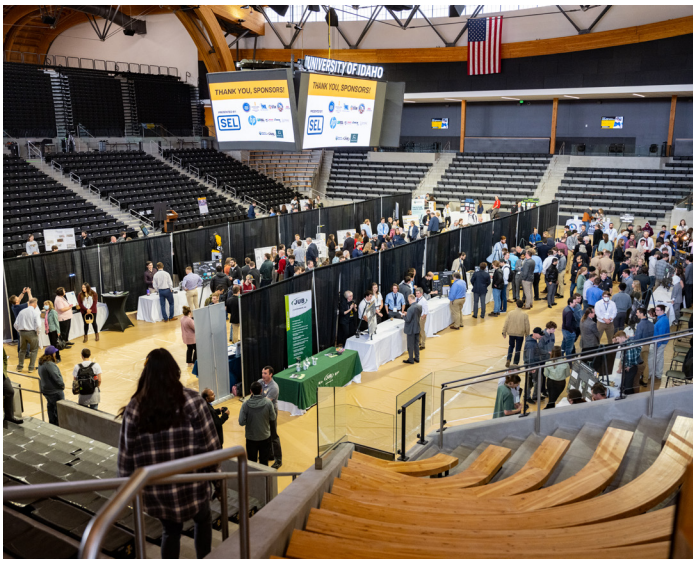
# MECHANICAL ENGINEERING NEWS

## CAPSTONE DESIGN

# Capstone Design Enhances Its Impact Every Year

*By Matthew Swenson*

The Interdisciplinary Capstone Design Program at the University of Idaho has historically been one of the foundational programs within the mechanical engineering department and throughout the College of Engineering. As we transition into the post-pandemic era of engineering education, we are excited to recognize that our Capstone Design Program continues to evolve and further enhance its ability to produce positive impact around the region. This impact is enabled through win-win partnerships with our great project sponsors, strategic teaching innovations, and grant-funded initiatives that will help us take the program to the next level.




*View of the 2022 Annual Engineering EXPO inside the ICCU Arena.*

In reflecting over the past few years, I recently had two separate conversations with past project sponsors and was keen to hear from them about how they used the products our students developed through capstone projects. One of these sponsors told me how they had adapted our student's design into their operation. In particular, they highlighted how the students created and validated unique concepts and identified a specific supplier that were extremely helpful for their engineers to finalize and implement the design. Another past sponsor told me that they pitched a capstone design concept developed by our students to the CEO of their company. The design was positively received and gained approval for continued development and implementation into their product line.

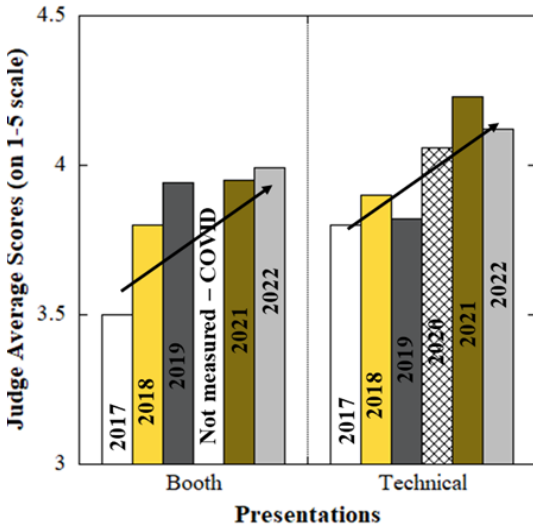
These stories are classic examples of the win-win results that we strive for and reflect how our capstone program is a great venue for proof-of-concept development at lower technical readiness levels and is a proven conduit for ideation of new solutions. (*Continued next page.*)

## IN THIS EDITION

# CAPSTONE DESIGN

We are grateful to work with our sponsors on authentic and impactful projects, and then highlight the efforts of our students each year. As I continue to reflect on where we have come from, I had the privilege of attending the every-other-year Capstone Design Conference in Dallas, TX in June 2022. This conference gathers engineering capstone design instructors and coordinators from all over the country. This is a great venue to benchmark many of the things we do in our program against some of the leading programs at various institutions (both big and small). The good news is that our program continues to be an exemplar for creating real-world opportunities for students and for leading the way in establishing best practices. In addition, our program has emerged as one of the most affordable opportunities for sponsors to support capstone projects that involve delivery of a physical prototype at their culmination. Many other programs around the country request substantially higher funding levels for comparable projects. We are proud of the fact that our students and faculty continue to use resources efficiently and have created a sponsor-friendly financial model that is sustainable and effective. Despite this, we recognize that sponsorship of projects involves non-trivial amounts of resources, and we sincerely thank all our sponsors that support our program each year and offer valuable funding and engagement with our students.

This past spring and for the first time, we had the honor of hosting our Annual Engineering Design EXPO in the new ICCU Arena on the Moscow campus. This beautiful and modern venue is the perfect complement for showcasing the talents and ingenuity of our engineering students as they display the outcomes of their capstone design projects. In addition to displaying the student's capstone projects, we enjoy highlighting some of the other novel and unique projects taking place in our classrooms, our active student clubs, and some of the top younger participants in the Invent Idaho program. We hope to continue to grow our collaboration with Invent Idaho in the future.




*Summary and evolution of average judging scores at EXPO over the past 6 years.*

As part of the Annual Engineering EXPO, the interdisciplinary capstone design student teams each deliver both a formal technical presentation and an informal presentation within their booth display on the EXPO floor. While students are presenting their projects in each of these formats, external judges from throughout the region provide formal and unbiased assessment of the student's projects, their delivery and professional skills, and the relative impact of the projects. Over the past five years, I have been tracking the average scores achieved by the mechanical engineering student teams, and the scoring trends suggest there has been tangible improvement over the baseline scores from EXPO in 2017. Of particular note is the step increase in judge scores for the formal technical presentations from 2019 to 2020. This jump coincides with the onset of the COVID pandemic during the Spring of 2020. At that time, we switched to delivering all the technical presentations online via Zoom. At the same EXPO in 2020, we also experienced an 8x increase in attendance at the technical presentations when they were presented online. As a result, we have chosen to continue to deliver the technical presentations on Zoom to enable outreach to a larger audience, which also enhances the experience for our students. In fact, we learned during the pandemic that variation in the forms of presentations for the students appears to expand their communication skills. Therefore, we are also maintaining a mix of online and in-person presentation formats throughout the year so that students can continue to become more comfortable with all sorts of communication practices, which we know has a strong correlation with the real-world environment.

Our team of instructors greatly appreciates the engagement from our judges at EXPO and throughout the year. We believe that our strong network of judges is one of the cornerstones of the positive health of our program. If you have not attended EXPO in recent years, I encourage you to come and witness what our students are capable of accomplishing. It is our plan to make the ICCU Arena our permanent home for EXPO for years to come.

Looking ahead, we have many more initiatives that are expected to contribute to the ongoing evolution and continuous improvement of our program. We recently completed the first phase of remodeling of our Capstone Design Suite, which is our central workspace for the student's prototyping efforts. We plan for ongoing renovation of this space to provide a more centralized location for students to host formal meetings with their sponsors as well as host and attend each other's formal design reviews. This will only enhance the student experience and their opportunities to learn from each other's challenges and discoveries more frequently and efficiently.

In addition, we are planning for increased emphasis on students adopting an entrepreneurial mindset in the context of their projects. This effort is supported via several awarded grants developed by a collaboration between multiple mechanical engineering faculty and our College of Business. Funding for these entrepreneurial developments includes the following sources: VentureWell, the NASA Idaho Space Grant Consortium (ISGC) via the NASA Transfer to University (T2U) program, and the National Science Foundation (NSF) to help establish the University of Idaho as an Innovation Hub in the "Desert and Pacific Region" over the next 5 years. All these programs are expected to provide unique opportunities for our students to innovate and pitch new products while also complementing our strong industrial sponsor network very effectively. We are excited about the future of the Capstone Design Program, and it is a great time to be a Vandal Engineer!

**If you are interested in serving as a judge for EXPO in the future, feel free to drop me a line at swenson@uidaho.edu. We always have room for more! I will be happy to add you to our judges mailing list.**

## CAPSTONE DESIGN

### THANK YOU TO THIS YEAR'S CAPSTONE DESIGN PROJECT SPONSORS!

- *Bastian Solutions*
- *Dean and Cindy Haagenson Endowment*
- *Hyster-Yale Material Handling*
- *Idaho National Laboratory*
- *NASA ISGC*
- *Schweitzer Engineering Laboratories*
- *VentureWell*
- *Vista Outdoor*

## TEACHING INNOVATIONS

# Introduction to Engineering Course Launched College-Wide

*By Steve Beyerlein and Dan Cordon*

*Steve Beyerlein*

Over the past two years there has been strong support among the ME and College of Engineering advisory boards about creating a common Introduction to Engineering (ENGR 123 ) course. Steve Beyerlein and Patricia Colberg did a 1-semester pilot in Fall 2021 which had very positive outcomes. Last spring the ME, CEE, and ChBE departments voted to adopt the new ENGR 123 course instead of former department-specific offerings. Over the past summer, Dan Cordon (ME) , Kevin Chang (CEE), and Nate Schiele (ChBE) joined Steve Beyerlein to create a common set of materials for this new class, which is being delivered in Fall 2022. There are four sections of the course, each with about 50-60 students. As expected, there are many ME, CEE, and ChBE students in the class, but ~20% of the class are from ECE or CS, undeclared in engineering, or have declared majors outside College of Engineering.

*Dan Cordon*

The over-arching goal of the course is to help students decide if they want to pursue a degree (and career) in engineering, and if so, decide which major and specialty they are passionate about. This emphasis has been broadly welcomed as a sizable number of students with declared majors remain uncertain about their choice. Class periods incorporate a strong active-learning component with lots of peer-to-peer interaction and homework assignments have proven to be equally engaging. For example, one assignment pairs students with alumni (matched based on student interests) where each student conducts an interview of a working engineer to learn more about the path taken to get where they are now, what they wish they would have done differently, and insights/ recommendations for current engineering students. There are currently over 170 alumni in our pool of interviewees, with over 100 related to the ME department.

One week of the course is dedicated to making sure all the students are adept at basic engineering skills in Excel (documenting data, performing analysis, plotting results, etc.). While most students indicated they were familiar with Excel before the class, few of them were able to perform a calculation, use absolute and/or relative cell references, or plot data. These are foundational skills that all ENGR 123 students gain experience with through activities, homework, and as part of data analysis related to their team-based design projects. These skills can also be readily applied in other STEM courses, especially those with laboratory components.

# Design Suite: Phase 2 Renovations Complete

*By Mike Maughan*

**The major phase 2 improvements to the college's Interdisciplinary Design Suite are finally complete! The room has new features from top to bottom.**

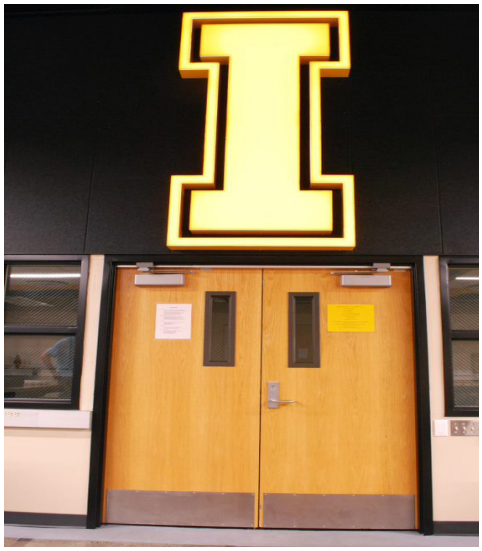
The utilities pipes in the ceiling were painted Vandal "Spirit Gold" to highlight their importance (this is engineering after all!). New multi-level ceiling tiles were added with openings to show off the piping above. Acoustic panels reduce the echo make it easy to talk in the room.

We added LED light fixtures and new UI logo whiteboards on the east all. A new countertop, cabinet, and soldering station were created, and the paint on the concrete floor was removed and polished. Capping it all off is an amazing 7-foot-tall lighted Vandal sign above the door into the back room.

We again want to express our appreciation to **Bob Parkinson** for the generous donation which has enabled this transformation.

**Next**, we will target upgrades in the back meeting room. We expect to create a professional meeting area that we call the Leadership and Innovation Studio and provide modern study tools.

*Design Suite After Phase 2 Renovations.*

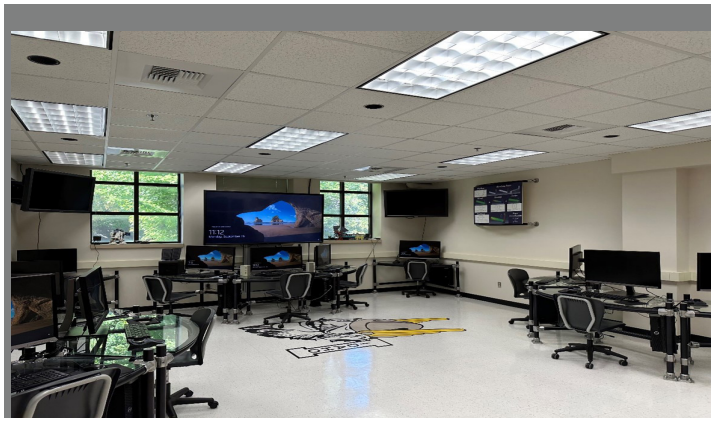


**We need your support to complete the back room!**

**Contact Bobbi Hughes, Executive Director of Advancement (bhughes@uidaho.edu) if you are interested in donating.**

# Computer Lab Upgraded

*By Ankit Gupta*



*GJ115 lab with large instruction screen and Dell T5820 computers (mounted underneath glass tabletops)*

The Mechanical Engineering Department maintains 2 computer labs, a general-purpose computer lab (GJ114) and a more advanced computer lab (GJ115) to fulfill advanced CAD needs. We have recently upgraded both of our lab computers to the latest model and technology.

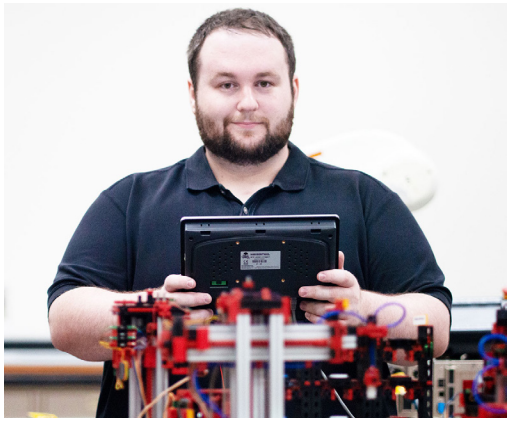
GJ114 computers are Dell T3650 Tower with the latest i7 processor and 16 GB of RAM. Computers in this lab are running the latest version of Software which includes MATLAB, SolidWorks, LabVIEW, and Ansys. We also have Arduino, Tk Solver, and EES for students to use in their coursework.

GJ115 computers are Dell T5820 Tower with latest Xeon processor and 32 GB of RAM. They also have NVIDIA T1000 graphics cards which are more than capable of running VR Software. These computers have all the above-mentioned software and are used for our Advanced solid design coursework, Ansys simulations, and Capstone projects.

# Robotics Laboratory Established

By Gabriel Potirniche

The Mechanical Engineering Department recently established a Robotics Laboratory in the McClure building on the University of Idaho Moscow campus. The robotics endeavors associated with this lab are envisioned as a collaboration with Computer Science and other engineering majors. Several faculty members and graduate students are involved in teaching, mentoring, and research activities in our college, and the robotics lab will be a natural center for many of these efforts.



*Doctoral student, Jacob Friedberg, working on a Fischertechnik simulation factory.*

Through the generous support of industrial partners such as Idaho Forest Group and Schweitzer Engineering Laboratories, we were able to grow the infrastructure needed to start robotics activities in the lab. We purchased two FANUC industrial collaborative robots (Cobots). These Cobots will be brought into the lab next spring and to be used for teaching robotics courses and robotics projects beginning fall 2023.

In addition, we have finalized setting up a Fischertechnik simulation factory currently being used for teaching a PLC programming course. In the spring 2023 semester, a joint-listed course between the Computer Science and Mechanical Engineering departments, called Robotics Systems Engineering, will be taught in both the McClure robotics lab and another lab on the Coeur D'Alene campus. A video conferencing system consisting of several large TV screens and high-definition cameras have been implemented to facilitate the teaching of courses and interactions on research projects between the Moscow and Coeur d'Alene campuses. The video conferencing system is also envisioned to facilitate future communications and interactions via virtual platforms such as Microsoft Teams or Zoom with industrial partners on research and capstone design projects.

Another recent activity has been the establishment of the Vandal Robotics Club, which is currently housed in the same McClure Robotics Laboratory. Club students are already embarking on exciting robotics projects, and we plan to report on these in the upcoming issues of our newsletter.

Finally, this year the newly established robotics lab will also house a capstone design team working on a NASA-sponsored project to develop robotics assembly methods for photovoltaic cells using DENSO robotic arms. We are encouraged by the student interest in learning about robotics and getting involved in industrial robotics projects and are committed to expanding the robotics program to attract more participants from other engineering majors.

# ME Students Receive Scholarships

## Shalom Masango - Frank Wesley Childs IV Scholarship and ME Advisory Board Scholarship

I am a senior in mechanical engineering who comes from a family of lawyers, and I am the only member in my family who is interested in STEM classes. I chose to study engineering because from an early age I was fascinated by planes, and I wanted to fly them. I initially wanted to do Aerospace Engineering, however I decided to study Mechanical Engineering because it is more portable and allows me to learn about other engineering disciplines.

I am currently fulfilling my interest in the aerospace industry by doing a Senior Capstone Project that involves oil-film interferometry on airfoils. As a woman of color, I want to represent my family and my country to showcase that women can do it, too. My parents have taught me to be independent and strive to do great things. I have a great support system including professors who are always ready to help and listen to my ideas.

I am interested in manufacturing and am open to working anywhere where I can apply my degree. I completed an internship with Applied Materials in Austin Texas during the Summer of 2022. During the Summer of 2021, I participated in research with Dr. Swenson evaluating fatigue properties on aluminum sheet metal. I am currently working at Schweitzer Engineering Laboratories as a Manufacturing Engineering Intern during the 2022-2023 academic year.

Furthermore, I want to contribute to the community by actively recruiting students into engineering. In addition to being a campus tour guide, I am an orientation leader, which allows me to help students navigate the university and their colleges during their first few weeks on campus. I am part of a mentorship program between the Society of Women Engineers (SWE) and Idaho National Laboratories (INL). I am a grader for Thermodynamics for Dr. Cordon's class and a Teacher Assistant for Elements of Material Science taught by Dr. Roll. In addition to this, I am a Project Coordinator for Applied Ethics & Professional Leadership and report to Dr. Cook.

I have volunteered at the Vandal Food Pantries, Paint the Palouse, and Serve Your New Community. I have been a member of American Society of Mechanical Engineers, National Society of Black Engineers, and Society of Women Engineers

I was recently featured in "The College Tour" by Amazon.com where I promoted the engineering program and our faculty. The episode will air in the future at www.thecollegetour.com/tour-colleges/university-of-idaho/.

## Cameron Kaminski - Frank Wesley Childs IV Scholarship

Growing up I had an acute interest in how mechanical components work and function. I can remember my parents being frustrated with me for taking apart miscellaneous household items to learn how they work.

This desire to know how mechanical components operate grew into a real passion and is the reason I chose to pursue a degree and career in the mechanical engineering field.

In middle school I joined the robotics club where I created an underwater robot for Spokane's wastewater treatment plant that was able to successfully pick up a handheld radio at the bottom of a chemical tank. I credit his experience most for me choosing mechanical engineering as my degree and career path.

I would like to invent or be a part of creating a product that can help the world with clean energy and how we can make the world a better place by reducing the pollution from different machines. When I look back on my work at the end of my career as a mechanical engineer, I hope I have made a real difference.

## Faith Pemble - ME Advisory Board Scholarship

My main interests in Mechanical Engineering are green technology and sustainable energy. I want to prevent further pollution by designing or refining solutions to our rapidly dying planet. We are the ones ruining it, and I feel responsible to be a part of the solution to fix it.

I have worked with Professor Michael Maughan on a wood 3D printer project. I was recruited for this undergraduate research project after having ME 223 with Professor Maughan. I worked with two other graduate students on this project.

I have worked with SolidWorks designing interchangeable die inserts with different extrusion shapes, as well as running experiments for a research paper on the addition of hemp fibers into our mixture to test its effect on strength and elastic modulus.

I am currently studying abroad in Spain because I feel it is important to learn a second language and experience another culture.

# COE 2022 Outstanding Senior Awards

## Drs. Edwin & Susan Odom Outstanding Student in Mechanical Engineering Award

*Alexander Chambers*

Alex Cambers was born and raised in Meridian, Idaho. After spending years taking things apart and attempting to put them back together with his father and grandfather in the garage, an interest in engineering was sparked. A legacy of the University of Idaho, Alex committed to a degree in mechanical engineering.

In his time here, he found a passion for aerospace fluid dynamics and tailored his education and experiences around this field. Working with the Vandal Atmospheric Science Team (VAST) for three years allowed him to develop carbon fiber scientific payloads, to be launched 15 miles into the atmosphere each semester, along with becoming the lead for the aeromechanics division.

This project gave him the opportunity to intern for the Idaho Space Grant Consortium for two summers and turned into undergraduate research. While the project was focused on atmospheric gravity waves from a total solar eclipse, Alex focused on the atmospheric thermodynamic response. This research yielded the development of a complex algorithm in quantifying and categorizing the response, of which he presented at a national conference (AGU) in 2021 and is currently working on a first author publication.

In his senior year, he worked on designing a wind tunnel force balance plate instrument, created a complex mechatronic control system to operate a solid metallic sodium extrusion press, and is currently developing a Finite Element Analysis simulation to quantify the curvature effect of sodium micro extrusion with the goal of publishing soon.

Alex has been accepted to the University of Washington Master's program and is currently discussing options for positions at multiple NASA Centers. He is grateful for the many hands-on experiences, helpful faculty, and peers who made his time at U of I an amazing experience.

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*Andrew Stucker*

I have had a long-standing interest in engineering, and my experience in high school with FIRST robotics pushed me toward a mechanical engineering degree.

Throughout my college career, I was heavily involved in the University of Idaho's Agricultural Mechanics (AgMEQ) Laboratory. This work gave me real-world experience in system design and product development. I also had the chance to work with older, more experienced, cross-disciplinary engineers on several projects.

My biggest achievement at AgMEQ was authoring an extensive paper outlining a device for measuring the transverse stiffness of maize stalks that I designed, built, and validated. I was also the co-inventor of a U.S. patent describing a device for meaning the rind penetration resistance of maize stalks.

After graduation, I am moving to Coeur d'Alene to work for Advanced Input System (AIS). AIS is an established company that specializes in human-machine interface equipment in harsh environments. I am looking forward to applying and sharpening the knowledge and tools that I gained at the University of Idaho in my career.

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*Sophia Wieber*

Sophia grew up in Boise, Idaho and has always had an interest in STEM fields. She decided to attend the University of Idaho after becoming a National Merit Scholar finalist, but originally planned to pursue physics. At the last minute before freshmen registration, she switched to mechanical engineering on a whim and never looked back.

Thanks to classes with Dr. Maughan and Dr. Perry, she discovered a passion for working on practical projects and learning about SolidWorks. She even had a chance to become a Certified SolidWorks Expert.

Sophia enjoyed taking all the opportunities she had to share what she learned by becoming a mentor. She mentored the ME 223 class (Mechanical Engineering Analysis), ME 301 class (Intro to SolidWorks), and even helped young Invent Idaho students develop their designs for competitions.

Sophia was a member of the honors program and will graduate Magna Cum Laude with minors in math and physics. After graduation, Sophia will return to Boise to work as a Hybrid Diffusion Process & Equipment Engineer at Micron Technology.

# 2021-22 Grand Challenge Scholars

## Joseph Dekold

*Challenge: Increase Food Security*

My vision and passion are defined by how and where I want to work.

After graduation I hope to spend a few years working stateside and then I hope to take my career overseas and work on integrating engineering solutions with existing infrastructure to improve quality of life in developing countries.

The connections and relationships I'm developing through the program are personally and academically energizing and I believe they will help me to achieve my career goals.

## Sebastian Garcia

*Challenges: Provide Energy from Fusion & Agricultural Sustainability*

I completed my bachelor's degree in in Mechanical Engineering spring 2022 at the University of Idaho. I am currently a master's student in the ME Department.

I have a passion for understanding and addressing the biggest challenges faced by our society. I am called to serve others and do my utmost to ensure that the work I am a part of secures, protects, and defends "life, liberty, and the pursuit of happiness," in all our lives.

## Jadzia Graves

*Challenge: Sustainability*

I joined the Grand Challenge Scholars Program (GCSP) in the spring of 2018.

I was interested in GCSP because I want to make a difference in the world, and it provides me with opportunities to explore my interests in an academic setting.

The GCSP is based in five components: research, global, interdisciplinary, entrepreneurship, and service learning. I have chosen two components to gain Expertise in and three components to gain Experience from.

## Andrew Stucker

*Challenge: Developing the Tools of Scientific Discovery*

I knew going into high school that I wanted to be an engineer, and my experience with FIRST robotics pushed me towards a mechanical degree. My passion for finding clever solutions to physical problems shaped my desire to go into mechanical systems design.

My classes at the University of Idaho, and my work as an undergraduate researcher, are helping me to become an experienced engineer. These experiences, along with my work in the GCSP will enable me to pursue my engineering dreams.

## Grand Challenge Scholars Program

**The University of Idaho College of Engineering is committed to the Grand Challenge Scholars Program — a combined curricular and extra-curricular program with five components designed to prepare students to address the 14 Grand Challenges of Engineering in the 21st century as established by the National Academy of Engineering (NAE).**

**Key Components**
**Research Experience | Interdisciplinary Curriculum | Entrepreneurship**
**Global Dimension | Service Learning**

**It is the only program of its kind in Idaho and the Pacific Northwest. The University of Idaho College of Engineering is among a select group of engineering schools nationwide that together plan to graduate more than 20,000 formally recognized Grand Challenge Engineers over the next decade.**

**uidaho.edu/grandchallenges**

## UNDERGRADUATE STUDENT NEWS

# Engineering Design EXPO Awards

*Mechanical Engineering Student Winners Spring 2022*

### Best Technical Presentation: Fixture for Measuring Backlash in Rifle Scopes

*•Trent Hunter •Tanner Abbott •Sarah Rochford •Paul Riebe*

### Best of Show: Pop 'n Lock Robotic Arms

*•Jesse Ebert •Levi Gallegos •Nick Lee •Justin Wick*

### Best of Show: SEL Package Dropping Machine

*•Lindsay Guthrie •Zane Holliday •Andrew Stucker •Sophia Wieber*

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## GRADUATE STUDENT NEWS

# ME Wind Tunnel - Shared Regional Resource

*By Vibhav Durgesh*

*Wind tunnel setup with the NACA-0012 airfoil, Brian Kirkland, Gonzaga University (L) and Rodrigo Padilla, University of Idaho (R).*

An engineering senior design team from Gonzaga University recently visited the University of Idaho's wind tunnel laboratory and used a 3D-printed NACA-0012 airfoil to learn about basic airfoil aerodynamics. University of Idaho mechanical engineering graduate student, Rodrigo Padilla, assisted in setting up the Gonzaga team's experiment, operating the wind tunnel, and collecting data.

A high-precision load cell was attached to the airfoil to measure the forces and moments experienced by the airfoil. The load cell was connected to a DAQ (data acquisition) system, which was used to record load forces and moments on the airfoil. The results from the experiment gave the Gonzaga students an understanding of how varying the wing position affects the lift and drag loads. The students observed that the drag and lift forces increased significantly for a small change in the angle of incidence. The design team students plan to use this finding in their final project report.

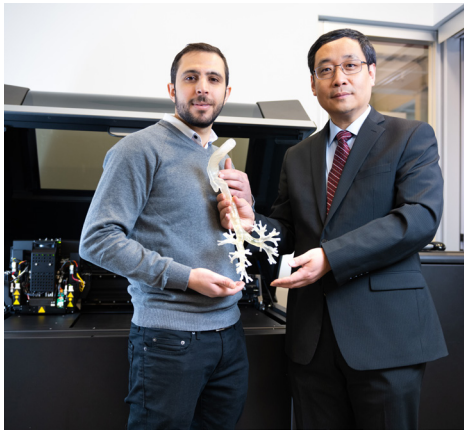
Through this project we fulfilled one of the missions of our Aerodynamics Laboratory at the University of Idaho, which is to provide various academic institutions and local industries access to our state-of-the-art wind tunnel facility. At the same time, I and my graduate students are dedicated to providing technical support such that any visiting team can use the wind tunnel effectively for their fluid flow measurements to achieve the goals of their projects.

## GRADUATE STUDENT NEWS

# Lung Research Progresses

*By Anas Nawafleh*

I am a third-year Ph.D. candidate from Jordan who joined the University of Idaho Mechanical Engineering Department in Fall 2019. My interest in engineering began at an early age when I became curious about how things work. I loved to take things apart and assemble them again to feed my curiosity. This led me to major in mechanical engineering, where my passion grew to further my study and solve real-world problems.



*Anas Nawafleh is holding a 3D printed lung model with Dr. Tao Xing in IRIC 221.*

My current graduate research focuses on high-fidelity fluid-structure interaction (FSI) simulations for predicting regional lung deposition for dry powder inhalers (DPIs) under the supervision of Dr. Tao Xing (MP) and Dr. Vibhav Durgesh (Co-MP). This research requires rigorous solution verification and validation (V&V).

I have successfully completed V&V for a flapping flag (a fundamental study to validate the FSI model) which has resulted in one journal paper manuscript under review (lead author) and another Journal manuscript under preparation.

I am extending this model to simulate DPIs for lungs with and without deformation. To validate the FSI model for lung DPI simulations, I used the state-of-the-art 3D printer (Stratasys J850 Pro) in the new University of Idaho 3D imaging and Printing Laboratory (IRIC 221; https://www.uidaho.edu/3dip) directed by Dr. Tao Xing. I have printed a rigid and transparent lung geometry based on an anonymous patient using high resolution (14 microns).

The printed model will allow in-vitro experimental measurement which is important to validate the simulation results and ensure the quality of the research data. The printer also allows printing the same geometry using flexible materials, which facilitates future experiments that consider lung compliance. Results from my research will provide a better understanding of lung ventilation and drug delivery and eventually help improve the design of DPIs to treat lung diseases more effectively.

## FACULTY AND STAFF NEWS

# Air Force Summer Fellowship

*By Vibhav Durgesh*

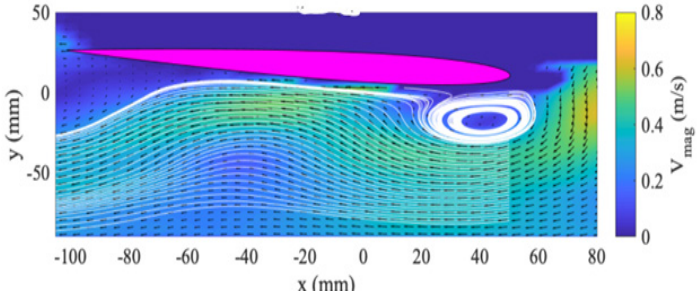
During the summer of 2022, I participated in a Summer Faculty Fellowship provided by the Air Force Research Laboratory at the Wright-Patterson Air Force base.

The focus of my research study in this program was to experimentally study the aerodynamics of an airfoil when operating in large-scale unsteady inflow conditions.

Large-scale unsteadiness is characterized by strong velocity perturbations like flow unsteadiness observed in shear layers, vortices shed from the wake and large regions of separated flow. Understanding these complex flow interactions with the airfoil will have applications in blade-vortex interactions in rotor-craft, wind turbines in large wind farms, and aircraft flying in ship air wakes generated by the ship body and superstructure.

In worst-case scenarios, these interactions may lead to loss of control during critical aircraft maneuvers or severe high loading on the aerostructures. Therefore, accurate knowledge of flow physics allows us to develop active flow control systems with capabilities for mitigating issues arising from large-scale unsteady perturbations.

Experiments were performed in the water tunnel facility at the Wright-Patterson Air Force base in Dayton, Ohio. The flow field over the airfoil was measured using time-resolved Particle Image Velocimetry (tr-PIV) system, and load on the airfoil was measured using a high-precision load system. Data from these experiments will help us learn more about the underlying physics of airfoil-flow interactions.



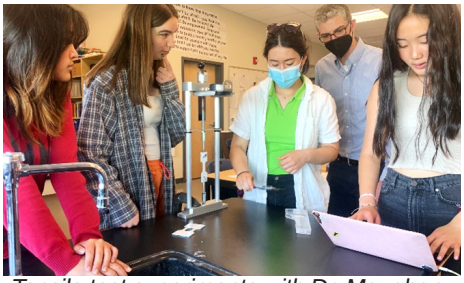

*A large-scale vortical structure impinging on an airfoil.*

# Inspiring High School Students

## Lessons in Mechanical Testing and Molecular Deformation of Polymers

*By Mike Maughan*

In May, Dr. Mike Maughan worked with students in AP Chemistry at Pullman High School, giving a hands-on lesson on the molecular deformation of polymers. This effort is connected with workforce development activities associated with the PrinTimber Team's recent grant focused on additive manufacturing.



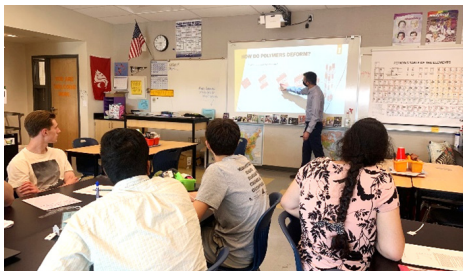
*Tensile test experiments with Dr. Maughan.*

Students participated in two Process Oriented Guided Inquiry Learning (POGIL) worksheets provided by Dr. Maughan and Chemistry Teacher Brown. The first POGIL focused on polymer molecule deformation, the second covered tensile testing and generating stress vs. strain curves.

An informational presentation on state-of-the-art activities at the University of Idaho was also given in addition to a more thorough discussion about polymer microstructure. Student teams of four then conducted a tensile test on polypropylene specimens using hand-operated test-frames.

Students were given a spreadsheet template to graph the data they collected. One student operated the test frame, reported the load, measured the specimen elongation, and recorded the data.

Students were then asked to share their concepts of what changes occurred at the molecular level within the polymer during the test.



*Dr. Maughan discusses polymer deformation.*

Students formed the correct concepts regarding polymer molecule unraveling. Dr. Maughan, Chemistry Teacher Brown, and the students then discussed the concepts in relation to established experimental findings shown by refined tensile tests and electron microscopy studies.

All 38 of the AP Chemistry students at Pullman High School from two different classes participated and received a Vandal "swag" bag.

# ME Faculty Career Highlights

## TENURE AND PROMOTION TO ASSOCIATE PROFESSOR

Dr. Daniel Robertson has been promoted to Associate Professor with tenure. This recognition is a result of his dedicated work and academic achievements in the last five years as an Assistant Professor. He specializes in agricultural biomechanics and is a leading expert nationally and internationally on the topic of stalk lodging resistance (breaking of grain crops prior to harvest). His research has been sponsored by the National Science Foundation, the US Department of Agriculture, and the Idaho Space Grant Consortium. Dr. Robertson has trained many young scientists and created much-needed research infrastructure at the University of Idaho.

Dr. Robertson has forged several collaborations and his work has been widely recognized outside of his own field of mechanical engineering. Plant breeders, biologists, agronomists, and commercial seed companies regularly use the research tools and data that Dr. Robertson and his group have produced over the years. He has taught the sophomore design course ME 223-Mechanical Design Analysis, the Engineering Grand Challenge Course, and several technical electives on plant biomechanics and compliant mechanism design. Dr. Robertson favors a problem-driven and self-directed nature in his teaching approach.

Dr. Robertson has excelled at advising and mentoring undergraduate and graduate students and is an outstanding and passionate mentor to his co-workers. He is the Director of the Grand Challenge Scholars Program in the College of Engineering and oversees students training to perform research that addresses the 14 Engineering Grand Challenges of the 21st century, as established by the National Academy of Engineering. These challenges refer to topics on sustainability, security, health, and joy of living. To date, he has overseen the mentoring of more than 50 students engaged in research through the Grand Challenge Scholars Program.

Dr. Robertson has also mentored numerous undergraduate and graduate students who have performed research in his lab. His mentees have obtained over 40 prestigious grants, scholarships, or awards. As a recognition of his impact on mentoring students, he received the UI Excellence in Advising Award in 2021.

# ME Faculty Career Highlights

## PROMOTION TO FULL PROFESSOR

Dr. Tao Xing was recently promoted to Full Professor.

This promotion is a recognition of his outstanding contributions in the areas of teaching and advising, scholarship and creative activities, and service and leadership.

Dr. Tao Xing has been a passionate and effective teacher in our department, teaching courses on fluid mechanics for juniors and Computational Fluid Dynamics (CFD) at the senior and graduate levels. In these courses, Dr. Xing emphasizes using computational tools to solve practical problems.

An important highlight of Dr. Xing's teaching is his ME 416 Fundamentals of Engineering (FE) Exam Review course. Dr. Xing has been the main instructor in this course since 2018 when it was established. He implemented ME 416 as an online offering, in which students have access to a wealth of pre-recorded review and example videos, practice problems, and sample FE tests. He worked with College of Engineering faculty members to create video recordings on each FE exam; and also worked with ME faculty and graduate students to create an extensive database of practice problems. ME students have excellent passing rates of the FE exam by ME, ranging between 80 and 100%.

Dr. Xing research focuses on CFD simulations, and as of late, he has focused his most fundamental inquiries on modalities for the verification and validation of CFD results. He has applied his knowledge and skills to study a vast range of problems, such as wind turbine applications, crosswind studies in automotive applications, flow around airfoils and hydrofoils, water flow in salmon redd, and fluid flow and fluid-structure interactions applied to human lungs.

Highlights of his research include significant external funding, an excellent publication record, and numerous multidisciplinary research projects.

## OUTSTANDING TEACHING AWARD

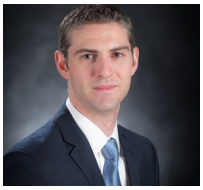
Dr. Robert (Bob) Stephens has been awarded the 2022 College of Engineering Teaching Award for his contributions to educational, advising, and mentoring activities over a three-decade professorial career.

Dr. Stephens is one of the best teachers in our college. During the last three decades, he has taught numerous courses, such as Statics, Dynamics, Mechanical Design, Engineering Materials, Mechanics of Materials, Machine Component Design, Fatigue and Fracture Mechanics, and Advanced Strength of Materials. His priority has always been teaching. He is a highly passionate, knowledgeable, and professional teacher, who spends a significant amount of time preparing his lectures and designing instructive classroom activities.

Dr. Stephens is also an excellent advisor and mentor to undergraduate and graduate students. He treats his students with the utmost respect and a certain degree of friendliness, which creates a comfortable environment that is highly conducive to learning and professional growth. Most often, his graduate students finish their degrees in a shorter time than the average graduate student because he begins working with them on research topics as undergraduates and mentors them closely. His students have access to state-of-the-art fatigue and fracture equipment, and they take advantage of those facilities to become expert researchers.

Dr. Stephens' research is in fatigue, crack growth, and material characterization of advanced materials at elevated temperatures. His recent research grants were sponsored by the Department of Energy (DOE), the Nuclear Energy University Program (NEUP), and the Energy Power Research Institute (EPRI). He has also mentored students performing research for corporations, such as Wagstaff, Boeing, and Siemens.

## OUTSTANDING EARLY CAREER AWARD



Dr. Michael Maughan is an assistant professor of mechanical engineering and holds a professional engineering license in the state of Idaho. Prior to joining the academic ranks, he worked in industry at both Fortune-50 and startup companies as a mechanical designer and engineering manager.

Dr. Maughan is a very prolific researcher. To date, he has secured more than $6.3M in total research funding. Most notably, in 2021, he secured as PI along with a team of UI co-PIs a $4M grant from NSF to study additive manufacturing techniques in wood composites. He has secured grants from the Idaho State Board of Education HERC IGEM, Idaho Department of Commerce IGEM, NASA – Glenn Research Center, NASA Idaho EPSCoR, and Idaho National Lab. Small and medium-sized companies, such as Night Force Optics, Vista Outdoors, Schweitzer Engineering Laboratories, and Colmac Coil, have also funded his research projects.

Dr. Maughan has published in technical journals and conference proceedings on topics such as materials characterization using nanoindentation, additive manufacturing, and friction stir welding. He has also published on engineering education topics, such as the assessment of students' design and communication skills.

Dr. Maughan is highly adept in training graduate students to become successful researchers. He has mentored undergraduates enrolled in the Honors Program Thesis, the NSF summer research experience, and the NASA Idaho Space Grant Consortium Summer Internship. He developed a popular new course on manufacturing and has been active in reimagining several existing courses for the digital learning era. From 2015-Spring 2022, he was the faculty advisor for the U of I ASME student section and has led numerous infrastructure projects within the ME department.

# New Faculty Joins Department

Dr. Gianluca Blois has recently joined the Mechanical Engineering Department at the University of Idaho as an assistant professor. He is located on the Boise campus in the Center for Ecohydraulics Research. Dr. Blois' expertise is in fluid dynamics.

He conducted his predoctoral studies in Milan, at the Politecnico di Milano, where in 2004 he completed a Master of science in Civil Engineering. During his Master thesis work he developed an interest in advanced flow diagnostics and developed an in-house PIV system with which he studied the flow physics of unsteady turbulent wakes produced by immersed bodies. In 2007 he earned a doctorate from the Politecnico di Milano with a thesis on the fluid-structure interaction of submerged bridge decks.

After earning his doctorate, he moved to the University of Birmingham, UK, as a postdoctoral fellow where he expanded his research interests on fluvial systems and subsequently to the University of Illinois at Urbana-Champaign (UIUC) where he was a member of both the Hydrosystems Laboratory and the Laboratory for Turbulent and Complex flows (LTCF).

At UIUC, Dr. Blois worked on a range of collaborative multidisciplinary projects focused on geophysical systems in which he played a central role by bridging the expertise of international scientists from different backgrounds brought together by the common desire of elucidating flow-driven natural processes with focus on the geomorphology and ecology of river systems.

In 2015 Dr. Blois joined the Department of Aerospace and Mechanical Engineering faculty at University of Notre Dame where he continued conducting flow physics studies in the context of interdisciplinary research expanding his interest on a broader spectrum of complex flow systems ranging from small biological systems to large-scale eolian systems.

Dr. Blois' research explores the intersection of flow physics and environmental processes across scales and focuses on turbulent and multiphase phenomena in a range of natural systems and engineering applications. His research portfolio is predominantly inspired by geological and biological systems with complex boundaries and interfaces.

Research areas of interest include: 1) turbulent boundary layer structure, modifications, modulation, and exchange mechanisms across permeable walls, with implications on hyporheic flows, sediment transport, and biofilms; 2) flow interactions and coupling with complex topographies that form and evolve in both aeolian and subaqueous natural environments with emphasis on 3D bedforms and craters; 3) pore-scale transient interfacial phenomena in immiscible multi-phase flow within heterogeneous porous structures with application to CO2 sequestration and EOR; 4) flow-plant coupling of semi-rigid aquatic vegetation in riparian environments; 5) fluid-structure interactions and surface manipulation of bluff bodies central to drag and lift control/reduction; and 6) compliant cardiovascular and respiratory systems.

Central to all of these research efforts is the development and utilization of novel methods to enable access of advanced flow diagnostics into otherwise inaccessible fluid domains. Dr. Blois will be developing his new research program at the CER in Boise working side by side with other preeminent researchers in the area of environmental flows.

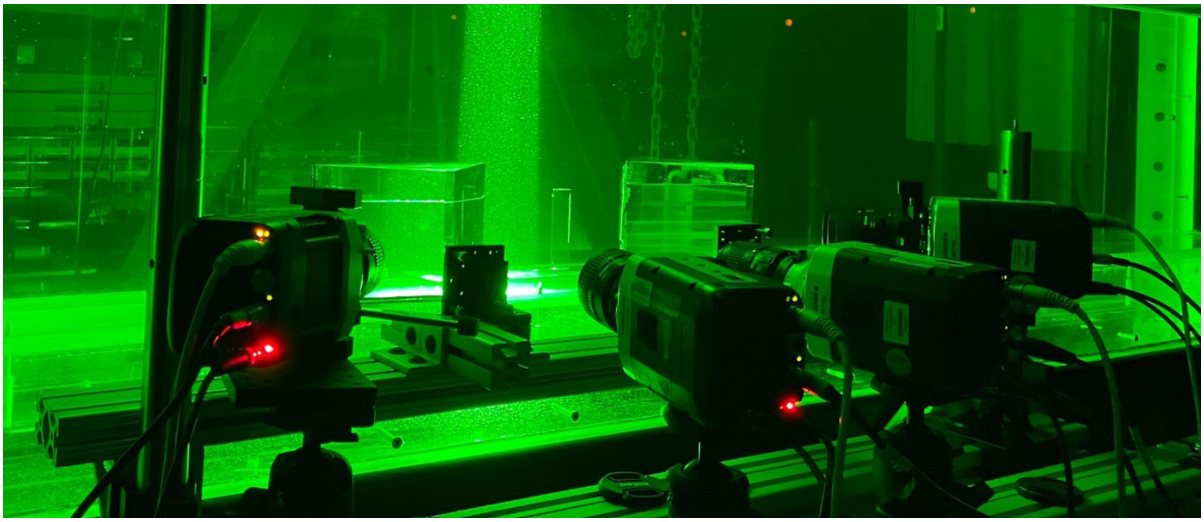


*Photo of time-resolved Tomographic PIV apparatus for the investigation of the wake generated by a finite flexible cylinder immersed in refractive index matching (RIM) environment.*

# Notes From a Former Student

### Koudjo Afantchao

I am an engineer and I currently work as a Roboticist at Fives Liné Machines, a manufacturing and automation company based in Quebec. Although I obtained my bachelor's degree in Mechanical Engineering from the University of British Columbia in Canada, I have taken the majority of my courses from the University of Idaho.

I came to the US from my home country of Togo and started studying at the U of I in January 2013. I first majored in Biology, with the intention of later becoming a medical doctor. I truly enjoyed Biology and Chemistry, however I found myself enjoying mathematics and physics a bit more. After taking the Engineering Statics and Engineering Physics I courses in my second year, I made the switch from Biology to Mechanical Engineering.

Some of the courses that I found particularly interesting were ME 223 Mechanical Design Analysis, and ME 301 Computer-Aided Design Methods. My ME 223 class was taught by Dr. Joel Perry, and it was my introduction to programming using Matlab and Arduinos. I grew up using computers and the internet only for basic tasks, so I was fascinated by the ability to program computers and microcontrollers to do specific tasks. This course has certainly fueled my interest in robotics. The ME 301 course was taught by Dr. Edwin Odom & Dr. Steve Beyerlein, and it was just as influential for me.

Being introduced to Solidworks as a drawing and design tool was a very valuable learning experience. As an engineer, it is very important to convey design intents as clearly as possible using drawings and 3D models. This course was valuable as it taught me a lot of those drawing and dimensioning standards as well as the fundamentals of building 3D models.

During my time at the University of Idaho, I have not only learned a lot in engineering but also learned to be more organized and resilient as some classes were more challenging. I am grateful for the experience, the professors, and fellow students I met along the way.

# ME Advisory Board Members

### Michael Klein

I graduated with my bachelor's and master's degrees in Mechanical Engineering from the University of Idaho in 2001 and 2004, respectively. My time as a graduate student and mentor for capstone design allowed me to gain experience as both a researcher and designer. I spent many hours in the shop learning from the great Russ Porter, Dr. Odom, and Dr. Beyerlein gaining confidence with shop equipment, and then teaching students how to break down their designs, and to always prototype early.

After graduation, I began working for Boeing on the 787 landing gear program that led to designing, building and certifying airplanes. After a few years I moved to product development and joined a unique environment within Boeing called the Structures Concept Center. This role looked at new technologies that could someday make it onto an airplane. I learned about composites, additive manufacturing, and a variety of new manufacturing methods.

My current role explores what it will take to build autonomous vehicles at Boeing. It is exciting to be on the leading edge of aerospace development for autonomous vehicles.

In all my roles I have drawn on my experience at the University of Idaho and how it prepares engineers for critical thinking, problem solving and being involved in every stage of the engineering process. I am very excited to be joining the advisory board as a member able to help develop great engineers at the University of Idaho.

### Sally Mei

I graduated from the University of Idaho with a bachelor's degrees in Mechanical Engineering and History, and a master's degree in Mechanical Engineering. Soon after, I started my career with Schweitzer Engineering Laboratories (SEL) as a Mechanical Engineer in Research and Development.

Working in R&D at a company that specializes in critical infrastructure can be a challenge. The ability to adequately balance between new technology and innovation, along with existing infrastructure is critical for future infrastructure.

Being a mechanical engineer, working in a primarily electrical engineering company, adds yet another layer of challenge due to the interdisciplinary branches of engineering at SEL. My time conducting the research for my master's degree adequately prepared me for this challenge.

Last year, I was privileged to be offered a position on the Mechanical Engineering Advisory board. I am grateful for the mentorship that was provided by the professors and staff at U of I, which provided me with the foundation to be successful in my career as an engineer and as a mentor for future students and engineers.

Since accepting the advisory board position, I have reconnected with many of the professors and fellow advisory board members who have helped cement my engineering foundation. I am excited to have been offered this opportunity to give back to the Mechanical Engineering department.

# LETTER FROM THE CHAIR

*Dr. Gabriel Potirniche*
*Department Chair and Faculty Member*

Dear Friends of the Mechanical Engineering Department,

During the summer and fall terms, several important events and activities have taken place, which have impacted our department in meaningful ways. Dr. Suzanna Long has been appointed the Dean of the College of Engineering. Before joining our college, Dr. Long was a Professor and Chair of the Engineering Management and Systems Engineering Department at the Missouri University of Science and Technology (formerly known as Missouri-Rolla University).

Dr. Long's research and teaching interests span various topics such as critical infrastructure systems, strategic management, supply chain system, systems management, organizational behavior, and sociotechnical system analysis. She brings to our college extensive managerial expertise and significant research experience. She has set several ambitious goals for us, among which the increase of research output in the college is at the forefront of her priorities. This goal aligns with the University of Idaho's strategy of achieving the R1-research level, which would represent a recognition of the significant research productivity as quantified by scientific publications, graduation of doctoral students, employment of postdoctoral researchers, and securing significant external research funding. R1 is a category in the Carnegie Classifications of Institutions of Higher Education, which includes the most research-intensive universities around the country.

We recently hired Dr. Gianluca Blois as an Assistant Professor in the Center for Ecohydraulics Research (CER) at our extension in Boise. Dr. Blois is an accomplished researcher in experimental fluid mechanics. He received his Ph.D. from Politecnico di Milano, Italy. Before joining our department, he was a Research Assistant Professor at Notre Dame University.

Dr. Blois's research interests cover environmental and geophysical flows, turbulent and multiphase flows, sediment transport, fluid flow in porous media, and boundary layer studies over complex geometries. One of the courses Dr. Blois has enthusiastically committed to teaching is our HVAC (Heating, Ventilation, and Air Conditioning) elective, which has been very popular with our senior undergraduates and graduate students.

Dr. Blois has ambitious plans to equip his research laboratory with a state-of-the-art Refractive Index-Matched tunnel and time-resolved tomographic imagining system. These facilities will help him to quantify fluid flows over complex geometries. His expertise and passion for research will undoubtedly positively impact CER research.

In terms of laboratory improvements to boost our research and educational activities, we have recorded progress in several directions. The infrastructure upgrades in the newly established robotics lab have been progressing at an alert pace. We have equipped the robotics lab with a Fischertechnik simulation factory and Programming Logic Controller (PLC) capability. We also purchased two collaborative robots and installed several high-definition cameras, large displays, and a computer. These facilities will allow us to perform remote teaching and research videoconferencing.

Our multi-prong approach to growing the robotics area has entailed building the infrastructure capabilities, reviving the college student robotics club, and establishing the Center for Intelligent Industrial Robotics (CI2R) at the college level. In this center, several faculty members, students, and research staff will work on research projects related to artificial intelligence for robotics, machine version, end effector applications for manufacturing, and other industrial tasks.

Another laboratory improvement has been the completion of the first phase in the renovation of our capstone design suite. We are currently undergoing fundraising for the adjacent lecture room to the main capstone design lab, which we intend to remodel into a mini-conference/innovation hub area. Dr. Michael Maughan and his research team will share the garage space with the Clean Snowmobile Team. Dr. Maughan is developing the equipment needed for their projects on 3-D printing of bio-based materials.

An idea that has been gaining interest in our recent departmental meetings and informal discussions is establishing an Engineering Innovation Studio (EIS), which will comprise as its centerpiece several laboratory spaces organized in a Makerspace. Additionally, the EIS would integrate our existing machine shop, the upcoming innovation hub in the capstone design suite, and the 3-D printing and laser cutting facilities that we currently possess.

We envision EIS to become a college-wide facility. Research has demonstrated that colleges with Makerspace-type facilities better perform their mission of hands-on engineering training. Such a facility would incentivize prospective students to choose our college as the home for their academic education. *(Continued next page.)*

Lastly, we are happy to announce that Dr. Matthew Swenson has become the department's American Society of Mechanical Engineers (ASME) student club mentor. Under Dr. Swenson's leadership, we will soon be restarting our traditional industry tours in which our ASME students and faculty members will visit various companies to learn about state-of-the-art technologies. These tours will also offer opportunities to continue our dialogue with expert practitioners, such that we can continuously reshape our department based on the current industry needs and the latest technological advancements.

# EXPO 2022

*Youthful onlookers evaluate a novel Package Dropping Machine demonstrated by Andrew Stucker at EXPO 2022.*

## GIVE TO THE DEPARTMENT

Visit UIDAHO.EDU/ME-GIVE to support the ME Department, through:

- Scholarships
- Student travel
- Senior design project support
- Competition team support
- Facility upgrades
- Equipment donation

## SAVE THE DATE

**ENGINEERING DESIGN EXPO**
**April 28, 2023**

UIDAHO.EDU/EXPO

**KEEP IN TOUCH:** (208) 885-6579 uidaho.edu/engr/me medept@uidaho.edu