



University of Idaho
College of Engineering

MECHANICAL ENGINEERING NEWS

SUPPORT LAB UPGRADES



(Above) Phase 1 of the Senior Capstone Design Suite renovation includes cleaning and repolishing of the laboratory floor. Removal and re-arrangement of ceiling ductwork is currently underway. (Below) Phase II will include adding more windows.

Launching a Renovation

Lead gift from alumnus Bob Parkinson '64 boosts updates to Senior Capstone Design Suite

We are happy to announce that Bob Parkinson has given the lead gift to support the renovation of our Senior Capstone Design Suite, which will be named in his honor.

Bob received his electrical engineering degree in 1964 from the University of Idaho.

After earning a master's in biological engineering from



Northwestern University and working for Beckman Instruments and the University of Calgary Medical School, Bob started his own company,

Current Control, which he still operates from Jerome, Idaho.

Bob's philanthropy is driven by a deep desire to help students

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and he supported this project because of the broad impact it will have on students in every discipline across the college.

"I just want to help and inspire others to give as well," Bob said.

We are extremely grateful for Bob's generosity. His investment will have an impactful and long-lasting effect on product quality and overall student experience while they engage in engineering design. With this renovation project, we seek to reshape our Senior Capstone Design Suite into an innovation hub and leadership training space.

The Senior Capstone Design Suite is a space in which many generations of students have honed their engineering design skills in preparation for work in industry. Along with the two modern computer labs, a fully equipped machine shop and a 3-D prototyping lab, the Senior Capstone Design Suite is part of our design infrastructure that provides student access to the equipment and space necessary to complete their projects. The products resulting from student design and manufacturing work have been appreciated by our industrial clients, who have fully sponsored most of our senior projects over the years. As a result of student motivation and hard work, coupled with dedication and support by our faculty and technical staff, the capstone program has been recognized and praised for its quality at the national level.

The design suite consists of a large laboratory space and an adjacent classroom. Last fall we initiated the renovation project, consisting of three phases. These were featured in the Fall 2020 edition of the Mechanical Engineering Newsletter.

Securing the large donation from Bob will allow us to complete the first two phases of the renovation project. We have continued working with U of I Project Architect Stephanie Clarkson, Design West Architects, and university Facilities teams in planning, scheduling, and



With floor renovations complete, other activities planned for phase I include the general cleaning of the room, repainting of the ceiling and walls, installing new cabinets in the sink area, and installing white boards on most of the available wall space.

HELP US REACH OUR GOAL & SUPPORT OUR STUDENTS!

We rely on the philanthropic support of our dedicated alumni, friends and trusted industry partners to bring this amazing project to reality. Naming opportunities still exist, and gifts of every level matter!

For more information on ways to give, contact Bobbi Hughes, Executive Director of Advancement, at bhughes@uidaho.edu.

performing renovations.

A card-access lock has been installed on the outer door of the lab. This will grant 24/7 student access to the design suite and help with timely completion of manufacturing and assembly tasks. The cleaning and

repolishing of the laboratory floor have been completed by an external contractor. Removal and re-arrangement of ceiling ductwork is currently underway. Other activities planned for phase I include the general cleaning of the room, repainting of the ceiling and walls, installing

new cabinets in the sink area, and installing white boards on most of the available wall space.

Once phase I is completed, we will proceed with more significant structural changes of the laboratory space in phase II. This will involve adding more windows on the wall separating the design suite from the hallway, installing new front doors, refurbishing the worktables, and installing acoustic absorption panels on the ceiling for noise attenuation.

We are hopeful that phases I and II of the project will be completed by the end of summer. At the same time, we are continuing our efforts to secure funding needed to complete phase III of the project. In this phase, the bulk of the work will center around the renovation of the classroom adjacent to lab space. We are planning to separate the existing classroom area into two distinct spaces, increasing its functionality. One section of the classroom will be modified into a lounge area provided with ergonomically designed furniture to allow room users to spend extended time collaborating in greater comfort. The lounge space will allow students to complete various assignments and project tasks, as well as discuss and brainstorm with their peers, faculty and staff on innovative ideas for their designs. The second section of the classroom area will be adapted into a conferencing space where student presentations, guest speaker seminars and interactions with industry clients will take place. The conference room will be equipped with a large TV screen and video conferencing capabilities, as we plan to take full advantage of the new remote-work trends in education and industry by leveraging digital communication technologies to increase engagement between our students and industrial clients. This will allow our students to host a wider audience for capstone design reviews and meetings, supporting in-person and/or web events.

ME Students Mentor Invent Idaho Participants

Several Invent Idaho invention ideas to become future capstone design projects

By Matthew Swenson

Each year, the Invent Idaho program offers pre-collegiate students (grades 1-12) the opportunity to generate novel ideas for solving real-world challenges and pitch their ideas in local competitions. Throughout the academic year, young inventors work independently to nurture their ideas, build working (or non-working) prototypes, and hone their presentations to sell their inventions. Stronger student presentations from the school competitions advance to one of three regional competitions in January and winners of each regional competition advance to the state contest, traditionally held on the U of I campus in March.

As a pilot initiative in Spring 2021, Dr. Matthew Swenson collaborated with Beth Brubaker (state coordinator for Invent Idaho) to offer opportunities for Invent Idaho participants to engage in one-on-one mentorship sessions (via Zoom) with undergraduate engineering students at U of I. Following the regional competitions in January, multiple Invent Idaho participants were invited from



Ten different Invent Idaho competitors participated in 30-minute Zoom sessions with several volunteer ME students, like Sophia Wieber, who donated their time.

all regions of the state to participate in these mentorship activities.

This spring, 10 different Invent Idaho competitors participated in 30-minute Zoom sessions with several volunteer ME students who donated their time: Sophia Wieber, Sarah Rochford, Zachary Furrow, Wil Jansen van Beek, Paul Riebe, and Malachi Mooney-Rivkin. The Invent Idaho participants were delighted to have one-on-one time discussions with the ME students, while the ME students were equally as enthusiastic about

the young inventors' ideas and novel approaches to solving real-world problems. As a result of each of these mentoring sessions, Dr. Swenson is working with several Invent Idaho participants to potentially convert some of their invention ideas into future capstone design projects. Following the success of this pilot program, the intent is to grow this relationship to encourage young inventors throughout Idaho while also creating opportunities for informal learning and development of leadership skills for everyone involved.

100% Success Rate Achieved on Fundamentals of Engineering Exam

Exam review course participation and passing rates increasing

By Tao Xing and Steve Beyerlein

Over the last three years, a faculty team led by Dr. Tao Xing, Dr. Steve Beyerlein, Dr. John Crepeau and Dr. Sean Quallen has created an interactively learning system in BbLearn for the ME 416 Fundamentals of Engineering (FE) Exam Review course.

The system consists of several dozen practice problems in each of the sub-topic areas addressed in the FE exam. With help of nearly all faculty in the department, learning resources are provided for 12 sub-topic areas on the Mechanical Engineering

Exam: mathematics, statics, dynamics, thermodynamics, ethics, fluids, mechanics of materials, heat transfer, material properties, economics, mechanical design, and circuits, measurements, instrumentation, and controls.

These consist of over one hundred 4 to 7 minute just-in-time videos that underscore key concepts along with approximately 500 unique problems. For each subject area assessment attempted by a student, BbLearn randomly draws problems from a pool 5-7 times larger than the number of questions drawn. Students need to correctly answer 5/7 problems to 'pass' each of the twelve FE topic areas. The instructor team has also been focusing on frequently missed problems during weekly interactive recitation sessions

about each FE topic area. Specific pages from the NCEES FE Reference Handbook related to example problems explored are highlighted during these sessions. Participation rates and passing rates on the computerized FE exam have steadily increased significantly among seniors taking our FE review course. During the last six-month period (July-Dec), 20 ME students took the FE Exam and all 20 passed it. Surveys of students in ME 416 have revealed a great appreciation for the efforts of ME faculty and graduate students who participated in preparing review materials and facilitating the recitation sessions. There is also significant interest in having the college expand the teaching/learning methods used in this course to help students in lower-division engineering courses.

Enriching the Capstone Laboratory Experience

By Kamal Kumar

Our senior laboratory course, ME 430, introduces engineering experimentation and group problem-solving similar to that practiced in industry. Students are responsible for decision-making, experimental design, data collection, and analysis. As a part of this laboratory, students put forward a research proposal that outlines the specific experiments and their research hypotheses. They are free to add or modify subsystems at their station to address their research question. Students must learn to define a problem statement and search for solutions. The new course content includes an introduction to LabVIEW, which the students use for data acquisition and analysis. ME 430 offers hands-on experience to over 70 senior undergraduate students

every year and introduces them to the planning, design, fabrication, and testing of real-world prototypes. Examples of student work are shown in the accompanying figures.

The course has recently transitioned from hardbound physical notebooks to entirely electronic records. Each of the approximately 15 groups each semester share space on a learning management system (BbLearn). They record their daily laboratory activities, prepare a wiki that provides detailed documentation of their experiment, and share experiment-related files. Such documentation provides a headstart to future students who can take their investigations to the next level. The system also enables collaborative work during lab hours if some team members work remotely. This was very helpful during the current academic year with strict



Students (left to right): Mark Jaskowiak, Andrew Brown, Siobhan McGuire, and Tyson Ostberg stand near their low-temperature heat release in a motored Cooperative Fuel Research (CFR) engine.

social distancing requirements surrounding our laboratory workstations. Electronic documentation allows students to maintain time-stamped lab records. It also allows the instructor to monitor team progress and provide regular

feedback. Student response to the online documentation system has been very professional and has raised awareness about best practices for knowledge management surrounding use of experimental equipment.

Freshman Year Experience Initiative for Vandal Engineers

By Steve Beyerlein and Dan Cordon

This past academic year a team of ten faculty from across the College of Engineering, including Dan Cordon and Steve Beyerlein, has been designing a shared first year experience (FYE) for engineering students in all disciplines. The goal is to better equip students for pre-engineering STEM courses and to engage them in meaningful personal development as well as career exploration.

The proposed FYE will adopt best practices in current introduction to engineering offerings, like ME 123, and is anchored in competencies prescribed by the National Association of Colleges and Employers (NACE). The NACE competencies include critical thinking/problem solving, oral/written communication, teamwork/collaboration, digital technology/computation tools,

leadership, ethical decision-making, professionalism, career management, and global/intercultural fluency.

The FYE course will leverage robust industry connections represented in department/college advisory boards, provide authentic, hands-on learning experiences intended to improve performance in pre-engineering coursework, and engage leaders from COE student organizations. Pilot implementation in existing disciplinary courses is scheduled to occur during the 2021-22 academic year followed by a college-wide, 2-credit FYE course beginning in 2022-23.

Our model for student development is based on transformation of the whole self that includes balanced mastery of (i) STEM knowledge, (ii) cultivation of life-long learning skills, (iii) culturally relevant hands-on learning experiences,

and (iv) attention to growth of academic as well as professional identity. FYE culture will combine three processes that promote academic success, diversity, and inclusiveness:

1. **Doing** – participating in the activities of the profession, learning the necessary skills and knowledge, and developing an affinity for professional activities.
2. **Interacting** - developing a social network with others in the profession. Identities are formed as we position or identify ourselves in a group and are identified or positioned by others.
3. **Sensemaking** - When identity is considered as a narrative, this is the process of negotiation between the roles and expectations placed on a profession by society, and the individual who enters the negotiation with their own abilities and desires.

A Life-Saving Gift



The team uses a training mannequin connected to a mobile app to record CPR performance, verify results and successful use of the custom device.

By Alexiss Turner

According to the Reeve Foundation, nearly one in 50 people are living with paralysis. Choosing a career in healthcare may be daunting for people with paralysis because of physical requirements.

University of Idaho College of Engineering students recently developed an assistive CPR device with application across a spectrum of users with limited arm strength or other disabilities.

U of I mechanical engineering students Abdulrahman Almajnouni, Ahmed Al Nahab and Josh Sewell as well as materials science and engineering student Tyler Newman worked with Idaho WWAMI Medical Education Program medical student Meagan Boll to design the device.

To successfully perform CPR, the American Heart Association recommends exerting enough force on the base of the sternum to compress the chest 1.5 to 2 inches – which can mean exerting up to 100 to 120 pounds of force on an adult victim. This force must also be sustained at a rate of 100 to 120 compressions per minute.

To achieve proper compression in their design, the engineering student team tested the idea of using a method similar to a fingernail clipper and discussed several mechanical options.

“We knew we needed to multiply the

WATCH THE VIDEO

Learn more about this project and watch the video at uidaho.edu/cpr

applied force out to achieve compression,” said Newman. “The easiest way to do that is through a lever.” The assistive CPR device is a modern version of a simple and primitive concept, one that goes back as far as Greek mathematician and engineer Archimedes’ “law of the lever,” proving force is amplified when transferred via a lever and a fulcrum.

The team’s first prototype clipped to the side of Boll’s wheelchair, requiring her to drive her wheelchair beside the victim and operate the wooden lever with one hand.

Since Boll’s finger mobility is limited, she suggested adding another handle to the design. The device was also upgraded to attach to the front of Boll’s wheelchair using a modified securement system like the one Boll uses when driving a car so that she can push forward to operate a lever placed on the victim’s chest.

The lever-action augments Boll’s force to achieve necessary chest compression. Using a training mannequin connected to a mobile app to record CPR performance, the team verified their results and Boll’s successful use of the custom device.

Key Card Access Provides Extended Hours for Selected Facilities

By Mike Maughan

The Mechanical Engineering Department has installed key card door handle/locks for access to five of our facility rooms. These include our multipurpose design spaces, computer labs, and rapid prototyping lab. The locks, manufactured by Schlage, interface with the University of Idaho wireless internet system for automatic locking, unlocking, and programming, providing easier access for students to the facilities using just their Vandal card. This has been particularly beneficial to be able to extend computer lab and design space hours to allow for social distancing. It is also very useful for access to the 3D printers where long prints can often finish outside of business hours. Students can now access their completed parts when they finish rather than waiting until the morning to retrieve them, which advances their projects faster. The locks also add security by providing the capability to look up user access logs if necessary and reducing the need for monitoring in the computer labs. Our department Infrastructure and Development Committee has developed a schedule and policy for gaining access as well as an access request form. The request form provides faculty oversight and a local record of who has access. The user database for each room can be revised on a semester by semester basis. The funding for the locks was provided by a variety of sources, primarily from course and lab fees assessed from our CAD and design courses, but also from the ME Equipment fund. At this time, facilities with potential for injury will continue to use traditional key locks.

ASME Innovations

By Rachel Stanley

Throughout this past school year, the American Society of Mechanical Engineers student club has completed phase 1 of our lounge renovation project which included purchasing worktables, couch tables and some small tables to help aid in social distancing. We are now well on the way to completing phase 2. We have recently ordered two computer tables, a stronghold cabinet, and storage drawers for student supplies. We are in the process of placing our last order that will include a TV, a microwave, and chairs.

More and more students have been using our ASME lounge space to participate in online classes and to relax or do homework between in-person classes. After this project is complete and the pandemic is



ASME hosted a tour of Idaho National Laboratory's EBR-1 reactor with informative tour guides from INL and an amazing 360-degree virtual tour.

behind us, we expect even more students will find the space attractive and useful for networking. The club is appreciative of the strong support offered by alumni in our 2020 U & I Give crowdfunding campaign. COVID-19 has certainly put a damper on ASME field trips and alumni visits which we look forward to resuming next year. However, we have found some creative ways to push through. This year we hosted a

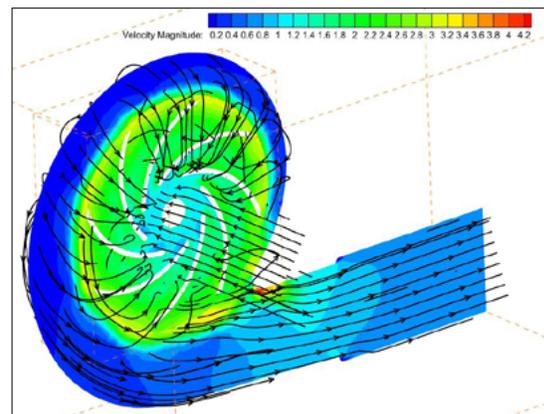
live virtual tour of Idaho National Laboratory's EBR-1 reactor. With the highly informative tour guides from INL and the amazing 360-degree virtual tour that was provided based on simulations and pictures, this event was a success. We are hoping to do another tour before semester's end featuring another Idaho Falls facility. We are also hosting a virtual session about undergraduate research at the University of Idaho.

Two Win DOE Energy Assessment Research Competition

By Piyush Basnet and Anson Lunstrom

Two ME students won a research competition award from the Department of Energy (DOE), Advanced Manufacturing Office (AMO). These students formed a research team under the direction of Dr. Dev Shrestha and Dr. Steven Beyerlein during the Fall 2020 semester. Their research entailed attempting to improve pump efficiency through impeller redesign for part-load operation and application of a hydrophobic coatings. The team has built a pump loop consisting of a ¾ HP self-priming centrifugal pump, two 56-gallon water tanks, and 1.5-inch PVC pipes. The loop consists of two pressure transducers to measure water pressure before and after the pump. There is a control valve to regulate the flow of the water after running through the pump and a flow meter for data acquisition. Two other undergraduate students, Meridian Hass and Gabryel Conley are conducting pump loop simulations in ANSYS with the help of ME PhD student Bishal Bhattarai. MacLean Landis is focusing on developing custom impeller designs using 3D printed materials. The team is scheduled to present their results in a DOE webinar this May.

Nearly all of the students involved in this project are part of the Industrial Assessment Center at the University of Idaho. This is a DOE program involving other centers at 28 universities across the country, with a mission to train next-generation energy engineers through participation in no-cost energy assessments for small to medium sized manufacturers. The U of I team involves students in Mechanical, Biological, and Chemical Engineering. Over the



ANSYS Fluent Flow Simulation with Customized Pump Design

last 10 years the U of I IAC program has provided an outstanding academic internship experience for more than 50 University of Idaho undergraduate students, strengthened partnerships with more than 75 regional industrials, and suggested more than 3.5 million dollars per year in energy savings for our clients. Adoption of our recommendations has not only reduced annual energy expenses but also made for significant reductions in Greenhouse Gas (GHG) emissions. The regional reduction in emissions facilitated by the IAC team is equivalent to GHG emissions from 5,600 people in daily life on an ongoing basis. The IAC program has also opened the door for many opportunities to collaborate with regional industry on SMART manufacturing. The recent pump loop project is an example of this engagement.

CSC Team Thrives in Virtual Competition

By Porter Dallenbach
and Garrett Potts

This year the University of Idaho's Clean Snowmobile Team competed for its 20th year in the 2021 Clean Snowmobile Challenge. Historically, the competition captures the elements of design innovation through efforts to improve emissions, reduce noise, increase upon fuel economy, and supply vehicle acceleration. This year's competition layout was changed due to the Covid-19 pandemic, resulting in a computer-modeling format. In combination with real world testing, a vehicle model was developed by the team in order to simulate a snowmobile within predetermined riding conditions. This simulation was designed using the



Team photo of the 20-21 CSC members in the Large Project Lab sitting with their latest snowmobile platform.

industry standard software GT Suite. GT Suite can simulate phenomena such as combustion chemistry and heat transfer, gas dynamics, sound, emissions, power, and vehicle movement. Our 2021

"snowmobile" was predicted to produce 86 Kw [115 hp], only 5hp different than reality. With the software's ability to produce sound files the team was also able to replicate the sound of the intake and exhaust of the

engine operating at steady state. Results of this year's competition are yet to be released. The team plans on using modeling more extensively in future design analysis prior to fabrication.

VAST Conducts First Tethered Balloon Launch

As a Vandal engineer, near space is at your fingertips.

Our Vandal Atmospheric Science Team (VAST) recently conducted its first tethered launch, using a high-altitude balloon to send aircraft communication cargo into the air and test the equipment that will be used this semester for scientific and humanitarian experiments.

The interdisciplinary team is closely affiliated with our NASA Idaho Space Grant Consortium on the Moscow campus, and welcomes members from all majors and levels to work with NASA on innovative projects.

"Our connection to Idaho Space Grant and NASA is really important because it gives students an opportunity to work on a NASA-affiliated project," ME senior Jadzia Graves said. "Multiple students from VAST also get NASA internships each summer."

Contained in three layers of foam, the cargo, or payload, of this tethered



Testing helps prepare the team for chase launches, where the payload flies up to 100,000 feet into near space.

launch included a satellite and radio tracking system. The launch was conducted to test these systems, which were recently upgraded.

During the launch, atmospheric science data is also recorded, including air pressure and temperature, to relay condition of the payload once every two minutes.

The testing helps prepare the team for chase launches, where the payload flies up to 100,000 feet into near space. Experiments have been done to determine the level of gas pollutants at different levels of the atmosphere, to detect low-frequency waves like lightning, and to test how altitude affects solar panel power generation.

Rene M. Maura, Ph.D.

Earning a PhD is a full-time job in and of itself. Throw parenting in the mix, and you have a recipe for some of the most challenging and sleepless years of your life. Rene Maura is a Mechanical Engineering PhD candidate in his fourth year of study, preparing to defend his work on development of a safe force-based controller to obtain reliable stroke metrics from an exoskeleton. For Rene, this has meant learning about robotic control theory, friction modeling approaches, industry standard EtherCAT communication protocols, safety systems, and much more -- all toward the development of a bilateral (i.e., left and right) arm exoskeleton instrument for assessment of arm and hand function after a stroke. The project, funded by the National Science Foundation, seeks to create a new instrument that measures signals simultaneously from the central and peripheral nervous system and resulting musculoskeletal responses via sensing systems on the scalp, arm musculature, and exoskeleton.

Rene has been the lead control and



Rene M. Maura

safety system engineer for the project. Over the past 4 years, he has developed a feedforward and feedback friction compensator to improve backdrivability of the high geared exoskeleton, designed

an admittance controller to give the impression to the wearer the robot is weightless with almost no friction, and designed software limits to ensure user safety. He is currently testing a way to limit the robot's workspace to the user's workspace to prevent the robot from over-stretching a limb. Long before attending the University of Idaho, Rene knew his educational goal was to get a doctorate degree in Mechanical Engineering.

"My favorite class as an undergraduate was Control Theory. This sparked my curiosity about advanced topics like system identification, linear systems, and random (stochastic) signals. When pursuing graduate schools, I researched schools that not only had projects that met my criteria, but also that had professors that I thought I could connect with. My first time meeting with the UI professors (Dr. Perry and Dr. Wolbrecht) gave me the impression they are approachable mentors that will teach me the skills to succeed as a researcher. Many UI professors have families and understand the challenges of having a child, and they are willing to work with their students who also have families to help them reach their academic and career goals."

Department Hosts Visiting Scholar from Belgium

By Matt Swenson and Laurie Delenin

For the Spring 2021 semester, the ME department has been delighted to host Laurie Delenin, a graduate student and J-1 Visiting Scholar from the Université de Mons in Belgium. Laurie is a Master student in Mechanical Engineering and is in Moscow to work on her final project for the M.S. program at her home institution. During her 4 months at the University of Idaho, Laurie has been working on a two-phase design project which includes learning principles of design for manufacturing combined with technical manufacturing-based research. Under the mentorship of Dr. Matthew Swenson, Laurie is designing a unique and innovative solution for trailer suspension systems that promises to dramatically increase the stability of trailer payloads. The new suspension

design takes advantage of a 1st class lever and offers the ability to make each side of the trailer suspension co-dependent, allowing the trailer to self-level during cornering or when heavy loads are unevenly distributed toward one side. This initiative is part of an ongoing collaboration with George Tanner and his Entrepreneurship students in the College of Business, with the intent to develop a robust business plan and pursue manufacturing partners to help bring the design to market.

In addition, Laurie is working on technical research to systematically evaluate advanced welding technologies to characterize the influence of laser welding techniques on the microstructure, mechanical properties, and larger-scale manufacturability of laser welding as a potentially alternative



Laurie Delenin

to traditional metal-inert-gas welding. The ME department is excited to host Laurie as a visiting scholar and to have the opportunity to provide a rich experience and help her finish her M.S. degree in Mechanical Engineering.

GRADUATE STUDENTS

Yusuf Oduntan, Ph.D.

I was born and raised in Lagos, Nigeria. My international education journey began in Liverpool, England where I completed a bachelor's degree in mechanical engineering. I was admitted into my master's program at the University of Idaho through the Global Student Success Program (GSSP). This program ensured I had a seamless transition into life in the United States and education at the University of Idaho. After progression from the GSSP, I connected with Dr.

Robertson and began working as a research assistant in the AgMEQ laboratory at the U of I. The laboratory's research is focused on developing techniques to address the prevalent agricultural problem of stalk lodging (crop stems breaking prior to harvest). My master's thesis project focused on developing a quick, simple and cost-effective methodology to quantify anatomical structures of plant stalks. Studying at the University of Idaho has enabled me to appreciate the comprehensive college



Yusuf Oduntan

experience especially being in the college populated

Moscow community. Faculty in the college of engineering have also been welcoming and are always very helpful. Working in Dr. Robertson's interdisciplinary research group is a rewarding experience that provides me the opportunity to explore and develop new skills and knowledge. I completed my master's program in December 2020 and began a Ph.D. program this Spring. In my dissertation work I intend to further develop cheaper and more efficient methods to measure and analyze the structural properties of plant stalks using Finite Element Analysis.

FACULTY & STAFF

ME, Nuclear Faculty Join CAES Summer Research Teams

Mike Maughan, Vibhav Durgesh, David Arcilesi to participate in summer visiting faculty program

Two faculty members in Mechanical Engineering, Dr. Michael Maughan and Dr. Vibhav Durgesh, and one faculty member in Nuclear Engineering, Dr. David Arcilesi have been selected by the Center for Advanced Energy systems (CAES) in Idaho Falls to participate in the 2021 CAES Summer Visiting Faculty Program (CSVFP). The collaborative program is scheduled to begin virtually in May with 15 research teams comprised of 17 faculty members from the CAES universities and 19 Idaho National Laboratory (INL) researchers. The program wraps up in August. The goal of the CSVFP is to pair faculty members and INL researchers so they can develop joint-funded research proposals.

Mike Maughan

Dr. Mike Maughan is an Assistant Professor in Mechanical Engineering and specializes in teaching and research on materials and manufacturing methods. To achieve higher nuclear power plant efficiency, reactor pressure vessel materials must retain corrosion resistance and high strengths at ever increasing temperatures. Additive manufacturing (AM) has the



Mike Maughan

potential to produce materials with unique and desirable properties while optimizing geometric design and functionality. One metal additive manufacturing technique that has a good balance among fabrication rate, microstructure, material efficiency, and part complexity is wire-arc additive manufacturing (WAAM). WAAM is also capable of producing composition gradients and dissimilar metal deposition. This combination of fabrication rate, which enables large-scale component manufacturing with composition gradients, can be an enabling technology for nuclear power applications. For next-generation applications, material strengths may not be adequate in the as-fabricated condition, which necessitates additional processing steps. Early results indicate that in-situ quenching can double tensile strengths in common steels fabricated by WAAM, therefore, in this work we seek to investigate in-situ quenching to induce desirable microstructures in ferritic-martensitic steels and combine these with corrosion-resistant material layers to understand the processing parameters and other challenges of making stronger, yet corrosion resistant components.

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Vibhav Durgesh



Vibhav Durgesh

Dr. Vibhav Durgesh is an Assistant Professor in Mechanical Engineering and specializes in teaching and research in experimental fluid mechanics. Modeling and Simulation (M&S) tools will play a crucial role in developing new nuclear energy technologies in the future. Therefore, it is paramount to generate robust experimental data to develop a better understanding of the underlying physics of M&S tools.

One of the areas where M&S tools may significantly benefit from experimental data is the study of thermo-structural-fluid interactions, which can be very challenging due to coupling between fluid, structure, and thermal behavior. Furthermore, nonlinear behavior and incomplete or inaccurate thermo-structural-fluids interaction physics may produce significant inaccuracies in M&S simulations that may lead to nuclear plant or subsystem failures. An example of thermo-structural-fluids interactions in a nuclear plant is the fluid flow through rod bundles. The thermo-structural fluids

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Advisory Board Chair Takes Lead

It is an honor and privilege to have been offered the Mechanical Engineering Department Advisory Board chair position last Fall. Since joining the board in 2016, I've been pleased to participate in many significant events. The board regularly interacts with student groups like ASME and the U of I Clean Snowmobile Team. There have been some stellar student presentations from these groups at our meetings. The board has awarded scholarships to numerous outstanding and deserving students. We have helped procure new equipment for the department and have seen first-hand exciting and innovative research progress. We regularly participate in plans for U of I facilities to grow and improve. We enjoy watching them be implemented. We've also said goodbye to familiar faculty and welcomed new members. To be able to look back on these eventful times brings me a feeling of warmth.



Jonathan Richards

More recently, as I reflect on 2020 and the lighter side of the pandemic, I realize how much we have learned. Pandemic related actions taught us how important education is to everyone and that distance learning is possible. It also forced us to begin teaching our own children the discipline to avoid distractions. Both are important lessons. Establishment of new unproven

data and communications infrastructure was fast tracked, which is something that might not have happened for a decade. New tools have emerged and granted us all the ability to extend wholesome education opportunities to more people, worldwide. I have a strong feeling this will be the new norm. Our workplaces have changed too. With no need to fight over physical space, we just connect and communicate. This is a valuable and efficient in so many ways. In the coming years as I start my term as chair, I'm excited to use these recent communication experiences to help implement a new hybrid advisory board meeting forum, both in-person and virtual, with more potential participation from members, students, and faculty. A web-based documentation strategy to record minutes and active efforts will make important information available to all participants. We also hope to

create an informative advisory board website showcasing our mission, members, and practices. A revision to the advisory board charter will be reviewed as well, which should include a fresh polish with new guidance on participation opportunities and expectations. The board will also be on the hunt for additional industry specific representation, including the food, forest, and automotive industries. We are all excited to see the debut of a newly renovated senior design suite in the Gauss Johnson building. As students, we spent thousands of hours there. Future Vandal Engineers will too and we are looking forward to watching their designs and their professional development. Without a doubt, education solves problems, enriches our lives, and makes the world a better place. I look forward to some exciting times filled with educational contributions. It is a pleasure to participate and watch the future unfold. Go Vandals!

CAES

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interactions, in this case, show a fluctuating behavior that may enhance the thermal behavior but may also induce unnecessary vibrations of the fuel rods. Over time, these vibrations may result in mechanical fatigue in the rods and eventually compromise their structural integrity. Therefore, the proposed research aims to perform a detailed experimental study quantifying the thermo-structural- fluids interaction behavior observed in a nuclear reactor. We intend to use data-drive analysis approaches (like Dynamic-Mode-Decomposition or Proper-Orthogonal-Decomposition) to identify the governing physics that can be used to develop a robust physical relationship capturing thermo-structural-fluids interactions in new generation M&S tools.

David Arcilesi

Dr. David Arcilesi is faculty member in



David Arcilesi

Nuclear Engineering, and teaches graduate-level courses in the Mechanical Engineering Department. Nuclear microreactors are very small modular reactors that are capable of producing 1 to 20 MW of thermal energy, which can be converted to electricity or directly used as heat. In recent years, microreactors have received significant interest due to a growing need for reliable and compact sources of electrical power. Frequent shipments of fossil fuels are often required to satisfy baseload energy requirements of locations not readily accessible to the electrical grid. Interruption of fuel supply lines due to natural or man-made causes can lead to a total loss of energy-generating capability. This can present a substantial threat in the case of national security or military installations and medical facilities. A microreactor can meet this energy demand with continuous operation for up to a decade.

Researchers at University of Idaho, Idaho National Laboratory (INL), and MicroNuclear, LLC have collaborated to design a molten salt microreactor, Molten Salt Nuclear Battery (MsNB). The MsNB reactor design utilizes natural circulation to transport the fuel-dissolved coolant through the reactor. To demonstrate the feasibility of natural circulation in the MsNB design, a scaled natural circulation test facility has been designed and constructed, which utilizes electric Ohmic heating to simulate the in-core fission heating. Successful experiments have been performed on this setup.

As part of this summer's program, Dr. Arcilesi will collaborate with INL researchers, Dr. Amey Shigrekre and Dr. Joshua Fishler. The group will develop computer simulation models in RELAP5-3D and a commercial computational fluid dynamics software to simulate the natural circulation phenomenon of the scaled natural circulation facility. The validated models will be part of a proposal to ARPA-E related to microreactors.



LETTER FROM THE CHAIR

Dear Friends of the Mechanical Engineering Department,

Our department takes pride in the quality of undergraduate education we provide to our

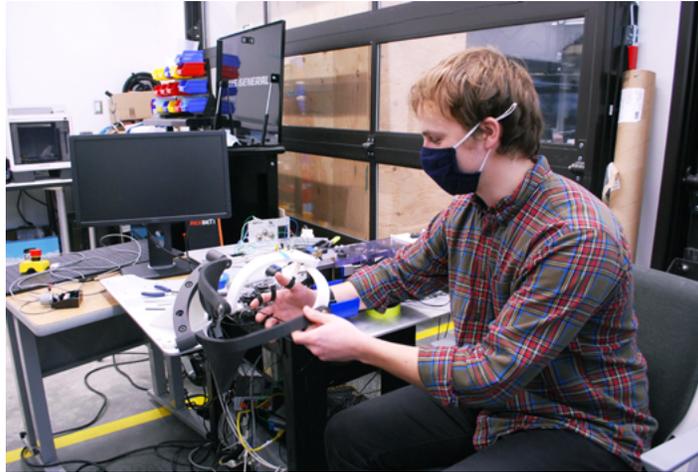


*Gabriel Potimiche,
Chair*

students. The knowledge and skills that our students accumulate during their mechanical engineering program set them on a path to achieving successful careers upon

graduation. Throughout the last few decades our faculty and staff members have worked diligently and passionately to mold aspiring students into successful engineers. The top-notch expertise and professionalism of our people is key to student success. At the same time, a continuous improvement of our didactic and research infrastructure has been an essential element in the education and training of our students to meet current industry demands. We provide rigorous knowledge and training in traditional mechanical engineering disciplines, while at the same time using modern engineering technologies and the latest computer tools. Our students apply the learned principles and methods in hands-on projects and laboratory classes.

The laboratory facilities that we have developed and upgraded over time have been a major factor for the success of our program. Two modern computer



The Finger INdividuating Grasp Exercise Robot, or FINGER, is a rehabilitation device for stroke victims.

labs equipped with numerous workstations allow our students to perform design and analysis tasks of different complexity levels with unlimited access to needed engineering software. A well-equipped machine shop and a 3-D prototyping laboratory provide our students access to manufacturing tools for their design products. These labs are equipped with lathes, Computer Numerical Control (CNC) milling machines, welders, 3-D printers, and a laser cutter. Our students perform design work using metals, plastics and wood materials using these facilities. Those who need to use the equipment for their projects get trained by student mentors and staff on how to use these machines safely and efficiently. In our laboratory courses, students get involved in testing of combustion engines, building and programming of electro-mechanical devices, fluid dynamics testing and flow visualization, data acquisition, solid mechanics or thermal

system designs, and testing of materials for various structural applications and manufacturing processes. An area of activity that has seen steady progress in our department over the last decade is rehabilitation robotics. Several exoskeleton robots have been designed and built with the purpose of helping patients recover their motion skills post brain stroke events. Our faculty, staff and students involved in teaching and researching robotics topics have applied their expertise on structural design, dynamic control, automation, and programming of such robots. The Finger INdividuating Grasp Exercise Robot, FINGER (featured in our Spring 2019 newsletter) and BiLateral Upper-limb Exoskeleton for Simultaneous Assessment of Biomechanics and Neuromuscular Output, BLUE SABINO, (featured in our Fall 2019 newsletter), are two examples of robots developed by a faculty and student team

in our department. In the past, our senior students worked on capstone projects focused on robot integration in assembly lines. They also programmed a robotic arm to perform simple manufacturing tasks. Our senior undergraduate and graduate students can take the elective course Robotics: Kinematics, Dynamics, and Control, in which they apply sophisticated mathematical theories to model motion and control robot movements. A previously offered summer course, Industrial Automation, has currently evolved into the Programming Essentials for Engineers course, in which students learn topics such as Graphical User Interface (GUI), Game Development, Data Analysis, Computer Vision and Artificial Intelligence. Students learn modern programming languages like Python and LabView and develop software applications, some of them applied to robotics.

We believe that we can better serve the career aspirations of our students while also addressing certain industry needs by expanding our educational activities on robotics and automation. Our near-term plans include establishing a robotics laboratory equipped with several educational robots that can be programmed to perform various industrial tasks. Access to an educational robotics laboratory will create an opportunity for broadening student expertise in this field. We are committed to dedicating resources to further educate our students on use of industrial robots.

EXPO 2021 In-Person and Virtual

By Matthew Swenson, Interdisciplinary Capstone Design Director

The University of Idaho College of Engineering is excited to again host the Annual Engineering Design EXPO on the Moscow campus on Friday, April 30, 2021. The EXPO is our annual celebration of the accomplishments of our engineering students, and is formal acknowledgement of our cherished partnerships with regional industry partners and collaborators. This year, the EXPO will be hosted within the charming confines of the U of I Memorial Gym to accommodate social distancing protocols while also providing opportunity for personal interaction with senior engineering students. We believe that this one-on-one interaction is highly valuable for all of the presenting students as they demonstrate the products of their senior capstone design projects. The event will start with team booth presentations from 9:00 am - 12:00 pm. These presentations will include detailed project posters and, in many cases, working prototypes of the student's designs. Students will interact with regional pre-collegiate students and volunteer judges to provide hands-on presentations and demonstrations of their projects. The judges for the student presentations are comprised of regional industry partners and U of I alumni, and will provide the basis for evaluation of the student's project. High performing teams that particularly impress the judges will be acknowledged at the annual Awards Ceremony on May 14. Following the team booth presentations, the College of Engineering is delighted to host our special guest speaker, Margrit von Braun, who is an environmental engineer and 1980 University of Idaho civil engineering graduate, working in the areas of hazardous waste management and risk assessment. Margrit will speak from the stage of the Memorial Gym to all in-person participants from 12:30 - 1:30 pm, and her presentation will also be live-streamed online for anyone to watch. Unfortunately, due to social distancing



Mechanical engineering senior Kaitlin Tabaracci capstone team is continuing a collaborative effort to bring an electrically-driven, remote-controlled stage to University of Idaho Vandal Marching Band halftime shows.

guidelines, the capacity for visitors at the EXPO will be limited. As a result, the EXPO event will additionally offer a multitude of online experiences for our partners, collaborators, and the public at large to engage. During last year's EXPO, which was exclusively online, we experienced an ~800% increase in engagement throughout the state of Idaho and beyond. As expected, providing an online experience allows anyone to engage with the University of Idaho and our fantastic engineering students from anywhere, including the comforts of their own home. In addition to the booth presentations, each senior design team will also deliver a

EXPO: APRIL 2021

Learn more and register for virtual sessions at

uidaho.edu/expo

20-30 minute technical presentation over Zoom. These presentation sessions will be spread out across two separate days with discipline-specific sessions scheduled for both Thursday, April 29 and Friday, April 30 afternoons (2:00 – 5:00 pm each day). The sessions are open to the general public (via free registration), including statewide pre-collegiate students, and will also include a panel of volunteer judges recruited to evaluate the student presentations and identify high performing teams for awards.

The online presence for the EXPO will also provide an opportunity for remote participants to navigate through the senior design projects. Each project will have a dedicated webpage which will include brief overviews of the project, the student team's poster, and other informational links related to the project. Pre-collegiate participants will also be able to engage in our "Extended experience" opportunities which will include: 1) exploring capstone projects, 2) participation in hands-on activities using pre-recorded walkthrough videos, 3) virtual tours through engineering labs and campus, and 4) meeting students, faculty and alumni through Zoom sessions.

The College of Engineering at the University of Idaho is sincerely grateful to all project sponsors, collaborators, and EXPO sponsors for enabling our capstone design programs to continue to thrive despite the ongoing challenges over the past year. The U of I students and community continue to be strong and resilient during our ongoing pursuit of excellence in the classroom and throughout the state of Idaho.

GIVE TO THE MECHANICAL ENGINEERING DEPARTMENT

Support the ME Department, through:

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- Competition team support
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