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ALUMNI SPOTLIGHT: ALEX HAGMULLER
“Ready for liftoff.”

That is the phrase that stuck in my head after I learned that all three of the MIME alumni receiving Oregon Stater Engineering Awards this year work in the aerospace industry — Randall A. Worsech ’83 and Heidi Wolfe ’06 at Boeing, and Jill Lewis ’11 at SpaceX.

In a sense, that phrase is a key part the mission of the School of MIME: to make sure the graduates we send out into the world are ready to lift off—that they have the tools and experience needed to make an impact in their chosen profession and beyond.

In addition to the 150th anniversary of Oregon State University, this year also marks the 20th anniversary of the College of Engineering's Oregon Stater Engineering Awards, which honor alumni and industry partners whose contributions exemplify Oregon State's leadership. As I look back at previous winners of the awards and as I meet more of our alumni, it's clear that the School of MIME is delivering on our mission. I am continually struck by the impact our faculty, students, and alumni are having on Oregon, the nation, and the world.

Yet, our work is never done.

We’re continuing to support the college's strategic plan with initiatives like BELONG (Bridging Engineering and Learning on New Ground), which supports engineering societies and organizations, undergraduate research experiences, online learning, and pathways for transfer students; and with our Strategic Excellence Awards, which provide funding to faculty working to move these goals forward.

I would like to acknowledge all of our alumni and partners who are committed to helping us continue to build a better future. Your support is ensuring that our students are ready to lift off and that they will fly far.

With regards,

Harriet B. Nembhard, Ph.D.
School Head of Mechanical, Industrial, and Manufacturing Engineering
Eric R. Smith Professor of Engineering
Unmanned aerial vehicles (UAVs), commonly called drones, are quickly becoming part of everyday life. In the past few years, as prices have dropped and control systems have become easier to operate, use of small UAVs has extended from government agencies and niche hobbyists to industries like agriculture, insurance, journalism, and more.

Yet, until now, small UAVs have run solely on batteries — limiting their flight time to a matter of minutes. Chris Hagen, associate professor of energy systems engineering at OSU-Cascades, in Bend, set out to change that.

Hagen and his team of researchers have developed a prototype hybrid engine for small UAVs capable of keeping them aloft for extended periods of time. The team’s concept miniaturizes technology that has been proven in larger vehicles, including aircraft.

The prototype, which was supported by funding from the MJ Murdock Commercialization Initiation Program and the OSU Venture Development Fund, combines a small gasoline engine with an electric motor. The engine powers a generator that charges the batteries, which in turn power the electric motors attached to the propellers.

So far, drones with this hybrid system have flown for over an hour without needing to refuel. The goal is to increase flight time even more.

“The UAV industry is growing by leaps and bounds,” said Hagen. “Having a powertrain that extends the range of these vehicles is a great enabler for adoption.”

This new technology could enable a number of applications, such as research and search and rescue. For example, drones that stay aloft longer could allow first responders greater capability to locate and bring

WITH LONGER FLIGHT TIMES, A NEW HYBRID DRONE COULD SAVE LIVES
ABOVE: Former graduate researcher Sean Brown (now at SpaceX) prepares a drone for flight.

essentials to people in need of immediate help in hazardous environments.

In addition to greater endurance, Hagen’s team’s powertrain design makes the drones more effective. With enough power for vertical takeoff and landing, it eliminates the need for a runway and makes it easier to send help as soon as it’s needed.

While he continues to refine the prototype, Hagen is getting the word out about his product. By working with SOAR Oregon, a nonprofit economic development organization dedicated to drone expansion, he plans to connect with established drone businesses and build relationships with first responders. Hagen is also protecting his engine designs with patent applications through Oregon State University’s Office for Commercialization and Corporate Development.

Oregon State has also provided Hagen access to talented, enthusiastic undergraduate and graduate student researchers.

“I have to thank Nancy Squires [senior instructor of mechanical engineering] and the OSU chapter of the American Institute of Aeronautics and Astronautics, which has encouraged both former graduate student Sean Brown (now an associate engineer at SpaceX) and now James Benbrook to join my group and work on UAV technology,” he said.

Hagen wants his drones to go even further. He is currently targeting them for use in other applications, like spotting forest fires and conducting wildlife research. And in the future, he hopes to make hybrid cars drive longer on electricity and develop mini-generators for home use.

BY ASHLEY LOCKE & OWEN PERRY
Helping eagles coexist with wind energy deployment

BY STEVE LUNDEBERG & OWEN PERRY

Above: Two white-tailed sea eagles fly by wind turbines on the island of Smøla in Norway. (Photo: Todd Katzner)
A growing energy source in the U.S., wind power uses towers up to 300 feet tall typically equipped with three blades with wingspans double that of a Boeing 747. At their tips, the blades are moving close to 200 miles per hour.

Wind power is generally regarded as a green energy source, but one key concern about its development is its impact on wildlife like bats and birds – particularly bald and golden eagles, animals protected under federal law.

Researchers from Oregon State University are working to make eagles less likely to collide with turbine blades without affecting turbine operations, thus making wind energy more wildlife friendly.

Last year, the U.S. Department of Energy’s Office of Energy Efficiency and Renewable Energy awarded Roberto Albertani, Boeing Professor of Mechanical Engineering at Oregon State University, a $625,000 grant to develop technology for detecting and deterring approaching eagles and for determining if a blade strike has occurred.

This research is part of the Energy Department’s efforts to enable wind power deployment and ensure coexistence with wildlife by addressing siting and environmental issues.

Albertani’s team is developing a three-part system for protecting the eagles.

“We’re one of the leading teams in the world doing this kind of work,” said Albertani.

The team includes Sinisa Todorovic, associate professor of computer science, Matthew Johnston, assistant professor of electrical and computer engineering, and three Oregon State graduate students, as well two collaborators from the U.S. Geological Survey, biological statistician Manuela Huso and wildlife biologist and eagle expert Todd Katzner. An external advisory board includes wind energy manufacturers and developers.

If successful, Albertani said, the system that he and his colleagues develop will be a major breakthrough in a safer-for-wildlife expansion of wind energy worldwide.

The system features a tower-mounted, computer-connected camera able to determine if an approaching bird is an eagle and whether it’s flying toward the blades. If both those answers are yes, the computer triggers a ground-level deterrent: randomly moving, brightly colored facsimiles of people—designed to play into eagles’ apparent aversion to humans.

“There’s no research available, but hopefully those will deter the eagles and their prey from coming closer to the turbines,” Albertani said. “We want the deterrent to be simple and affordable.”

At the root of each turbine-blade will be vibration sensors able to detect the kind of thump produced by a blade hitting an object. Whenever such a thump is detected, recorded video data from a blade-mounted micro-camera will be examined to determine the cause of the event and the animal species involved. The system will be also able to estimate the blade position at the time of the event, a critically important piece of information for biological studies.

“If we strike a generic bird, sad as that is, it’s not as critical as striking a protected golden eagle, which would potentially cause restrictions to wind farm operations and new construction with big losses in revenue, and, most important, the loss of a member of a protected species,” Albertani said.

Primary field testing is taking place at the National Renewable Energy Laboratory’s National Wind Technology Center in Boulder, Colorado and at the North American Wind Research and Training Center and Community College in Tucumcari, New Mexico. Additional field work with trained and wild eagles is also being done in locations in Oregon including at the High Desert Museum in Bend, Oregon.
PARTNERING TO MAKE TIMBER HARVESTING SAFER

BY OWEN PERRY
Researchers at Oregon State University are partnering with Blount International—a company that manufactures saw chains and other equipment for the forestry, agriculture, and construction industries—to help make timber harvesting safer.

Led by John Parmigiani, associate professor of mechanical engineering, the team aims to understand what happens when saw chains break on large timber harvesters.

Timber harvesters look similar to an excavator you might see on a construction site, but instead of a shovel, they have an extendable boom fitted with a large chainsaw and clamp. From the cab of the harvester, an operator controls the boom to grab a tree at its base and cut it off just three or four inches from the ground.

“In the span of 30 seconds, it can take a 100-foot Douglas Fir from standing to 30 or 40-foot logs that can then be loaded onto a truck and taken away,” says Nathan Frechen, a product design engineer in Blount’s forestry product design group.

Occasionally, the saw can run into a rock or piece of equipment, breaking the chain. When this happens, the broken chain can whip out with enough force that a secondary break may occur, potentially sending a short section of chain through the air at speeds exceeding 300 meters per second if not blocked by protective guarding.

These phenomena are rare, but present the potential for serious injury, and Blount is determined to work towards understanding the factors that can lead to their occurrence, and make improvements wherever possible. To do that, they first need to understand exactly what happens when a chain breaks under these circumstances.

Blount reached out to Oregon State to help them figure that out.

“We wanted to have an automated test that would be able to simulate those incidents and allow Blount to continue developing safer products for sale in the marketplace,” said Parmigiani. “We designed it so that it used the same components—the same bars, the same chains, the same sprockets – that are used in the field and attached to the machine.”

What they made is a remotely-operated chainsaw inside a shipping container along with various instruments and a high-speed camera. The chain is propelled around a bar until it reaches the desired speed, and then a metal pin is driven into it causing it stop suddenly and break, sending a section of chain through the air where it embeds into the thick plastic walls of the container. The instrument and camera capture data that can then be analyzed. Of course no one is inside the test chamber when the test is conducted. The finished test fixture was shipped to Blount in late 2017 and now resides in their Portland facility.

“Will be using [the data collected] to further advance our understanding of the chain-shot phenomenon, then using that to continue developing products,” said Harfst. “We would anticipate that within a couple of years, we will have moved the bar for what constitutes state-of-the-art with these products, which as I said before, is all oriented towards safety.”

“These projects have been great for my research group and for Oregon State,” Parmigiani said. “It’s a way for students to both work on a real-world engineering problem, and really have to take it through to the point it works, but also interacting with the practicing engineers in industry.”
Warm-air blowers that keep patients at a safe
temperature also interfere with operating
room ventilation systems, potentially making
it easier for microbial skin colonizers to cause
infection at surgical sites.

The findings by collaborators at Oregon State
University and the University of California,
Irvine, shed new light on the most common
type of HCA – healthcare-associated infection.

According to the Centers for Disease
Control, about 30 percent of all HCAs
among hospitalized patients are surgical site
infections, or SSIs.

About two patients in 100 will develop an SSI,
with a mortality rate of 3 percent.

When those numbers are multiplied by the
millions of surgeries conducted each year in
U.S. hospitals alone, the result is wide-scale
human suffering and economic loss.

Corresponding author Sourabh Apte, professor
of mechanical engineering, and other
engineering researchers at Oregon State and
UC Irvine conducted high-fidelity simulations
of how thermal plumes from a warming blower
interact with the ventilation system tasked
with minimizing the amount of airborne
bacteria in an operating room.

Apte and his team specifically looked at the
dispersion of squames that each person
sloughs off at the rate of about 10 million per
day. Squames are tiny, disc-shaped flakes of
skin, about 4 to 20 microns in diameter and 3
to 5 microns in thickness and with the density
of water.

“In an operating room, everyone is wearing
gloves, masks and hats, but they’re still
shedding skin cells,” Apte said.

The squames are problematic because
of microbial skin colonizers such as
Staphylococcus aureus; when squames and
the bacteria that live on them get into surgical
sites, infection can be the result.

“An ultra-clean ventilation system constantly
delivers highly filtered air with a uniform
downward velocity, and its performance
depends on volumetric air flow and proper
temperature gradients,” Apte said. “Medical
equipment in the OR, and the surgical staff, can
disrupt the air flow in ways that increase the
amount of bacterial colony-forming units, and
so do the rising plumes of hot air from forced-
air warming devices that prevent patient
hypothermia.”

Researchers performed a high-fidelity, large-
eddy simulation to predict the flow field in
an operating room in which a patient was
undergoing knee surgery. The simulation
tracked 3 million squames and assumed a best-
case, and very unlikely, scenario of all of the
squames starting out on the floor.
“This numerical approach is fully three-dimensional and time-dependent and accounts for the effects of turbulence and heat transfer on the dispersion of squames,” Apte said. “The approach is fully predictive and captures the turbulent flow accurately without requiring any tunable parameters. This is the first study of its kind where large-eddy simulation was used to investigate dispersion of squame particles in an operating room.”

The results, published in the International Journal for Numerical Methods in Biomedical Engineering, show that with the blower off, the ventilation system quickly moves the squames toward exit grilles.

“But with the hot-air blower on, rising thermal plumes drag the squames above the operating table and side tables, where they’re advected downward toward the surgical site by the ventilation air entering from the ceiling,” Apte said. “We modeled the actual trajectory of each of 3 million squames.”

All of the calculations were performed on a parallel computer and used 1,600 processors. The overall calculation required more than 2 million central processing unit hours. Calculating the flow field with the hot-air blower and the trajectory of 3 million squames for about 25 seconds of physical time required about 200 hours of dedicated parallel computing.

Such predictive simulations of flow in a real operating room were feasible because of the unique computational capabilities developed by the researchers at Oregon State.

“The numerical approach lacks any limitations from a theoretical point of view, but there is a lack of detailed experimental measurements of the 3D velocity field in an operating room during a clinical trial,” Apte said. “Such data would help validate the numerical predictions. According to experts in fluid flow measurements, gathering such detailed data during a clinical trial is potentially feasible but may cost up to $2 million.”
An update on Strategic Excellence Awards

In 2016, the School of MIME launched a set of Strategic Excellence Awards in support of the College of Engineering’s four strategic goals:

- Become a recognized model as an inclusive and collaborative community.
- Provide a transformational educational experience that produces graduates who drive change throughout their lives.
- Lead research and innovation to drive breakthroughs that change the world.
- Establish the College of Engineering as the partner of choice for industry, government, and academia.

These awards, made possible through gifts from alumni and other supporters to the MIME Excellence Fund, provide faculty with grants to move these goals forward and create a better future.

In a little over a year, we have already seen tremendous impact. Here is a snapshot of just some of what recent awards have enabled:

A team of students along with Senior Instructor Nancy Squires was able to participate in A Rocket Launch for International Student Satellites (ARLISS) in the Black Rock Desert in Nevada. The team also had a chance to launch their high altitude rocket at the event. It reached an Oregon State record altitude of 80,000 feet!

David Porter, professor of industrial engineering, and Hector Vergara, assistant professor of industrial engineering, acquired and installed new light-directed systems, which are designed to improve accuracy, speed, and efficiency in manufacturing processes.
Julie Tucker, assistant professor of mechanical engineering, and Melissa Santala, assistant professor of materials science, updated and modernized the Materials Science Metallography lab, enhancing students’ research capacities.

Nordica MacCarty, assistant professor of mechanical engineering, along with Shaozheng Zhang, assistant professor of anthropology, and MIME graduate student Jennifer Ventrella (pictured) conducted pilot testing in Uganda and Honduras of 100 sensors for their research on cookstoves used in the developing world.

MacCarty and Somayeh Pasebani, assistant professor of advanced manufacturing, were also able to initiate accelerated lifecycle testing of novel coatings and materials for combustion chambers of cookstoves, which will push this vital research forward.

Many of our students are benefiting from newly purchased state-of-the-art pieces of equipment, including an ORLAS CREATOR metal 3D printing system, a desktop PCB printer for rapid prototyping, a smart grinding testbed for clean energy manufacturing research, and an Autometrix Advantage Ply Cutter. These tools will help advance research and provide students with hands-on experience with the latest technology.
Delphine LeBrun Colon, a senior in mechanical engineering, has been accepted into NASA’s prestigious Pathways Program.

The Pathways Programs were established in 2010 to provide clear paths to federal employment for students and recent graduates. After completing her degree at Oregon State University, Delphine will join NASA as a full-time rocket scientist.

Born in France but making her way (by way of eight years in New York City) to the Pacific Northwest to study ecological engineering, Delphine transferred to Oregon State in the spring of 2017 from Linn-Benton Community College, where she had been enrolled in the LBCC/OSU Degree Partnership Program. While at LBCC, Delphine participated in the Space Exploration Club, which ultimately changed her career direction from ecological engineering to mechanical engineering with a minor in aerospace engineering.

“Experiencing a rocket launch sparked something in me. I knew I wanted to work in aerospace,” she said. Delphine wasted no time engaging in leadership and research opportunities at Oregon State. In the spring of 2017, she became the vice president of the American Institute of Aeronautics and Astronautics chapter at OSU. That fall, she helped lead a team of Oregon State and LBCC students to launch a high-altitude balloon to view the solar eclipse from almost 20 miles above Earth. Delphine also led a team of senior engineering students, mentored by Nancy Squires, senior instructor of mechanical engineering, and sponsored by Oregon Space Grant Consortium and NASA’s RockSat-C program. Their team designed, built, and tested a gamma ray polarimeter utilizing Compton scattering to detect the polarization of gamma radiation.

“Delphine is an amazing leader,” said Squires. “She is passionate about aerospace, and I am confident she will make great contributions in her academic program and beyond.”

Delphine previously interned at Marshall Space Flight Center in Huntsville, Alabama, along with four other Oregon State students, as one of 200 interns from across the nation, selected from a pool of over 10,000 students. There she assisted with data assessment of the RS-25 engine. Four RS-25 engines will power the core stage of the world’s most powerful rocket, NASA’s Space Launch System.

Delphine currently works as a research assistant for graduate students at the Propulsion Lab, working on sub-atmospheric and dilution testing of jet fuel flames and has begun her own research on radiation emissions as part of her Honors College thesis. She is a recipient of the Furman Class of 1964 Scholarship and the Mimi Shawe Scholarship.
Beaver Overdrive kicks into gear

BY OWEN PERRY

This past fall, Joshua Gess, assistant professor of mechanical engineering, and a group of his graduate students started Beaver Overdrive, a competitive computer overclocking team.

Overclocking a computer, or pushing its processor past the manufacturer’s designed limits to achieve greater performance, introduces many challenges that cover various engineering disciplines. This problem has brought students from various fields together to tackle a real-world problem with hands-on experience.

“I’ve always wanted an interdisciplinary competition that highlighted extreme thermal management,” said Gess. “High-performance computer overclocking is the perfect marriage between electrical, computer science, and thermal engineering.”

The students on the team are learning fundamental thermodynamic principles years before they would typically see them in their coursework. In addition, Gess adds, “Industry partners love that we are preparing our students for more impactful experiences at their internships.”

So far, Beaver Overdrive has competed in two HWBOT Rookie Rumbles. HWBOT is the world’s recognized leader for holding overclocking competitions. The competition includes a number of tests of how fast and efficiently the team’s system can perform calculations such as pi to one billion digits.

In its first competition, Beaver Overdrive placed 10th out of 465 worldwide competitors. In its most recent bout, the team placed fourth.

“I am so excited to see where this goes, especially when we start beating other universities,” said Gess. “Since we are the first, we will have the leg up, but we know the competition will be fierce once other universities figure out what we have going on here at Oregon State University.”

Special thanks to Intel, IEEE, and Facebook for their support getting this group off the ground.
Alumni spotlight:
Alex Hagmüller ’09, Co-founder, AquaHarmonics

Where did your interest in wave energy come from?
Growing up in the small fishing town of Cordova, Alaska, I spent my summers working aboard commercial fishing boats. You get to experience firsthand how quickly things can change, from flat calm to absolute terror. There is nothing forgiving about the immense power of the ocean. While at OSU, I took a class with Dr. Annette VonJouann, who was working on a wave energy converter that used a linear permanent magnet generator. She took us on a tour of her lab and was really excited to show the work being done on their linear test bed. I think these experiences formed the basis for my interest.

How did the School of MIME prepare you?
Formula SAE taught me invaluable skills in team-building, manufacturing, and practical design. Dr. Robert Paasch was a fantastic advisor and really allowed us to explore our interests, while still stressing the importance of function.

In addition, I attribute a lot of learning the rigors of numerical analysis to Dr. Nancy Squires. I did not find her class to be easy, but I did find it extremely fascinating. I was learning mathematics from a talented engineer who had seen it all. Dr. Squires was always available, always cheerful, never assuming, and humbling beyond words. It did not matter to her where your level of understanding was, she would efficiently give you the path to build your understanding.

In fact, just a few weeks ago we were developing a new numerical model in Matlab for our Wave Energy Converter. The problem needed to be transferred from time domain equations to frequency domain. After a bit of digging, I found the Fourier Transform notes that Dr. Squires had put together. There were the best and cleanest explanations and derivations I had ever come across, and completely relevant to the task at hand! (Thanks again, Dr. Squires!)

What is your best memory from your time at OSU?
Participating on the Formula SAE team, you are confronted with the incredible amount of work and skill required to build a successful race car, which can take its toll on a student. Balancing the team project, work and school was challenging, and often it felt like you are doing all these things but none of them very well. That is a difficult thing to work through, and you really have to refine what success means for you, and what your priorities are. You eventually come to the conclusion that you can only do so much; you only have so much time, so much focus. It causes you to organize in a different way from everyone else and be responsible for what you are delivering in a different way. That being said, there is nothing easy about this process, and it can result in a lot of stress and despair at times. In these darkest of moments is when the silliness reigns supreme; you remember the power of goofing off and how productive and emancipating that can be. One spends so much time and effort on these very rigorous, disciplined subjects, and everything becomes so serious. It’s in these moments you really find that connection with your team, and this can result in much ridiculousness.
MIME BY THE NUMBERS (2016-17)

1,700 undergraduate students
340 graduate students
6 areas of research excellence
18 engineering-focused student organizations
$3 million scholarships received
>$113,000 annual fellowships
9,700 alumni

55 tenured/tenure-track faculty
14 NSF CAREER and ONR Young Investigator awards
$14.1 million research expenditures
$19.6 million research funding
133 inventions in 10 years
29 patents issued in 10 years