



Department Overview

As of this Fall semester, total enrollment in the Biological Systems Engineering Dept. is 265 students, with the following breakdown in specializations:

Specialization	Students
Food and Bioprocess	44
Machinery Systems	67
Natural Resources	50
General Program	73
Graduate Program	31

Featured Articles:

- Updates from ASABE and Quarter Scale Tractor Team
- Farm Safety and Health Week
- Drones and Wisconsin agriculture
- Advancing agricultural and public health
- The career of BSE's David Bohnhoff
- And more!

Fall 2018 Newsletter

News from the Department Chair – Troy Runge



Welcome to the Biological Systems Engineering Fall 2018 Newsletter from Madison, WI. The leaves have turned color, students have exchanged their t-shirts for fleeces, and the weather has become decidedly cooler. Along with these seasonal changes, our department has been undergoing some changes as well.

One area of change I am excited to share has been in the area of recruitment for several new faculty and staff. Jessica Drewry started in August 2018 as a new faculty associate. She is both teaching several classes to help with instructional needs from our burgeoning student population and is also working with Brian Luck in precision agriculture research. We have also hired Zhou Zhang in our Machinery Systems

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BSE's Scott Sanford Working to Develop Better Practices for Wisconsin Mint Production

As you drive near the West Madison Agricultural Research Station on Mineral Point Road, your nose informs you that you are near the laboratory of Scott Sanford, a UW agricultural engineer. For three years, Sanford has been honing an energy-miser, continuous flow method to remove mint oil from tons of mint plants. Today, extraction occurs by injecting steam through a tub-load of chopped mint, in a two-hour process.



Mint oil – an essential flavoring for gum, toothpaste, mouthwash and tea – is grown by a dozen Wisconsin farmers on about 3,000 acres, usually on lowland, “muck” soils in the south-central part of the state.

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ASABE Update



The UW-Madison student ASABE chapter of enjoyed another active semester. From networking with BSE Alumni to the lawnmower clinic, here's a summary of what's been happening.

- Grace Skarlupka attended the ASABE Annual International Meeting in Detroit, Michigan. Here she was elected to the IPC Executive Board.
- A team of BSE students placed 2nd in the AGCO Design Competition (*more details on page 3*).
- The Student Organization cover various topics during their monthly meetings. For example, representatives from Ardent Mills, BSE Alumni Kelsey Parker and Avi Babu shared their employment experiences and other opportunities with Ardent Mills. In addition, current members Parker Williams, Sydney Katuszonek, Victoria Shveytser, Grace Skarlupka, and Simon France discussed their summer internship experiences.
- Members attended the ASABE Wisconsin Section Meeting to discuss the current state of the dairy industry. The UW-Madison chapter was awarded financial support as well.
- In November, the Student Organization held a successful annual lawn mower clinic fundraiser. Many lawn mowers and snow blowers were repaired, while raising money for the organization. ASABE students also organized industry tours to The Little Potato Company and the Forest Products Laboratory.



2018 ASABE Student Officers

President - Kyle Winkler	Public Relations - Jack Jones
Vice President - Claudia Lopez	CALS Representative - Sydney Katuszonek
Treasurer - Jacob Roundy	Social Chair—Greg Fehring
Secretary - Eric Daehn	Engineering Expo Chair - Mitchell Schroepfer
Fundraising - Grace Skarlupka	

Quarter Scale Tractor Team Update

The 2018 UW-Madison Quarter Scale Tractor Team recently placed 15th at the 2017 competition, and we were itching to get back to work to prove ourselves and our ability to produce a competitive, appealing tractor. Meetings began in the summer of 2017 to lay out the ground work and start the 2017-2018 school year strong. The progress we made that summer was quite beneficial to our design process.

In 2018, a rule change to prevent stagnation of design and to encourage innovation was put in place to outlaw the use of continuously variable transmission (CVT). In 2017, our tractor was driven by a CVT. As a result, we used a hydrostatic drive to increase the ease of use for the operator and to use the most relevant technology. We continually pride ourselves on using different and new technology on our tractors, which allows our members to gain valuable experiences for their future careers. We were the only team in the competition to run a hydrostatic transmission. Additionally, we moved from a front only suspension to a fully suspended tractor, being one of few teams to use such a design. The full suspension, while being more challenging to design, would give us a competitive edge in the durability bump course and allow us to stand out as a team.

The ASABE International 1/4 Scale Tractor Student Design Competition this summer ran from May 31-June 4 in Peoria, Illinois. It is five days of fun with moments of frantic building and making speedy repairs as unexpected breaks happen without notice. The best part about the competition is the camaraderie between teams. In between events, you will find members from different teams socializing and mingling. In competition, equipment failure is almost inevitable; a harsh reality of engineering. Despite the beating your tractor takes, other teams' generosity is a resource. They will assist with tools, parts, and even lend extra hands to speed up repairs for the tractor. This year, our team's steering system came apart during the maneuverability competition. Not one, but unexpectedly two ball joints had broken. However, after a couple quick welds, we were back up and running. After the competition, due to some competitive banter between us and another team, we hooked our tractors together and had a "pull off" (after getting the OK from competition organizers, of course). While a clear winner was uncertain, we were proud that we were able to develop such a quality machine and enjoyed the competition's camaraderie.

A key part of the competition is the oral presentation and report, which includes a comprehensive breakdown of the tractor's parts for the intended industry and customers. The presentations are given at Caterpillar Headquarters in front of a panel of engineers from companies such as John Deere, CAT, and Case-New Holland. The panel listens and asks questions about the tractor and the report, referring to the design and testing. Testing is helpful because it shows that the design is suited for the circumstances. Our best speakers and top designers took the stage to discuss the manufacturability, safety, ergonomics, serviceability, and other design aspects of our tractor that were best suited to an orchard farmer's needs, which was our target customer this past year. Our presentation team pointed out that the full suspension was perfect for uneven

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CALS Department Scholarships

Don S. Montgomery Scholarship

Taylor Iverson
Tony Hildebrandt

Wisconsin BSE Scholarship

Angela Brandl
Aidan Moore
Kathy Liu
Sean Thiboldeaux

Dick J. & Grace B. Stith Scholarship

Anson Liow
Jacob Kirsch Tornell

Ham Bruhn BSE Scholarship

Alan Meza
Hannah Lois
Chase Covey
Daniel Johnstone
Margaret Meyer

Gail Edwin & Janice Faye Janssen BSE Fund

Nicholas Tennessen

John Deere Scholarship

Laura Rodriguez Alvarez

Orrin I. Berge Scholarship

Rafe Shohet

Ervin W. Schroeder BSE Scholarship

Rachel Steiner
Mitchell Schroepfer

Robert H. & Willa Meier Scholarship

Lee Hermus
Baylor Haen
Arabelle Force

Roger W. Ambrose Scholarship

Nichole Truby

Wisconsin Agricultural Engineer Scholarship

Victoria Shveytser
Sydney Katuszonek
Jack Rickelman

Krutz Scholarship

Gus Quade

Ervin W. Schroeder BSE Scholarship

Rachel Steiner
Mitchell Schroepfer

Lynndon & Norma Brooks Scholarship

Caleb Fitzgerald
Tanner Wears
David Barrett

BSE Student Awards

UW BSE Students Place 2nd at National ASABE Competition

UW BSE students James Dodge, Yash Mirchandani, Javier Castro, Zachary Wilson, and Jason Ha recently placed 2nd at the 2018 AGCO National Student Competition. The competition allows undergraduate students across the country to engage in the design of an engineering project to benefit agriculture, and competed against universities like North Carolina State and Oklahoma State. UW's team successfully designed a Prestressed Concrete Post Fabrication System. Congratulations to our Badgers!

Congratulations to all scholarship and award recipients!

Faculty Update

National Farm Safety & Health Week Provides Opportunities for Education

The National Farm Safety and Health Week, Sept. 16-22, was the week dedicated to different topics related to agricultural safety. The fall harvest season provides an opportunity to highlight and focus on some of those key safety considerations to help everybody stay safe during harvest.

BSE's Cheryl Skjolaas, who is also a UW-Extension agricultural safety specialist, reports, "there are a lot of different occupational hazards within farming because we cover such a diverse type of agriculture. Especially here in Wisconsin as we will not only be harvesting corn and soybeans, we still have some alfalfa that might be taken as a fourth crop.

"We're going to be having cranberries and potatoes, but with all of that, some of the common factors is that we're using machines, we're using tractors, and we're taking some of those products as feed for livestock. Within each of those systems are different types of risk — from machinery entanglements to falling off equipment to operating that equipment at all times of the day and night because we have weather that we have to deal with."

Skjolaas also provided these safety tips for producers: "The harvest season can be really stressful. Take breaks, give yourself a rest from that equipment that you're operating. Eat well so that your body has that nutrition to keep it going throughout the day. Get good sleep, know to take that break from the day. Also, be sure to spend that time with family. Be sure that you're in the best shape throughout the season."

Over 65 percent of the cases in a research study that reviewed details of more than 1,200 "confined space" deaths and injuries in agriculture from 1964 to 2010 resulted in one or more deaths. (Journal of Agricultural Safety and Health)

Seventy-one percent of the cases were in grain storage facilities. "The analysis suggests that the number of cases is increasing rather dramatically over the last many years, though I would suggest that part of that trend might be attributed to better reporting about these kinds of incidents," said BSE's John Shutske, also Director of the UW Center for Agricultural Safety and Health.

Grain bins, silos, manure pits are all common on-farm confined spaces. When these types of structures are located off farms (in factories, refineries, etc.) confined spaces are tightly regulated with an elaborate set of protocols required to enter them safely.

The National Agricultural Safety Database (NASD) contains detailed, farm-specific information to improve safety in these types of facilities and structures. Documents such as "Grain Bin Entrapment" can be used as training information for farm workers and family members.

Looking forward, Shutske stated "There is so much to do if we want to make future progress to make farms safer and more healthful places to work."



Agriculture By Air

Right now, cranberry growers who suspect that pests have invaded their crop have two options: hunt around in the beds themselves, examining each individual plant, or spray the entire field and risk wasting costly resources. But agricultural engineers at UW–Madison are trying to change that by experimenting with unmanned aerial vehicles (UAVs), more commonly known as drones, that could take a more comprehensive look at cranberry plants that might be infected. They fitted a UAV with two special cameras that capture temperature and other information. Unhealthy plants exhibit signs of stress that the device can detect, including how leaves reflect light patterns. Healthy plants are key for Wisconsin, which has 21,000 acres of cranberry marshes in 20 counties and grows more than half of all the cranberries in the world. Cranberry country lies east of the Wisconsin River, beginning at the Wisconsin Dells and stretching north.



The ultimate goal for Brian Luck, an Assistant Professor of BSE, and his research team is to use machine-learning technologies, much like facial recognition on Facebook, to predict what exactly is wrong with diseased plants. But for now, the research is in its' primary stages as they collect baseline data in greenhouses and move out to cranberry beds this summer for real-world deployment. However, there are a few hurdles to clear before the practice can be widely implemented. Though UAVs are commercially available, the cost is high. And to fly one for commercial purposes, a farmer must be licensed through the Federal Aviation Administration. Still, researchers say the potential benefits for farmers are exciting. "The more precise data you have on the field, the more precisely you can manage it, which can lead to more efficient and sustainable agriculture," says Jessica Drewry PhD'17, a Postdoctoral Assistant on the project.

Quarter Scale Tractor Team Update, (continued from page 3)

terrain, while the hydraulic system and tight steering provided the necessary maneuverability and control required for precise driving, and the judges were impressed with how our team had prepared. To ensure the designs stay safe for operators and bystanders, we are required to partake in sound testing. This year's tractor featured an aftermarket exhaust by MarshMellow that had fewer baffles. This allowed us to increase horse power and produce a sharper exhaust sound. We received many compliments. Our one and only concern with this system is that it would be too loud and not pass the sound test, but without fail it came in at ~85 decibels. We were really humming along.

The 2019 returning team members voted Ryan Kudek as captain, a 3-year member majoring in Mechanical Engineering with lots of experience in industry through multiple internships. He has a knack for CAD design and is a jack of all trades when it comes to manufacturing. We are happy to have him as our fearless leader for this year and to have the opportunity to be successful in the future. We have also begun meeting weekly this summer to once again hit the ground running once the school year starts. During our first few meetings, we have decided to continue with the hydraulic systems and are looking into differential/skid steering options. While nothing is set in stone, the progress we hope to make this summer will be invaluable.

BSE Professor John Shutske on Front Line in Advancing Agricultural and Public Health

In late 2016, a team led by Dr. Pam Ruegg, then a UW Professor in the Dairy Science Department, BSE's John Shutske (Professor and Extension Specialist, pictured right), Garrett Suen (Professor, Bacteriology), all from CALS, worked with researchers in Veterinary Medicine and the School of Medicine and Public Health to develop an innovative agricultural and public health project proposal to USDA.



The team's successful \$1.2 million project envisioned working as partners with 40 large Wisconsin dairy farms to quantify antibiotic use on farms and to examine the workplace, environmental, and worker health/safety conditions and practices that could lead to human exposure risk to antibiotic resistant pathogens (and the resistance genes from these bacteria).

The team's proposal to USDA's National Institute for Food and Agriculture received positive feedback based on the creative inter-disciplinary approach and reputations of key investigators. The project received funding in 2017. The project involves research and Extension-related components. The team will use epidemiological and observational data to develop educational programs for dairy farm managers, employees and others to reduce risk associated with exposure. The Extension and outreach efforts will be evaluated by measuring changes in the biology, environmental conditions and work practices on farms.

Since the team began its work last summer, Dr. Ruegg left UW-Madison to become the Department Chair in Animal Science at Michigan State. Dr. Ruegg remains the overall project lead and Dr. John Shutske is the principal investigator for the UW subcontract (about \$800,000) since dairy farms in Wisconsin remain the team's focus.

The first part of the project is now complete where the team measured antibiotic usage on 40 farms. Data and reports are being prepared to send to each farm which will help them understand and benchmark antibiotic use relative to peer farm operators. Eventually benchmarked "averages" and other combined statistics will be made available to the broader industry to allow operators to make informed animal health decisions.

In phase two, the team is developing a unique approach to evaluate all potential risk factors that could lead to worker exposures to resistant pathogens and their genes. The project team is adapting techniques first developed in human healthcare at UW-Madison including a model first referenced as "SEIPS" (Systems Engineering Initiative for Patient Safety). The SEIPS model will be tailored to the farm setting and may become a way to better analyze any effort aimed to protect farm worker health. The dairy farm version of SEIPS will look at workplace factors that include workers, tools and technologies, tasks, physical and biological environment, and workplace organizational factors (training, supervision, etc.).

Resulting education and other recommendations will be connected to workplace and animal handling facility layout, health/hygiene practices (like handwashing, uniform laundering), and protective equipment (such as gloves). Ultimately, these findings and the program evaluation information will be used to help dairy farmers throughout the country to minimize the risks associated with the dairy sector's potential role in this important public health concern.

BSE's Scott Sanford Working to Develop Better Practices for Wisconsin Mint Production, (continued from page 1)

Nationally, 82,700 acres of peppermint and spearmint were grown in 2017, mainly in the Northwest.

In Sanford's tests, mint hay is unloaded from a wagon and metered into a 13-foot-long, steam-heated chamber where an 18" auger moves and mixes the hay. At the far end, the steam and oil are condensed, and then, in a separate tank, the oil floats to the top of the water and is drained off. The pleasant, familiar scent of mint is concentrated into a cloying one under a temporary shelter, but to a mint farmer, that is the smell of money.

Then, as Sanford describes his search for a low-energy, continuous extraction process, an auger plugs, and instantly the afternoon program shifts from taking samples and analyzing productivity to disassembling and unplugging the auger, the centerpiece of Sanford's invention.



As UW–Madison BSE student Jack Kotte opens the system and pulls out the jam (pictured on page 1), Sanford says he has shown that oil can be extracted in only five or six minutes, versus a couple of hours for the conventional method. “A second benefit is greater process control,” says Sanford, who has appointments in UW–Madison extension and its department of Biological Systems Engineering. “All the motors are variable speed, so we can control the residence time, feed rate and steam pressure.” Current methods, he says, only control steam pressure and time. “The material sits in a tub as the steam is forced through,” he says, “but if the tub is not loaded evenly, you can get dry pockets, or the steam may exit too quickly through an unwanted escape channel. With the new method, the mint hay is continuously being mixed to ensure good steam contact.” If Sanford can prove that the process will save energy, he says it will be up to private industry to make and sell the equipment. “I’m not trying to invent a product. I’m trying to prove a process.”

News from the Department Chair, (continued from page 1)

area. With her expertise in sensors and machine learning, we are excited for her start date of March 1, 2019. Finally, we are also currently searching for another Machinery Systems faculty which we hope to have start in August 2019. We are excited with the new ideas these individuals will bring to our department, and the support to allow us to continue to grow our program's student population, propel research, and train the next generation of engineers.

Another area of change we have embraced is within the college structure. CALS has undergone an organization redesign for departments with some programs possibly merging. The BSE program, which has been growing substantially will remain as-is, but we are seeking to form stronger collaborations with both the Soil Science and Food Science departments, looking for even more opportunities to share resources on campus and work together on new research and programs.

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BSE Emeritus Professor David R. Bohnhoff Honored by ASABE

The spectacular career of Dave Bohnhoff has yielded a wide array of accomplishments and recognitions through the Biological Systems Engineering department. The recently appointed Emeritus Professor has been honored by the American Society of Agricultural and Biological Engineers (ASABE) for his exceptional leadership and outstanding contributions to research, teaching, and outreach. In addition, he is being recognized for his research in the design, analysis, and construction of post-frame buildings. This research eventually led to the establishment of a post-frame building research program, managed by Bohnhoff.

As a 39-year member of ASABE, Bohnhoff's main contributions lied in multiple Plant, Animal, and Facility Systems Committees. He has been a recipient of an abundance of ASABE awards, ranging from awards in advancing the knowledge of agricultural structures and the environment to upholding and generating ASABE standards.



Along with ASABE, Bohnhoff is a member of the National Frame Building Association's Technical and Research Committee. Here he received two NFBA Bernon C. Perkins Awards, and is honored as a member of the Rural Builder Hall of Fame.

News from the Department Chair, (from page 8)

Our student numbers have also been changing. We completed our last academic year with a record number of degrees granted and have a population of 234 undergraduate and 31 graduate students in our program. Students are enjoying the strong job market and finding employment in a wide variety of industries beyond traditional agriculture and environmental firms.

A final area of change worth noting is in our facilities. Although we are still in the same building, we have continued to improve our teaching spaces with continued investment into our shop, making it not only a great asset for research, but also a place for students to participate in active learning whether it be for design classes or part of open shop times to become confident in using the shop equipment. Many of these improvements have been made possible through your kind donations to our BSE Facilities fund. We have plans for further improvements particularly in creating Student Design Spaces in both of our buildings and need your support to make them a reality. This will allow us to continue to serve our growing student population and modernize for tomorrow's engineering challenges. Please consider a donation to the BSE Facilities fund to make this happen (info on back page).

Coming in Fall of 2019

BSE is currently recruiting for an Assistant Professor - Machinery System Engineering position, with an anticipated start date of August 2019. This tenure track professor will specialize in advanced agricultural machinery systems and automation engineering. In addition to teaching core engineering courses and mentoring students, the successful candidate will be responsible for developing a nationally recognized research program through extramural funding. We are very excited to bring on a new colleague, facilitating BSE's continued growth.

BSE Donors (October 2017 - September 2018)

**To Our Donors, We
Thank You.**

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BSE Thanksgiving

Every year, BSE hosts a Thanksgiving celebration for our students. We all come together to share traditions and build a sense of community. This terrific event is made possible by the continued support of BSE's faculty and staff. Thank you!



Funding Update

Please consider making a contribution to one of the funds listed below:

- Biological Systems Engineering Fund
- Biological Systems Engineering Student Activities Fund
- Biological Systems Engineering Student Scholarship Fund

We sincerely wish to thank our alumni and friends who have generously supported the College of Agricultural and Life Sciences Department of Biological Systems Engineering. Your gifts today are more important than ever as the University faces challenging budget constraints. Gifts made to the Department of Biological Systems Engineering help us with scholarship, facilities improvement, endowed professorship and graduate fellowships, and carry on our tradition as leaders and innovators in the Biological Systems Engineering field.

An invitation to join the prestigious Bascom Hill Society is extended to those who provide support of \$50,000 or more to the department or to a specific project or program of their choice. You can pledge your commitment over a 10-year period, provide for a gift in your will, or give a gift of annuities or appreciated stock. If you have specific questions about giving, please contact Barbara McCarthy at the UW Foundation (Phone: 608-265-5891; Email: barb.mccarthy@supportuw.org).

Department of Biological Systems Engineering Funds

Two options to make a gift:

1. Visit the All Ways Forward campaign website at www.allwaysforward.org
2. Make checks payable to University of Wisconsin Foundation and return this form to:

University of Wisconsin Foundation
US Bank Lockbox
PO Box 78807
Milwaukee, WI 53278-0807

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I/we wish to pledge \$_____ over _____ years. Please remind me of my pledge in _____ (month).
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All Ways Forward will help to shape and ensure UW-Madison's lasting impact. Gifts to this campaign will fund initiatives and programs that will keep UW-Madison the world-class institution it is today. To learn more or make a donation please visit www.allwaysforward.org.
Thank you for your support.

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