ANNUAL REVIEW 2015

BAE BULLETIN

Michigan State University Department of Biosystems and Agricultural Engineering

MSU ADREC AND SOUTH CAMPUS ANAEROBIC DIGESTER REPORTS ACTIVE 2015
Page 9

REDUCING THE RISK OF SALMONELLA IN LOW-MOISTURE FOODS
Page 5

EXPLORING TUBERCULOSIS IN MEXICO
Page 11

PHOSPHORUS: FRIEND OR FOE?
Page 7

SPECIAL EDITION: CLIMATE CHANGE

In this issue...

3 Greetings from the Chair

5 Reducing the risk of Salmonella in low-moisture foods
Marks' multimillion-dollar research project designed to improve food safety

6 Shedding light on new methods for ensuring food quality
Guyer uses next generation technologies, will benefit plant commodities and specialty crops

7 Phosphorus: Friend or Foe?
Safferman's research focuses on win-win scenarios for reducing environmental impacts and preserving resources

8 BAE expertise in water quality and quantity may contribute to state's economic growth
Miller spearheads efforts to increase use of irrigation scheduling tools

9 MSU ADREC and South Campus Anaerobic Digester reports active 2015
Kirk confirms ADREC and SCAD projects continue developing innovative and multidisciplinary approaches to energy research

10 Scaling up algal cultivation for carbon sequestration and value-added chemical and fuel production
Cleaner emissions on the horizon thanks to research efforts by Liu and Liao to produce algae commercially

11 Exploring Tuberculosis in Mexico
Alocilja shares findings for expediting diagnosis of deadly disease in Latin America

12 MSU hosts first annual intensive microbial risk assessment course
Mitchell helps lead innovative 10-day program sponsored by NIH

Editor:
Sara Long
Write Way Creative, LLC
Lansing, Mich.

Design and layout:
Celeste Harned
Celeste Communications
Paducah, Ky.

Copywriting:
Sara Long
Write Way Creative, LLC
Lansing, Mich.

Danielle Heisler
East Lansing, Mich.

FRONT COVER
Top left: BAE Chairperson Darrell Donahue and students pose next to the portable pilot-scale anaerobic digester on display at Cowles House prior to the MSU versus Air Force football game on Sept. 19.
Top right: Testing in the MSU BSL-2 Pilot Plant includes validation of pathogen-reduction processes for nuts and other low-moisture food products.
Bottom left: MSU students learn alongside students in a laboratory at ECOSUR in Mexico about improving tuberculosis research techniques.
Bottom right: MSU students prepare to conduct a nutrient management experiment.

BACK COVER
Students in the Summer 2015 Sustainable Food, Environment and Social Systems Australia study abroad learn about managing water rights, allocations and pumping stations designed to divert Murray-Darling river water back to drained wetlands simulating natural flooding events. Having suffered through an extended drought of almost 10 years, these pumping stations are designed to divert water back to critical ecosystem services.

CLIMATE CHANGE SPECIAL FEATURE

Translating big data to help policy makers improve agricultural systems across the globe is goal of DSI unit at MSU 13

Advances in computer modeling software speeds up the time it takes to conduct climate change research 15

Predicting how to sidestep future climate-related health scares 16

Faculty News 17

Research News 19

Selected Research Portfolio 20

Student News: Ph.D. Profile 21

Undergraduate Profile 22

2015 Senior Design Capstone Projects 23

Student News 27

BAE News 28

Alumni News 29

Campus Happenings 30

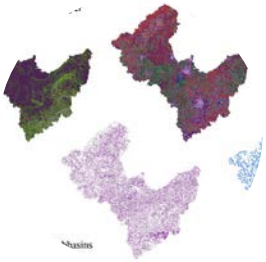
In Memory 30

Degrees Conferred 31

2015-2016 Scholarship Recipients 32

Support BAE 33

Faculty and Staff 34



Since 1906, the Michigan State University (MSU) Department of Biosystems and Agricultural Engineering (BAE) has responded to the changing needs of society by integrating and applying principles of engineering and biology in a systems con¬text. Today, biosystems engineers at MSU solve complex and rapidly chang¬ing problems related to maximizing food quality and safety, preserving ecosys¬tems, protecting health and homeland security, utilizing biomass and developing renewable energy. Articles and information featured in the annual BAE Bulletin newsletter highlight research, teaching and outreach accomplishments achieved during the previous year.

Michigan State University Department of Biosystems and Agricultural Engineering
Dr. Darrell W. Donahue, Chair, 524 S. Shaw Lane, Room 216, East Lansing, MI 48824
(517) 355-4720 (517) 432-2892 (fax) www.egr.msu.edu/bae

Mission statement:

To improve quality of life by integrating and applying principles of engineering and biology to systems involving food, environment, energy and health.

Scholarly foci:

- **Food:** food safety and quality
- **Environment:** sustainable ecosystems and resource conservation
- **Energy:** bioenergy and bioproduct solutions
- **Health:** diagnostics, systems models and risk-assessment tools to enhance public health

Greetings from the Chair

Hello BAE family:

I am now officially the "new guy" in BAE and thankful for the opportunity to lead such a great department as Biosystems and Agricultural Engineering at Michigan State University (MSU). A bit later in this article, I will be sharing some of my background.

At this point, however, I wanted to pay tribute to the outgoing chairperson, Dr. Ajit Srivastava. Take yourselves back to 1977. Some of us were born, maybe others reading this were not, but it was during that fateful year that Dr. Srivastava began his career at Michigan State when the department was under the guidance of Dr. Dennis Heldman. Who knew back then that the mild-mannered Ajit would rise through the ranks to become professor and chairperson and hold that position for 18 years?

Well, there are probably several who did if they watched him closely. Ajit started out as many faculty members do, focusing on teaching and research. But Ajit, keenly aware of his surroundings and knowing how to get things done, started reaching out to Extension and stakeholders alike to test and implement his new ideas and technologies. It was Ajit's affable approach to teaching, research and service that won many folks over all around Michigan, throughout the United States and internationally, all while gaining and providing leadership experience in many areas and for new initiatives and innovations at Michigan State and around the world. Additionally, he has been actively advancing the profession through his work in ASABE, ABET and other organizations, and is continually recognized for his accomplishments. Ajit has been recognized by MSU, nationally and internationally for his leadership in agriculture, engineering, higher education and world food security. Even after 38 years of service to MSU, Ajit will return to the BAE faculty to continue teaching, conducting research and contributing service, the epitome of a faculty member who stands strong on our tripartite land grant mission! For me personally, it has been quite reassuring these first few weeks to see Ajit around Farrall Hall, have him close by to ask questions and provide me with guidance. Thank you, Ajit, for being there for me.

I believe we all agree that Ajit has left his mark on BAE, our students, our profession and the world, so when you have a chance, please send Ajit a note, call him, or stop in to say hello and thank him for the many years of service he has provided our students, our alumni, Michigan State and the profession, all the while making MSU and the world a better place.

Now a bit about Darrell.

Darrell W. Donahue

I grew up on a farm in North Carolina. I attended and obtained all my degrees from North Carolina State University (NCSU), concluding with my doctorate in engineering and mathematics in 1992. I came to Michigan State from Maine Maritime Academy (MMA) where I was most recently Vice-President for Operations and Research Director. Prior to MMA, I was a professor of chemical and biological engineering at the University of Maine (UMaine) for more than 17 years. It was during my time at UMaine that I was introduced to MSU and BAE through a USDA multistate project working with Drs. Dan Guyer and Renfu Lu. In fact, we did some collaborative work early on during that project and I met many of the BAE family during a visit to MSU. Over the years at UMaine, I was a faculty member, department chairperson and associate director of a research institute before going to MMA to initiate their faculty research program and become vice-president.

I am humbled and honored to come to MSU and lead BAE – thank you to the search committee, the Deans and Associate Deans for their support and providing opportunities. Michigan State is at the center of innovation and technology and simply a cool place to be. Some might even say it is at the center of the universe!

I have always been drawn to the land grant mission and its focus on educating the masses to make the world a better place. I was fortunate to get my education at NCSU (another land grant) and never will forget those who helped this old farm boy learn how to apply engineering to make things better. I hope that I can continue to bring that same energy for education that others before me have brought to me, MSU and BAE. Students are the lifeblood of an institution like MSU, and the reason why many of us do what we do. Ajit, the faculty and staff members in BAE have

made this place feel like home to me as I get settled. Our students, friends and alumni are always welcome to stop by, visit and share a memory or two; I love to hear the stories of old times, as well as the new.

Being at the nexus of food, energy and environment provides BAE with many opportunities to learn and grow while providing leadership at MSU. Throughout my first few weeks in BAE, faculty and staff members have come to me discussing a variety of proposals, topics and ideas to continue increasing and showcasing the BAE innovative spirit. In the following pages, you will see examples of that spirit as we review the past year and prepare to move into the future. Please enjoy your browse through the BAE Bulletin, and as you will see, the BAE family has many things of which to be proud. If you have any questions about anything, just give me a holler!

I look forward to seeing and getting to know you. Please stop by Farrall Hall or invite me to visit you so that I can learn about you, your BAE past, present and future.

Thanks for the opportunity to serve,

Darrell W. Donahue

New department chair Dr. Darrell Donahue (left) honors outgoing chair Dr. Ajit Srivastava (right) at a department barbecue held this past fall.

QUICK FACTS

2014-2015 Academic Year

31 *2014-2015 B.S. Biosystems Engineering graduates*

15 *2014-2015 M.S. and Ph.D. graduates*

219 *Fall 2015 undergraduate enrollment*

54% *Fall 2015 female enrollment*

58 *Fall 2015 freshman enrollment*

90 *Fall 2015 BE 101 enrollment*

11 *Fall 2015 BE 101 enrollment*

>$2.1M *Total 2015 Grant Funding*

28 *Students awarded 2014-2015 scholarships*

$58k *Total 2014-2015 scholarships awarded*

38 *Study Abroad Programs (all enrollments) – Winter Break 2015 Ecological Engineering in the Tropics Costa Rica; Summer 2015 Sustainable Food, Environment and Social Systems Australia*

2014-2015 undergraduate placements

- *Archer Daniels Midland*
- *Cargill*
- *ConAgra Foods*
- *Ford Motor Co.*
- *General Mills*
- *General Motors*
- *H.J. Heinz*
- *Johnson & Johnson*
- *Kroger*
- *Leprino Foods*
- *Michigan Department of Environmental Quality*
- *Natural Power*
- *Neogen*
- *Nestle USA*
- *Nestle Waters*
- *PepsiCo*
- *Perrigo*
- *Pittsburgh Glass Works*
- *Pizzo & Associates*
- *United Asset Management*

Reducing the risk of *Salmonella* in low-moisture foods

Marks' multimillion-dollar research project designed to improve food safety

The presence of *Salmonella* in low-moisture foods and ingredients is an emerging and particularly difficult challenge, as evidenced in several recent nationwide outbreaks and/or recalls of food products, including almonds, pistachios, peanut products, hazelnuts, pecans, pet food, cake batter mix, soy products, black pepper and dried hydrolyzed vegetable protein. Because even strictly enforcing rigorous hygiene and sanitation practices is insufficient when it comes to ensuring food product safety, processing interventions are an emerging imperative for reducing the risk of *Salmonella* in low-moisture products. Food Safety Modernization Act (FSMA) Preventive Controls rules implemented by the Food and Drug Administration (FDA) will soon mandate that the food industry implement and validate interventions to prevent or control identified hazards, such as *Salmonella* in low-moisture products. Significant gaps in the knowledge and tools needed to achieve these goals exist, however.

The U.S. Department of Agriculture and Food Research Initiative recently awarded a five-year, $4.7 million grant to Michigan State University (MSU) Department of Biosystems and Agricultural Engineering (BAE) professor Bradley Marks and a team of collaborators (MSU, Washington State University, the University of Nebraska, Illinois Institute of Technology, North Carolina State University and the FDA) to enhance the development, implementation and validation of pathogen-reduction processes to address this challenge. The project objectives are to: (1) develop standardized validation protocols for low-moisture food pasteurization; (2) conduct an extensive battery of inoculated challenge studies with multiple pathogen-reduction technologies; (3) develop improvements of existing thermal processes for enhanced food safety; (4) develop and implement multiple outreach resources (technology comparison tool, workshops, webinars, and a "Validation Center" for long-term industry support via validations and training); and (5) develop online graduate modules in low-moisture food safety, technologies and validation.

Research activities will include inoculated challenge studies in three Biosafety Level-2 pilot plants (including the MSU BSL-2 Pilot Plant) for evaluation of technologies and testing of validation protocols. These unique facilities enable the project team to conduct tests with *Salmonella*-inoculated food products in pilot-scale versions of commercial processing equipment and compare and validate the repeatability of such validation studies across multiple facilities. Technologies being tested include thermal, steam, radio-frequency, gas, extrusion and "legacy" technologies, such as drying, roasting and toasting. Product categories in the study include particulates (e.g., whole grains and intact spices), powders (e.g., wheat flour and spray dried powders), and paste-like products (e.g., nut butters or chocolates).

Testing in the MSU BSL-2 Pilot Plant includes validation of pathogen-reduction processes for nuts and other low-moisture food products.

Additionally, the project entails significant industry engagement, outreach and training. An Industry Advisory Group includes engineering/science professionals representing five equipment companies, three ingredient suppliers, two end-product processors and two industry associations. Multiple workshops, webinars and unique curricula development will specifically target professionals in the area of low-moisture foods. Cross-institutional and -disciplinary graduate learning modules will fill a gap related to low-moisture food safety and technologies. Ultimately, this project will help technology companies, processors and regulators to better evaluate, implement and validate low-moisture food pasteurization processes, thereby enhancing the microbial safety of these types of products.

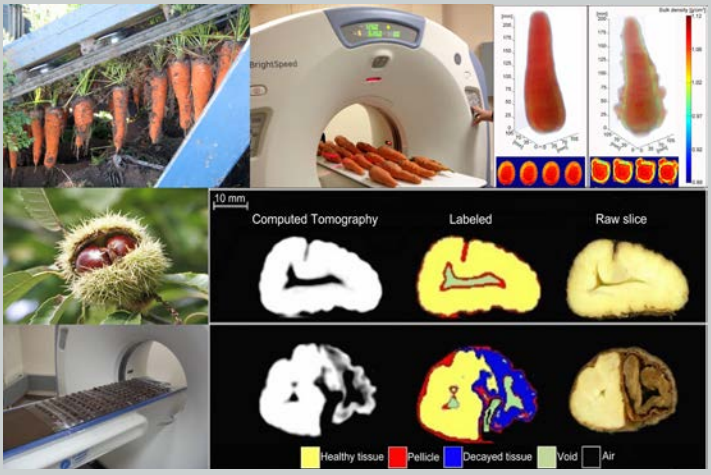
Shedding light on new methods for ensuring food quality

Guyer uses next generation technologies, will benefit plant commodities and specialty crops

Developing and applying new technologies to solve challenges facing the specialty crop industries are motivating factors for Dr. Daniel Guyer, Michigan State University (MSU) professor of biosystems and agricultural engineering (BAE), and his former Ph.D. student and research associate Dr. Irwin Donis-Gonzalez, now a faculty member at University of California-Davis.

A case in point is stretching beyond the capabilities of the many existing commercially available electronic-based sorting systems that for the most part assess surface defects (color, shape and size) of fruits, vegetables and nuts that, if present, can render a crop unusable or unmarketable. The next generation system needs to be able to distinguish undesirable qualities within these crops, internal defects or characteristics otherwise invisible without deploying costly, destructive and time-consuming sampling methods.

Light wavelengths (spectroscopy) passing through or being absorbed or altered as it transmits through or interacts with materials can potentially identify internal variances in an object. Computed tomography (CT), a type of three-dimensional x-ray, however, has the capacity to better resolve both spatially and physically, thus making it easier to detect and classify tissue differences in areas where internal issues are known to develop. Applying these understandings, joint studies between BAE, the Interventional Radiology Service at the MSU Veterinary Medical Center and some national and international collaborative partnerships, have investigated the potential and developed measurement parameters for using CT to non-destructively detect negative quality issues affecting several commodities in the specialty crop industry. To date, these have included detecting cherry pits and fragments, cucumber damage, fibrousness in asparagus, internal kernel breakdown in chestnuts, and the translucency of pineapples (so we ventured outside of Michigan crops!). More recently, CT was used to detect woody fibrousness in processing carrots – a significant specialty crop in Michigan, worth an estimated $7.7 million annually – which causes both a food safety hazard as well as an undesirable flavor and texture.



Future sorting technology may rely on computed tomography to quickly and consistently identify internal blemishes and other quality problems postharvest for specialty crops.

Researchers looked at the whole carrot before dicing it into smaller pieces to try to determine which plant tissues were the source of the problem and potentially increase sorting effectiveness. As evidenced in the in the upper right portion of the accompanying graphic, the CT measurements indicate differences in tissue density between the healthy and affected carrots. The resulting image can be automatically analyzed according to a computer algorithm to sort out the desirable and undesirable carrots. Similar examples noting tissue decay in chestnuts appear in the lower right-hand section of the same graphic.

Evidence generated through this study, together with advances in computing power and generating faster results using the less expensive CT hardware, hint that it may be the next generation of sorting technology to help optimize the economic sustainability of specialty crops by consistently identifying blemished produce.

Faculty

Phosphorus: Friend or Foe?

Safferman's research focuses on win-win scenarios for reducing environmental impacts and preserving resources

Students preparing for an experiment entailing nutrient management.

The environmental impacts resulting from the excretion of microcystins by blue-green algae (cyanobacteria) has been documented and publicized. These toxins can affect the health of both humans and animals, contaminate drinking water, and prevent people from enjoying recreational activities. Though excess cyanobacteria growth is caused in part by runoff from agricultural and municipal sources, phosphorus is essential for life and producing food. Only a few countries have phosphate rock that can be economically mined to produce fertilizers, and the estimated world reserves are less than 100 years. The price of phosphorus has logarithmically increased over the last several decades and its short-term price is extremely volatile.

Reducing phosphorus loss in agricultural applications and recovering it from wastes offers a "win–win" scenario: environmental impacts may be reduced and a scarce resource preserved. Researchers in the Michigan State University Department of Biosystems and Agricultural Engineering are conducting studies on both.

A recent research program funded by the Michigan Alliance for Animal Agriculture is focusing on the fate of phosphorus and other nutrients from animal manure applied to crops. Using animal manure to fertilize crops is an efficient way to reuse phosphorus; however, questions exist regarding the best application practices for maximizing its value while minimizing environmental impacts. The complexity of phosphorus makes finding answers to these questions challenging.

Phosphorus is found in both particulate and soluble forms. Traditional conservation practices that minimize erosion and runoff, such as no-till and cover crops, greatly reduce the transport of particulate phosphorus. However, these same practices may not minimize the transport of soluble phosphorus through the macro pores in the soil and into tile drains. Add to this the complexity of soil freeze and thaw cycles, the diversity of soil and farm management practices in Michigan, and the best site-specific management strategies become even more elusive. Recently initiated research is focusing on the fate of nutrients under varying, realistic Michigan scenarios to ultimately provide farmers with guidance on the best manure application practices for their farm-specific conditions.

Research efforts also entail recovering and concentrating phosphorus directly from manure and municipal wastewater. Converting such wastes into clean water and concentrated phosphorus and other nutrients provides the ultimate environmental protection and flexible reuse of valuable constituents. For phosphorus, the concept seems simple – precipitate out soluble phosphorus and then separate these precipitants and particulate forms from the bulk water. In practice, engineering practical and economical recovery systems is challenging. Research has emphasized using columns with nano-enhanced iron media so the soluble phosphorus becomes immobilized when it precipitates from the water onto the media. The phosphorus is recovered and concentrated from the media by reversing the chemistry using a caustic solution. To remove particulate phosphorus from waste slurries, researchers are investigating the effectiveness and developing design and operational criteria for ceramic, tubular ultrafiltration membranes. Substantial advancements in membrane technologies are proving to be effective and efficient for use in recovering phosphorus and clean water.

The challenges of maintaining surface water quality also encourages opportunities to find novel, sustainable solutions. The wastes that are causing the impact are also our raw materials, essential for life.

BAE expertise in water quality and quantity may contribute to state's economic growth

Miller spearheads efforts to increase use of irrigation scheduling tools

Michigan's food and agriculture sectors account for approximately $91.4 billion in direct, indirect and induced economic activity[1], and Governor Snyder has identified agriculture as a priority area for continued growth. Water is critical for agriculture and, in contrast to many places around the country and throughout the world, annual Michigan rainfall amounts adequately support the state's crop and food processing industry's needs.

Irrigation is used in some areas of Michigan to meet water demands during critical parts of the growing season to avoid yield losses and on coarse-textured soils to produce high-value specialty crops, including seed corn and vegetables. A recent study on southwest Michigan's agricultural industries estimated irrigation's economic impact at $500 million each for blueberries and ornamentals and $1 billion each for seed corn and vegetables.

Water use by all industries, including agriculture, needs to be balanced with the needs of entire communities, including stream ecosystems. Laws passed in 2006 were designed to prevent excessive water use from altering the fish populations of these ecosystems.

The Michigan State University (MSU) Department of Biosystems and Agricultural Engineering (BAE) has built a respected history of irrigation management research and outreach. Professor Emeritus Ted Loudon led numerous efforts for effective irrigation water and energy use in cohort with his students working on water issues throughout the world. Associate Professor A. Pouyan Nejadhashemi is an experienced irrigation engineer with expertise in modeling irrigation water demand and relating how that demand may change because of climate change. New BAE hires, including assistant professors Amor Ines and Jade Mitchell, expand this expertise. Dr. Ines has experience with irrigation management and expertise in water resources systems analyses, remote sensing, soil hydrology and crop modeling. Dr. Mitchell touts expertise in a number of areas, including risk, perception, analysis and management and benefit cost analysis and decision support systems. Dr. Mitchell led an MSU team working with five other states on a $10 million USDA Agriculture and Food Research Initiative (AFRI) grant to improve irrigation management.

MSU Extension irrigation specialist and BAE faculty member Steve Miller works with irrigators to produce the most crop yield per amount of water used by minimizing runoff and overuse of water and nutrient loss below the root zone. Working with Enviroweather staff members and MSU Extension irrigation educator Lyndon Kelley, he has lead education efforts to increase the use of irrigation scheduling tools. Miller has completed extensive training on Michigan Water Law and provided technical support to policy groups exploring ways to improve implementation of the laws and farmers trying to understand what is expected of them by the legislation. BAE students have been actively involved in installing soil moisture sensors, data loggers, remote access to data and analyzing the extensive data from on-farm research plots, and assisting with extracting practical information that can we used in training programs.

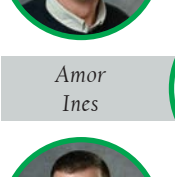
The state's rich water resources make the state attractive for economic development, and BAE expertise in water quantity and quality management will help to support that growth while protecting the resources that are so important to quality of life in Michigan.

[1] *Report generated by the Michigan State University Product Center (2012)*

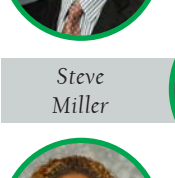
Faculty


Evangelyn Alocilja


Tim Harrigan


Amor Ines

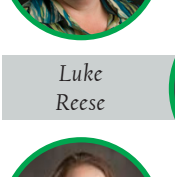

Dana Kirk


Steve Miller

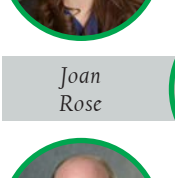

Jade Mitchell


Pouyan Nejadhashemi


Wendy Powers


Luke Reese


Dawn Reinhold


Joan Rose


Steve Safferman

MSU ADREC and South Campus Anaerobic Digester reports active 2015

Kirk confirms ADREC and SCAD projects continue developing innovative and multidisciplinary approaches to energy research

New portable, pilot-scale anaerobic digester designed for small- to mid-sized dairy farms displayed at tailgate event

Brandon Handy, a student employee at the Anaerobic Digestion Research and Education Center (ADREC) designed and constructed a portable, pilot-scale, two-stage anaerobic digester with support from faculty members and Michigan-based small business Quantalux, Inc. Funding for the work was provided by Quantalux through a USDA Phase II Small Business Innovation Research (SBIR) program grant and the Michigan Economic Development Commission (MEDC) Small Business Innovation Program.

The energy-efficient design readily accepts various feedstocks for digestion, and the pilot-size system can be scaled up from its current size (five to seven cows) to deliver a turnkey anaerobic digester for small to mid-sized dairy farms (100- to 300-head herds). The new system was featured at the Cowles House Tailgate held prior to the MSU versus Air Force football game on Sept. 19.

SCAD faced with problems related to thermodynamics and garbage, results in repairs and new processes

After enjoying a productive and uneventful first six months of 2015, the South Campus Anaerobic Digester (SCAD) struggled with a couple of major challenges: thermodynamics and garbage!

In late June, the engine generator suffered a major (and premature) failure with a cracked cylinder head. Repairs were made quickly and electricity production resumed, only to have the same issue reoccur after a few days of operation. It turned out the cylinder heads were designed to operate on the European standard of 50 Hz and at a lower speed compared to North American operations. Repairs were made and the engine generator has been running better than ever since the end of July.

The second challenge has been inorganic material. Garbage comes in many shapes and sizes ranging from stones to hammers to shirts, shovels and food service packaging – all of which do not contribute to producing biogas and wreaks havoc on pumps and pipes. Time was spent re-educating feedstock suppliers about keeping the organic waste "clean" and redesigning the process by which feedstocks are collected, mixed and pumped into the digester. By Nov. 1, the updates should be installed and the digester operating again at full capacity. Louis Faivor, the digester operator, and his team of students need to be acknowledged for keeping the system going through all the challenges thrown their way over the past months.

A portable pilot-scale anaerobic di¬gester demonstration unit was displayed at Cowles House during the Sept. 19 MSU versus Air Force football game tailgate.

Work continues in Detroit to establish first anaerobic digester at zoo in North America

MSU ADREC researchers and staff members have been working with the Detroit Zoological Society (Zoo) over the past year to engineer the first dry anaerobic digester system at a zoo in North America. Citizens of the City of Huntington Woods and Zoo neighbors have learned about the anaerobic digestion process and how the system can be operated safely with no impact on the surrounding community. Additional efforts include working with Zoo administrators to determine how best ADREC can support startup, operations and community outreach activities.

Scaling up algal cultivation for carbon sequestration and value-added chemical and fuel production

Cleaner emissions on the horizon thanks to research efforts by Liu and Liao to produce algae commercially

Carbon dioxide (CO2) contributes up to 26 percent to the global greenhouse effect, and developing technologies to fix and utilize CO2 to reduce the impact of greenhouse gas emissions on climate change has attracted increasing attention. Microalgae have been considered one of the most promising biological CO2 utilization systems because of their high photosynthetic efficiency, fast growth, carbon-concentrating mechanism, and accumulation of high-energy-content cell components (lipids and carbohydrates). However, massive cultivation of microalgae for CO2 sequestration and value-added chemical and fuel production is still not a reality. Water demand, light efficiency, strain stability, land requirements, energy input, and the high cost of processing algal biomass are the main barriers hindering commercial applications of algal cultivation.

Drs. Yan "Susie" Liu and Wei Liao in the Michigan State University (MSU) Department of Biosystems and Agricultural Engineering (BAE) have been teaming up with a California-based algal company, PHYCO2 L.L.C., and the MSU T.B. Simon Power Plant to carry out a pilot-scale algal cultivation project on power plant flue gas. The project goal is to develop new scalable algal cultivation technologies for cost-effectively growing algae to sequester CO2 and produce value-added chemicals. Two Algae Photo Bioreactor (APB) systems are being constructed at the MSU Power Plant using PHYCO2's patented reactor that absorbs the CO2 from a slip stream of the boiler exhaust and allows high light transmission efficiency to promote algae growth. A robust algal strain screened and selected in Dr. Liu's lab that has capability to efficiently convert CO2 into value-added lipid and protein products is used as the strain for the system.

"With the strong industry-university collaboration, the integration of the patented PHYCO2's reactor and MSU-selected algal strain could lead soon to a commercially available solution for sequestering CO2 and producing high-value chemicals," Liu said. "Co-locating the APB with the power plant allows the process to utilize waste heat from the power plant to dry and process the produced algae to further improve the energy balance."

Combining scalable algal cultivation and robust algal strain will address the issues plaguing commercializing algal cultivation.

"We are confident that this partnership between MSU and PHYCO2 will address the global warming challenge issued by the White House," said PHYCO2 Chief Executive Officer Bill Clary. "The unique algal cultivation system developed by the team represents the future of cleaner emissions and the first CO2 capture technology that truly is market sustainable."

Besides sequestering CO2 and producing value-added chemicals, algae are good at taking up nutrients such as phosphorus and nitrogen. The algal cultivation system could possibly be used to remove nutrients and reclaim water from animal-generated and municipal wastewaters.

Faculty

Exploring Tuberculosis in Mexico

Alocilja shares findings for expediting diagnosis of deadly disease in Latin America

Dr. Evangelyn Alocilja and Michigan State University (MSU) students Nate Murray, Kasey Pryg and John Shinners (pictured at right) traveled to an international conference in San Crístobal de las Casas, in Chiapas, Mexico, to present their research concerning the diagnosis of tuberculosis using functionalized magnetic nanoparticles and handheld detection methods and demonstrated their technology's ability to detect Mycobaterium tuberculosis successfully. Travels were funded courtesy of the MSU Nano-Biosensors Laboratory, Honors College, Lyman Briggs College, MSU Department of Biosystems and Agricultural Engineering, and the Undergraduate Student Travel Support Office.

Left: Pictured from left to right are: Dr. Evangelyn Alocilja, John Shinners, Nate Murray, Kasey Pryg and Emily Holley.

Laboratory Testing

Our lab at Michigan State has been coordinating with a lab at El Colegio de la Frontera Sur (ECOSUR) in Chiapas to incorporate our magnetic nanoparticle technology into actual M. tuberculosis diagnostics. While in Mexico, the group spent its final day working in ECOSUR laboratory facilities to learn their techniques to improve research at home and aid in incorporating MSU diagnostic methods into their current standard diagnostic practices.

Left: Students merging technologies in the laboratory. Pictured from left to right are: Nate Murray, two ECOSUR students, Kasey Pryg and John Shinners.

GRAAL Conference

Dr. Evangelyn Alocilja and MSU students Nate Murray, Kasey Pryg and John Shinners presented their research on "Improving Tuberculosis Diagnosis Using Smear Microscopy" at the VI Encuentro de la Red de Grupos de Investigación en Salud para América y África Latinas (GRAAL) conference. including 8 other countries from Latin and Central America. This conference took place at ECOSUR and included participants from eight other Latin and Central American countries. Attendees learned about the diagnosis of tuberculosis, difficulties in treatment, its comorbidities, and plans for its eradication.

MSU hosts first annual intensive microbial risk assessment course

Mitchell helps lead innovative 10-day program sponsored by NIH

The first annual Quantitative Microbial Risk Assessment Interdisciplinary Instructional Institute (QMRA III) was held this past summer at Michigan State University (MSU). The 10-day hands-on intensive microbial risk assessment course was led by co-program directors Drs. Jade Mitchell, of MSU, and Mark H. Weir, of Temple University, and sponsored by the National Institute of Health (NIH). A cohort of 32 participants, consisting of graduate students, postdoctoral fellows and early career professionals with backgrounds in quantitative science, biology and social science from several national and international universities and government agencies, attended the institute.

QMRA III participants learned the underlying concepts for using scientific data to perform a risk assessment for assuring safety and health goals by attending a series of lectures and practical exercises. Courses were instructed by top scientists in the QMRA field from the following institutions: MSU, the University of Michigan, University of Arizona, Drexel University, North Carolina A & T State University, Delft University of Technology, the University of Washington, the Army Institute of Public Health, Temple University and the University of Alberta.

An integral part of the program consisted of the development of novel research case studies, which were used as an instrument for problem-based learning. Participants were organized into multidisciplinary teams and assigned faculty mentors with expertise in QMRA to conduct the QMRA research case studies. This year the topics included some important but poorly understood risks related to water, food, and person-to-person exposures. Specifi¬cally, the teams worked on: (1) Norovirus risk from ingestion of shellfish after water contamination events; (2) the risk of ex¬posure to *Salmonella* from consumption of Paneer in India, where original data was contributed by an international partner; (3) the first application of QMRA to understand the highly infection transmission of measles based on a recent outbreak at a theme park; (4) risk-based guidelines for the unrestricted reuse of greywater and/or wastewater on U.S. military bases as part of the Army's Net Zero sustainability initiative; and (5) quantifying the risk to hospital staff and visitor during the 2015 outbreak of Middle East Respiratory Syndrome (MERS).

Each team produced a case study report and presented their findings to the full group at the end of the course. While the case studies enabled team members to gain hands-on experience using a host of risk assessment software and other tools such as the QMRAwiki (http://qmrawiki.canr.msu.edu), the research case studies contribute to the scientific understating of risks posed by these hazards and several groups will pursue publication of their results. Additionally, a synopsis of the case study reports and presentations will be located on the QMRA wiki.

Dr. Jade Mitchell

QMRA III received positive reviews from both participants and faculty members. In addition to providing a forum to increase participant engagement and participation in the QMRA community and build interdisciplinary collaborations, the majority of participants believed that having participated in the QMRA III will change their approach to and expand opportunities for research and industry clients.

The second annual QMRA III will be held during the summer of 2016 at MSU.

Faculty

Translating big data to help policy makers improve agricultural systems across the globe is goal of DSI unit at MSU

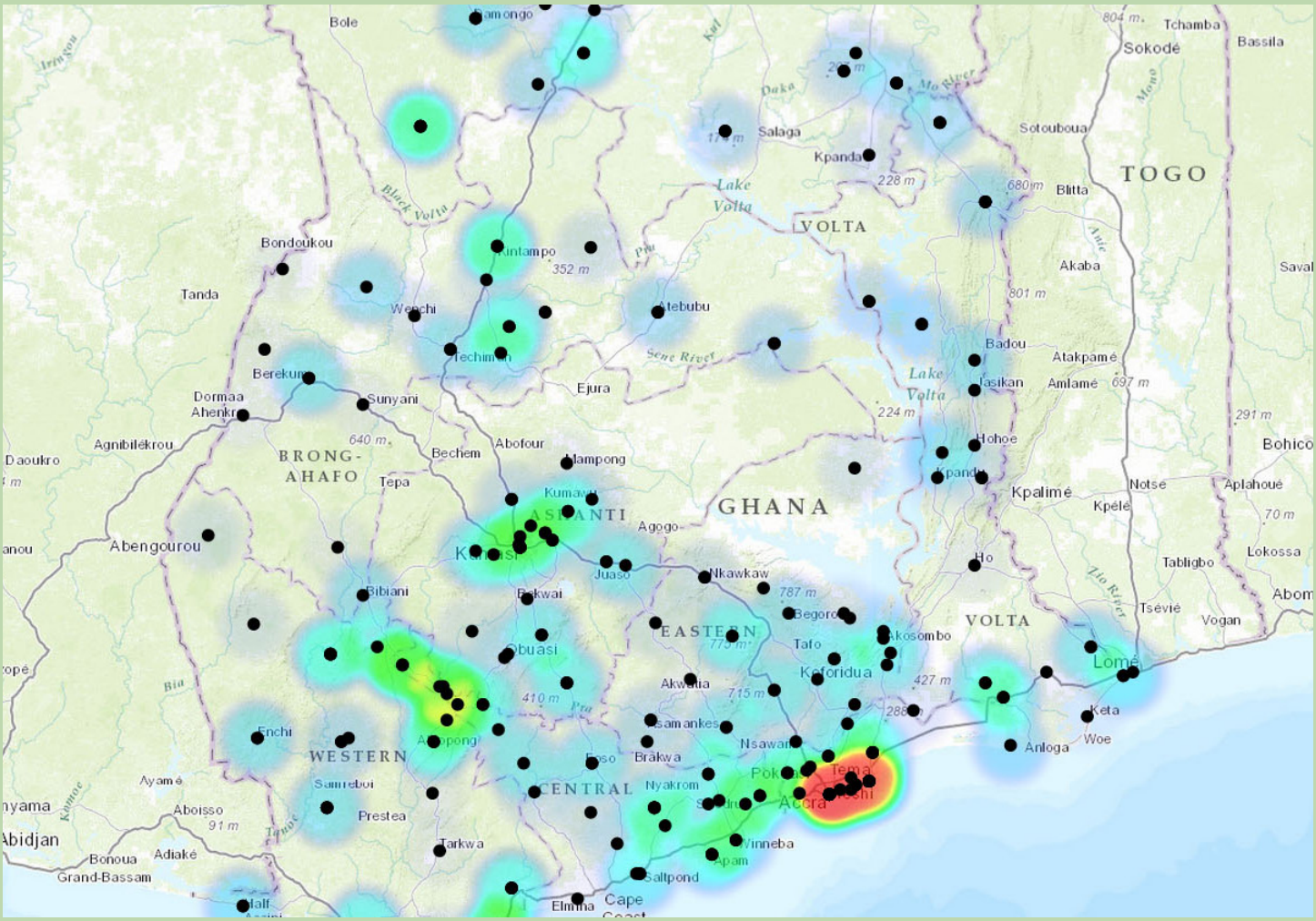
Policy makers and other decision makers charged with formulating sustainable initiatives to feed the world's growing population need access to detailed data and analytics, but having information in its raw form is often of little value. The Decision Support and Informatics (DSI) (http://dsiweb.cse.msu.edu/) unit at Michigan State University (MSU) is designed to solve this problem: it transforms comprehensive sets of raw data into an integrated, standardized and accessible format. The DSI is a flagship program in the Global Center for Food Systems Innovation (GCFSI), one of seven research laboratories funded by the United States Agency for International Development (USAID) in their Higher Education Solutions Network (HESN). Its mission is finding solutions to the most pressing current and emerging global problems, especially in developing countries. One global issue that GCFSI is keying in on is finding way to improve agricultural systems in a world facing shrinking natural resources, climate change, population growth, and rapidly increasing demand for food.

The current director of the DSI unit is Dr. A. Pouyan Nejadhashemi, MSU associate professor of biosystems and agricultural engineering department. He has an extensive background in computer programming, developing decision support tools, geographic information systems (GIS), and soft computing techniques (artificial intelligence). He said the purpose of DSI is to build integrated data sets that can be used in developing analysis and decision support systems for evaluating the economic, social and environmental dimensions of development projects in other countries.

Dr. Nejadhashemi conducts a discussion with students in his research group during a journal club meeting.

"DSI serves as a highly technical data mining tool that provides several levels of support in accessing and integrating data, creating and translating information and generating knowledge," Nejadhashemi explained. "Data from hundreds of different databases that contain hundreds of thousands of indicators can be compared in one place. It's a transparent process."

DSI is designed to shorten the time it takes to amalgamate data and simplifies the search for and integration of data sets and information. It goes beyond simple data delivery and documentation by providing access to a vast pool of scientific and technical experts in advanced analytics, including custom mapping, integrated index creation, raster calculations, relational mapping, information communication and basic statistical analysis. The platform serves as a gateway for more advanced research needs, such as assembling teams of



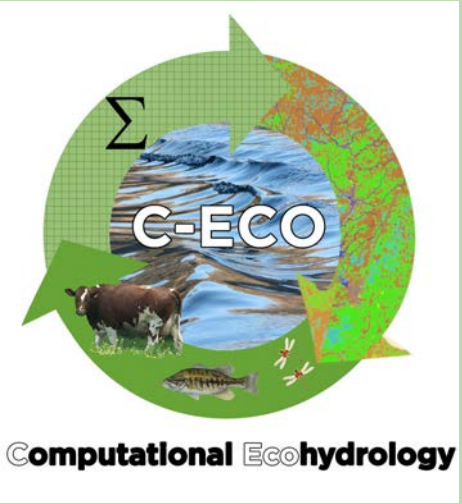
DSI constructs integrated data sets that can be used in developing analysis and decision support systems for evaluating the economic, social and environmental dimensions development projects in Africa. This map utilizes heat-density reflections to visualize the geographic distribution of aid spending (in U.S. dollars).

scientists to work on more complicated research projects, which in turn may pave the way for leveraging additional funding streams.

DSI is unique because it draws open source data from multiple locations, including the United Nations Food and Agriculture Organization (FAO), World Health Organization, World Bank, USAID, academia, and non-governmental organizations, among others, together in one place. Information is accessible online for downloading anywhere in the world. The dataset currently covers nearly 10,000 national and subnational development and policy indicators in temporal and spatial formats.

DSI can provide several services on a project and request basis: mapping visualization design and implementation, collecting data, cleansing data, managing databases, analyzing trends, and non-mapping database visualization.

"One of the greatest challenges policy makers face is not having sufficient information readily available when they need to make decisions," Nejadhashemi said. "DSI fills this void. It's a great tool for facilitating data-driven decision making instead of relying on personal opinions."



The Decision Support and Informatics unit is a flagship program in the Global Center for Food Systems Innovation at MSU and identified by this logo.

Advances in computer modeling software speeds up the time it takes to conduct climate change research

Writing computer codes to process data faster doesn't just provide faster results, it also makes it possible to pursue research that may not have been possible in the past. Many issues being studied today involve processing huge amounts of raw data using computer modeling software, and this requires having programmers such as postdoctoral research associate Mohammad Abouali who likes to figure out how to make the best models being used by researchers around the world work faster and more efficiently.

Computer parts communicate with one another so codes must be written to minimize latency and idle time. Many of today's climate- and environmental-type of research projects are so large that data must be divided amongst multiple computers (supercomputers), referred to as parallel computing. These supercomputers act as a single large computer and communicate with one another over networks. It's not uncommon that one system may need the results of a calculation performed by another computer to complete its own calculation.

Writing computer codes to process data faster doesn't just provide faster results, it also makes it possible to pursue research that may not have been possible in the past.

"A tremendous amount of time is wasted transferring data, so codes needs to be written in a scalable manner. This means we can still optimize performance even though we are increasing the amount of data being processed and number of computers being used," Abouali said.

Abouali's focus on expediency explains why he embraces using graphics processing units (GPUs) because it's another way to generate results more quickly. GPUs are the same processing units that exist on a computer graphic card and designed to hold thousands of computing cores. As an example, he adjusted one numerical model used to estimate the amount of actual evapotranspiration to use GPUs and was able to increase the processing speed by 550 times. A calculation that would normally take him 10 days to complete now only takes 30 minutes.

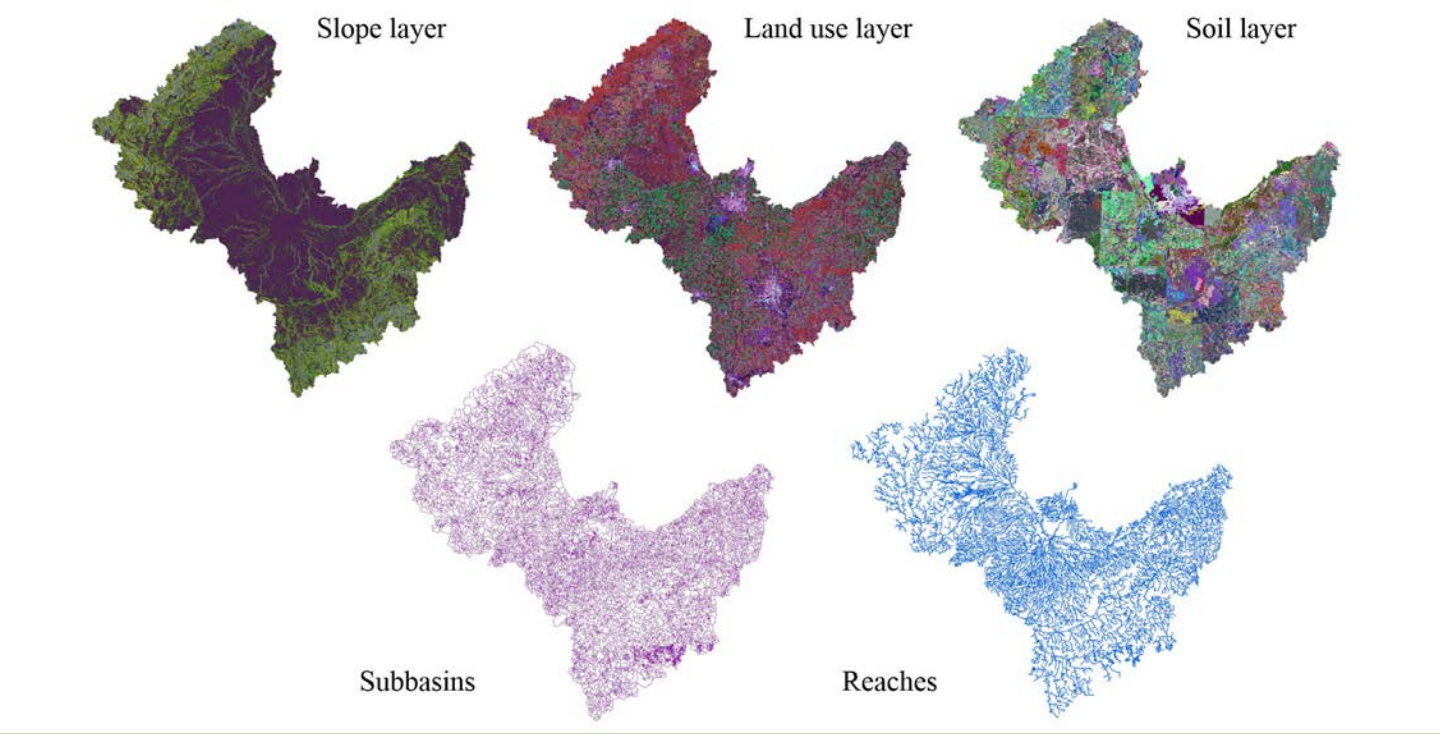
Abouali is interested in environmental science, and especially problems related to the water cycle because its components are interrelated and play an important role in studying and understanding climate. As a case in point, Abouali conducted a study to determine best management practices for increasing the production of bioenergy crops while minimizing the stress imposed on the 3,800 streams in the Flint watershed. The study required processing data thousands of times. He developed two sets of computer codes to perform calculations for 171 biologically relevant hydrological indices. One of the codes speed up data processing by 0.094 seconds for each stream.

"The difference of less than one-tenth of a second for each stream may seem insignificant, but this could scale to 120 days, or about four months, once applied to the full problem," Abouali explained. "The slightest improvements to computer codes can provide decision makers and stakeholders with information they need faster. In this case, one code produces the information about four months faster than the other code once applied sequentially. Both codes that we developed were faster than the code that was available before; the faster code that we developed was about 227 times faster. Our tests on a single data set, not a full problem, shows that while our code takes only 12 minutes to finish, the older code that was publically available took 47 hours to process the same data set on the same computer."

Dr. Mohammad Abouali

"If we do not find methods for processing data in a faster and more acceptable time frame, our research is doomed and policymakers and other decision makers don't have access to information when they need it," he added.

Predicting how to sidestep future climate-related health scares



Geospatial layers including slope, landuse, soil type, subbasin boundaries, and river networks are used to build a biophysical model for the Saginaw River watershed in Michigan.

Extreme weather shifts and single severe weather events can lead to significant public health concerns, including hypothermia, heat-related illnesses, pollen- and other allergen-related attacks, and infectious disease outbreaks. MSU Biosystems and Agricultural Engineering graduate student Fariborz Daneshvar is delving into the potential impacts that global warming and climate change have on human health in the Great Lakes region. Thus far, research findings indicate that although winters appear to be more moderate and cold-related deaths are decreasing, the number of days experiencing hotter temperatures will more than double.

It has been predicted that by 2081-2100, there may be more than 2,000 deaths per year from heat-related causes in Chicago alone. In the Toronto-Niagara region of Ontario, Canada, the number of days with temperatures above 90 degrees Fahrenheit is expected to double by 2030, and by 2080, that number will increase by at least 50 more days. Conversely, fewer cold-related deaths will be expected by the end of the 21st century, winter winds will be weaker, wind chills will be more tolerable, and extreme cold events will be less frequent and shorter in duration.

Daneshvar said higher ozone levels will be more frequent and, in the case of an extreme heat event, many researchers claimed ozone levels may increase two to five parts per billion (ppb), possibly leading to increases in respiratory infections and lung problems, more cases of asthma or cause premature death. Allergy seasons will likely begin earlier and last longer, and the distribution of allergenic plant varieties will change over time. Warmer temperatures and increased precipitation will cause certain plant species to grow more rapidly, bloom earlier and produce more pollen.

"Climate changes may also lead to more cases of waterborne and vector-borne diseases in humans. For example, an additional 2.5 inches of rain in a single day may result in 50 to 100 percent more outbreaks of disease in the Lake Michigan region each year," he said. "Mosquitos and ticks will have more of a chance to survive through moderate winters and, as a result, the risk of diseases such as Lyme disease or West Nile virus will increase."

Daneshvar next plans to start developing and adapting systems and protocols for intercepting the first signs of impending severe weather events. These may include developing heatwave warning systems, upgrading sewage and storm systems, developing a system for the early detection of vector-borne diseases, and identifying ways for reducing ozone emissions and concentrations.

Faculty News

Three MSU BAE faculty members awarded tenure

Michigan State University (MSU) Department of Biosystems and Agricultural Engineering (BAE) faculty members Drs. David Hodge, A. Pouyan Nejadhashemi and Dawn Reinhold have been awarded tenure.

Nejadhashemi, associate professor of BAE, was awarded tenure in 2014. His specific areas of research interest are: ecohydrology; sensitivity and uncertainty analysis of water quality mitigation as approaches to climate change; assessing environmental impact; soft computing applications in water resources; developing Decision Support System (DSS) for human impact evaluation on ecosystem sustainability; evaluating and developing watershed/water quality models; and describing, analyzing and preventing non-point source pollution at laboratory, field, watershed and regional levels. At MSU, Nejadhashemi teaches ecohydrology, water resources system analysis and modeling, advanced watershed modeling, land and water conservation engineering, and dynamics of biological systems. He earned his Ph.D. in Biological Resources Engineering in 2006 from the University of Maryland.

Reinhold, associate professor of ecological engineering in the department of biosystems and agricultural engineering, also was awarded tenure in 2014. As an associate professor, she juggles engineering research, undergraduate teaching, Scholarship of Teaching and Learning (SOTL) research, and professional service. Reinhold earned her dual Bachelors of Science degrees in biological and agricultural engineering and natural resources and environmental sciences at Kansas State University in 2002 and her Ph.D. in environmental engineering at Georgia Institute of Technology in 2007. Her research interests include: wetlands and vegetative technologies for protecting water quality; plants for remediation of emerging organic pollutants and hazardous wastes; fate of emerging pollutants and pesticides in vegetated systems; plant tissue culture and genetic engineering to enhance the capabilities of plants to address water quality problems; and ecological engineering. Reinhold is also a recipient of a fellowship through the Lilly Teaching Fellows Program.

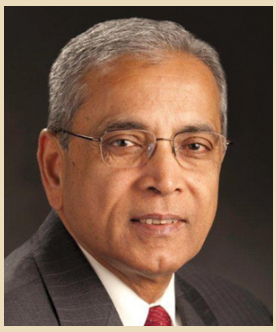
Hodge was awarded tenure in 2015. His expertise and research interests lie in biomass conversion, bio-based industrial products, biotechnology, energy production, process optimization, modeling and control. Hodge completed his Bachelors of Science degree in chemical engineering at Auburn University in 1999, and then earned his Master's degree and Ph.D. in chemical engineering from Colorado State University in 2002 and 2005, respectively. He holds a joint appointment with the departments of biosystems and agricultural engineering and chemical engineering and materials science.

Dr. A. Pouyan Nejadhashemi

Dr. Dawn Reinhold

Dr. David Hodge

Dr. Srivastava receives 2015 Presidential Distinguished Service Citation



Dr. Ajit Srivastava

Dr. Ajit Srivastava was one of seven recipients of the American Society of Agricultural and Biological Engineers (ASABE) 2015 Presidential Distinguished Service Citation. The awards were presented in July at the 2015 ASABE annual meeting held in New Orleans.

Srivastava was recognized "for ably transitioning the outcomes from the Global Challenges Forum into a successful Global Engagement Day at the 2014 AIM where panel discussions and a SWOT analysis culminated in the ASABE white paper, Global Partnerships for Global Solutions: An Agricultural and Biological Engineering Global Initiative, and established the framework for holding specialty conferences globally to address food, water and energy security challenges."

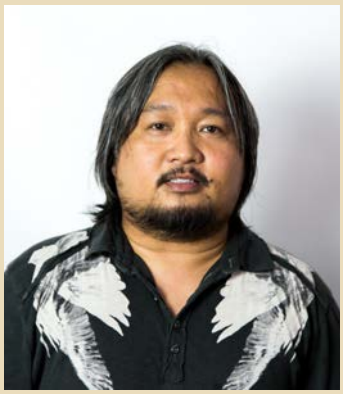
Ines joins MSU faculty

Amor Ines joined the faculty at Michigan State University (MSU) in April of 2015. He is an assistant professor of plant soil and microbial sciences and shares a joint appointment with the department of biosystems and agricultural engineering. Most recently, he was a faculty associate with the Fulbright Scholar Program (Sept. 2014 to March 2015) and an associate and research scientist with the International Research Institute for Climate and Society at The Earth Institute at Columbia University in New York. Ines has also worked for the Department of Biological and Agricultural Engineering at Texas A & M University, the Asian Institute of Technology, and the International Water Management Institute in Colombo, Sri Lanka.

Ines earned his bachelors of science degree in agricultural engineering (Magna Cum Laude and valedictorian) in 1994 from Mariano Marcos State University, Batac, Ilocos Norte, Philippines. He completed his masters of science and Ph.D. in water engineering and management from the Asian Institute of Technology, Bangkok, Thailand, in 1998 and 2002, respectively.

Ines's research interests include: linking climate with agriculture and water management for climate adaptation; using remote sensing in agriculture and water management; assimilating remote sensing data with soil-vegetation-atmosphere transfer models; statistical downscaling of climate; crop modeling and forecasting; vadose zone hydrology; evolutionary and biological algorithms for agriculture and water management; analyzing water resource systems; and high performance computing.

Ines received the 2007 Editors' Citation for Excellence awarded by the American Geophysical Union (AGU) for his excellence in refereeing for Water Resources Research. He was also a 2009 Department of Science and Technology (Philippines) Balik Scientist Program Awardee.



Dr. Amor Ines

Nejadhashemi honored with Withrow Teaching Excellence Award

Dr. A. Pouyan Nejadhashemi, associate professor in the Michigan State University Department of Biosystems and Agricultural Engineering, was awarded the Withrow Teaching Excellence Award, an honor recognizing a faculty member's teaching, advising and mentoring skills. One faculty member is chosen from each academic unit annually, based primarily on nominations received from students.

Nejadhashemi is recognized at both the graduate and undergraduate levels for his high quality instruction. Most notably, students appreciate his knowledge – and especially his contagious passion for – ecohydrology. He is dedicated to ensuring that each student builds upon his or her educational ambitions and succeeds in meeting individual learning goals.

Dr. A. Pouyan Nejadhashemi

Are you an alumni or former faculty member of the Michigan State University Department of Biosystems and Agricultural Engineering? Do you have news to share?

Please submit all information to Jamie Lynn Marks at marksjam@msu.edu and include appropriate contact information for follow-up.

Research News

Marks receives research grant totaling $4.7 million

Bradley Marks, Michigan State University (MSU) professor of biosystems and agricultural engineering, has received a $700,000 (first year) research grant from the U.S. Department of Agriculture National Institute of Food and Agriculture (NIFA). The grant is estimated to total over $4.7 million over the course of five years. Marks' research focuses on enhancing the development, improvement and commercial adoption of pasteurization technologies for low-moisture foods. His project will take into account efficacy, product quality, regulatory requirements, energy use and suitability for the targeted end users.

NIFA awarded $19 million in grants to 36 grantees. The awards were made through the Agriculture and Food Research Initiative (AFRI) authorized by the 2014 Farm Bill, which was signed at MSU. The AFRI Food Safety program aims to protect consumers from microbial and chemical contaminants that may occur in the food chain, from production to consumption.

Dr. Bradley Marks was recently awarded a $4.7 million food safety research grant from the U.S. Department of Agriculture National Institute of Food and Agriculture.

Spartans Make Plant Bottles Greener

Making Coca-Cola's Plant Bottle even greener is the challenge that researchers in Dr. Chris Saffron's laboratory accepted back in 2008.

Currently, the Plant Bottle (you know, the one with the green cap) is a copolymer of renewable ethylene glycol and nonrenewable terephthalic acid, which makes polyethylene terephthalate (PETE) known as plastic #1. This material already benefits from an established recycle system as many states collect bottle deposits.

The problem is that terephthalic acid is derived from petroleum-based feedstocks, namely aromatic chemicals such as para-xylene. Dr. Saffron's group is investigating renewable strategies for making these bottles using plant biomass as a feedstock.

Fully renewable plastic bottles will benefit the environment by reducing the use of petroleum feedstocks, thus limiting global warming potential and resource depletion.

The bio-based process works by breaking apart plant matter using fast pyrolysis, a technology that rapidly heats biomass without oxygen to temperatures around 500°C. Then, the pyrolysis vapor is catalytically converted into aromatic compounds using patent-pending catalysts that are prepared in-house. Further conversion and purification results in an aromatics stream for subsequent transformation to terephthalic acid, which is used to make plastic bottles.

This project between Biosystems Engineering and The Coca-Cola Company was the first collaboration brokered by MSU's Business-CONNECT office, which is part of the MSU Innovation Center. It stands as a case study for how University-Industry collaborations can successfully engage in applied research, share intellectual property, publish in academic journals, and graduate doctoral researchers.

Dr. Chris Saffron (center) and graduate students Rachael Sak (left) and Li Chai (right) pyrolyze biomass to make plastics.

Selected Research Portfolio (Total grants last year = $2,168,834)

Title	Direct Grantor	First PI
Federal Government		
Reclaiming Soil Health and the Natural Productivity of Crop Land	USDA - NRCS	Harrigan
Understanding and Modulation of Interfacial Properties Within Plant Cell Wall Pores to Facilitate Enzymatic Deconstruction and Conversion to Biofuels	NSF	Hodge
Understanding Bacterial Dry Transfer Mechanism During Nut Processing	USDA	Jeong
Hybrid Bioenergy Production System	USDA – NRCS	Kirk
A Self-Sustaining Solar-bio-nano-based Wastewater Treatment System for Forward Operating Bases	US Dept of Army	Liao
Factors Affecting Pasteurization Efficacy for Salmonella in Low-Moisture Foods	USDA	Marks
QMRA III - Quantitative Microbial Risk Assessment Interdisciplinary Instructional Institute: a yearly, intensive short course in mathematical modeling techniques for QMRA	NIH	Mitchell
NSF IRES: Engineering Sustainable Biological Solutions for Clean Energy and Water in Costa Rica	NSF	Reinhold
A Generalized Phenomenological Model for Bacterial Transfer to/from Fresh Produce	USDA	Marks
Development of a Biosensor for Rapid Detection of E.coli (0157:H7) and Salmonella sp. I in Fishery	USAID	Alocilja
Enhancing Low-Moisture Food Safety by Improving Development and Implementation of Pasteurization Technologies	USDA	Marks
REU Supplement to: CAREER: Programming Proteins by Deep Sequencing and Design	NSF	Whitehead
State of Michigan/Local		
Development and Demonstration of Scalable and Economic Waste Treatment and Utilization Systems for Small-scale Meat Processing Facilities	MI Dept of Agriculture & Rural Dev.	Liao
Feasibility of Using Sugar Beet Pulp to Produce Chitosan as a High-value Bioactive Agent for Food and Agriculture Applications	MI Dept of Agriculture & Rural Dev.	Liu
Michigan Farm Energy Implementation Project	MI Energy Office	Surbrook, Go
A Novel Hybrid BMP Auction Program to Maximize Environmental Outcomes of BMP Implementations	Shiawassee Conservation District	Nejadhashemi
Michigan AgriEnergy Audit & Renewable Energy Assistance Project	MI Energy Office	Surbrook, Go
Association/Foundation		
Rapid Accurate Detection of Pulmonary Tuberculosis Using a Low-cost Field-operable Biosensor	WK Kellogg Foundation	Alocilja
Comparative Techno-Economic Analysis of Two Solar Thermal Systems in Michigan: Novel Flat Plates vs. Established Evacuated Tubes	Herrick Foundation	Go
Advanced Technology for Addressing the Challenge of Quality Assurance of Processed Carrot	MI Carrot Committee	Guyer
Evaluation of Vertical Tillage Tools for Residue Management, Manure Incorporation and Seeding Cover Crops	Corn Marketing Program Of MI & MI Soybean Promotion Committee	Harrigan
A Life-cycle Assessment Comparing Soybean Rotation Methods, Equipment Age and Tilling Practices	MI Soybean Promotion Committee	Saffron
MI Ag Electric Council	MI Electric Cooperative Assoc, Consumers Energy & DTE Energy	Surbrook
Industry/Company		
Development of Imaging Techniques for Defects Detection of Horticultural Products	Nestle	Dolan
An Innovative Pilot-Scale Anaerobic Digester	Quantalux, LLC	Kirk
Evaluating Micro-bubble Facilitated Electrocoagulation-flotation (ECF) Technologies for Cost-effective Treatment of Wastewater from Anaerobic Digestion	Helee, LLC	Liu
Improving Validation Methods for Pistachio Pasteurization Processes	Administrative Committee for Pistachios & Center for Produce Safety	Marks
Phase 2, Integration of Consumers Energy Transmission and Energy Demand Data with the MI Waste Biomass Inventory to Support Renewable Energy Development from Anaerobic Digestion	Consumers Energy	Safferman
Food Processing Wastewater Irrigation Field Monitoring and Optimization	Nestle	Safferman
An Economic and Environmental Comparison of Renewable Gaseous and Liquid Hydrocarbon Fuels	Ford Motor Company	Saffron
Quantitative Microbial Risk Assessment (QMRA) for Various P&G Antimicrobial Products on Porous and Nonporous Surfaces (Category B)	Procter & Gamble	Mitchell
Biomass to Terephthalic Acid: Development of a Decision Support Tool and Analysis of Potential Conversion Scenarios	The Coca-Cola Company	Saffron

Student News: Ph.D. Profile

Sean Woznicki

More than 70 percent of the Earth's surface is covered by water, but only about 2.5 percent of it is freshwater, and lakes, rivers and streams make up only about 1.2 percent of that component. Forty years since the Clean Water Act was adopted, 42 percent of U.S. streams still rate poorly for quality based on the health of native fish and insect populations. Contributors to stream health extend beyond chemical quality standards to climate change, such as fluctuating water cycles and increasing surface temperatures.

Michigan State University (MSU) climate researchers such as Sean Woznicki, biosystems and agricultural engineering 2015 doctoral graduate, understand the urgency behind figuring out strategies for keeping freshwater streams, rivers and lakes healthy and viable for generations to come. He has developed models to help assess the impacts of climate change on stream health and aquatic life and identify which ones are most at risk.

Historically, water resource management studies have focused on its use for and by humans – drinking, recreation, agricultural, industrial – whereas surveys related to stream health typically explore the relationship between land use and stream biotic responses, such as determining how fish populations are affected when nearby land is transitioned into agricultural acreage. While these models are useful, they neither account for the conditions in which the biota live or have the potential for addressing the addition of new stressors to the system, such as climate change. Smarter and more comprehensive management practices assessing stream biology, chemical criteria and water quality standards are needed.

"How do we develop predictions? We may have 1,000 streams, but yet only have data on 50 or 100 of them, in addition to a poor or good rating," Woznicki said. "When it's time to make recommendations, it's difficult to do so with such limited information so we need climate models to help fill in the gaps."

Woznicki said there hasn't been a robust way to develop these models for untested streams because of the complexity of integrating water quality data, physical characteristics of the stream, and variables related to timing and duration of major low and high flow events. Tying in climate change adds another variable.

"How can we assess the impact of climate change on stream health and aquatic life? These changes are projected to redirect how streams flow, result in longer periods of drought, affect when we get rain, and produce more intense storms that lead to flooding. These outcomes, in turn, will contribute to changes in land use (urbanization)," Woznicki said.

Sean Woznicki (back row, third from left) displays his Fitch Beach Outstanding Graduate Research Award sur¬rounded by members of Dr. Nejadhashemi's research group. He received the award in 2015.

He says that different fields need to collaborate – like a spider web – to fully understand the depths of change.

"The overall impacts of climate change on stream health were low in terms of the magnitude of stream health decline. However, at the reach level there were many streams at high probability for large projected declines in health, thus revealing highly vulnerable aquatic communities," Woznicki reported. "By combining the probability and magnitude of declining stream health, decision makers can target stream ecosystems that are critically at risk."

Watershed and natural resources managers can use the results from this study to decide how best to allocate limited resources for protecting aquatic ecosystems and developing measures for adapting to climate change. This process was developed for Michigan and has been designed to be transferrable to other regions with different physiographic, biotic, and climate characteristics.

"The risk map is very unique. Decision makers can study it at the state, river network or watershed level to decide how best to use limited resources instead of blindly spending money on areas that may not be at risk," Woznicki said.

Student News: Undergraduate Profile

Mariana Madrigal Martinez, 22, Novi, Mich.

Biosystems Engineering, BS, 2015
Michigan State University

Entry Level Manager, PepsiCo/Frito Lay, Wooster, Ohio

"Presenting awards at the SWE banquet was a highlight of my undergraduate career."

Funny story! As a Society of Women Engineers co-chair for a banquet themed "An Evening with the Industry," various company sponsors joined SWE for festive feasting, PepsiCo among them. The next day, with a PepsiCo company representative, conversation started to flow. He asked if I would attend an informational session PepsiCo was hosting at the MSU Union. I received an interview on the spot and was invited to the second round of interviews at their plant in Wooster. Who knew that planning a dinner with industry would bring me an internship with Frito Lay—and the job I know have!

It was a summer internship packed with learning, and I was offered a permanent position after returning from rollout presentations in Dallas. I was honored to be the only senior in my engineering department that had a full time job waiting after graduation—before senior year even began! The takeaway: get involved! Through clubs, sororities, travel abroad—connections happen!

My study abroad is the classic tale of an opportunity falling in your lap. The first MSU Costa Rican trip was planned for a winter break. The "plane was full," but someone had to pull out. Being fluent in Spanish and very interested in other countries, two days after turning in my last final, I found myself on a plane to Costa Rica. Paired with current biosystems engineering students from Universidad de Costa Rica, we met researchers and professionals in anaerobic digesters, biofuels, and renewable energy. An amazing introduction to biosystems engineering and as the youngest in the travel group, I had the most to learn about ecological engineering in the tropics. When we returned, connections made brought opportunities: translating and organizing biodigestor and wetland reports from doctoral researchers.

Now a mentor to young female engineering students, I emphasize getting involved beyond the classroom, broadening horizons, increasing your viability as an engineer and so much more.

Rachel Kurzeja, 21, Rochester Hills, Mich.

Biosystems Engineering, BS, 2015
Michigan State University
ASABE Graduate Student Member

Manufacturing Engineering Associate, General Mills (Yoplait plant), Reed City, Mich.

"My family bleeds green. My brother and I have sported MSU attire since we were born, and we experienced amazing college football together—especially at the Rose Bowl when State won. We were the first students to pick up our tickets: front row seats!"

My internship experiences helped me discover my passion for working in operations, and showed me that the most critical component of being happy and successful is not the job itself but how a company values its people. I identify with General Mills' company culture and their values: "do the right thing all the time" and "grow and inspire." These company-culture values facilitate working and collaborating in a challenging and dynamic environment and enable me to make a positive impact. The company culture within General Mills provides opportunities for employees to grow together as engineers and professionals.

My internship and co-op experiences include working for Perrigo Company as a production-engineering intern in Allegan, Mich., and for DePuy Synthes Joint Reconstruction as a shoulder product development co-op in Warsaw, Ind. As a production engineering intern, I worked in a Tablet Manufacturing Value Stream and led a plant-wide continuous improvement project from creation through implementation. I was given autonomy, resources, and opportunity to present regularly to upper management and operators about my project. I grew as an engineer and in leadership skills. As a co-op, my job was similar to an entry-level engineer. I supported project engineers and ensured progress and timeline. This helped me to further develop my communication skills, ability to work with a team, and strong work ethic.

My biggest takeaways from these experiences are to always be open-minded, remembering that opportunities come in all shapes and sizes.

Reprinted from the DISCOVER September/October 2015 issue of Resource, the magazine of the American Society of Agricultural and Biological Engineers, with permission from the publisher.

2015 Senior Design Capstone Projects

About the Program

Dr. Dana Kirk, PE
Asst. Professor

Dr. Luke Reese
Assoc. Professor

The Biosystems Engineering (BE) undergraduate program prepares graduates who will integrate and apply principles of engineering and biology to a wide variety of globally important problems. To achieve that purpose, the primary objectives of the BE program are to prepare graduates to:

- identify and solve problems at the interface of biology and engineering, using modern engineering techniques and the systems approach, and
- analyze, design, and control components, systems, and processes that involve critical biological components.

Additionally, the Biosystems Engineering program is designed to help graduates succeed in diverse careers by developing a professional foundation that includes vision, adaptability, creativity, a practical mindset, effective communication skills for technical and non-technical audiences, the ability to work in diverse, cross-disciplinary teams, and a commitment to sustainability, continuing professional growth, and ethical conduct.

BE 485 / BE 487 Courses

Biosystems Engineering student teams, enrolled in the two-semester biosystems design capstone experience, BE 485/487, develop, evaluate, and select design alternatives in order to solve real-world problems. Projects are diverse, but each reflects systems thinking by integrating interconnected issues affecting the problem, including critical biological constraints. The engineering design process is documented in a detailed technical report. Teams present project designs to engineering faculty and a review panel of professional engineers for evaluation. Each BE 485/487 capstone design team prepares and presents a design solution in report, poster and oral formats to industry, faculty, peers and the public that:

- Requires engineering design
- Uses a holistic approach
- Combines biology and engineering
- Interprets data
- Solves a real problem
- Evaluates economic feasibility

Industry Advisory Board and Project Evaluators

The purpose of the Industry Advisory Board is to facilitate the exchange of ideas between Board members, faculty, and students of the BE program. Its function is to improve continuously the BE program quality by keeping it current and relevant to industry needs. Regular and adjunct board members also serve as external project evaluators.

2014-2015 BE Industry Advisory Board

Rebecca Bender - Graduate Student Representative
Lisa Buchholz - Dow Agrosciences
Michelle Crook, P.E. - Environmental Stewardship Division of the Michigan Department of Agriculture and Rural Development
Cassaundra Edwards (Chairperson) - ConAgra Foods
Bryce Feighner, P.E. - Michigan Department of Environmental Quality
Gene Ford (Past Chairperson) - Nestlé Nutrition
Andrew Granskog, P.E. (Ex-Officio) - USDA Rural Development Community Programs
Kyle Guyer - Undergraduate Student Representative
Ashley Julien, E.I.T. - TetraTech
Dr. Leo Kempel (Ex-Officio) - MSU College of Engineering
Dan King (Ex-Officio) - MSU Department of Biosystems and Agricultural Engineering
Andrew Knowles - JBT Food Tech
Jeffrey Mathews - PepsiCo Beverages
Mitch Miller (Chairperson-elect) - General Mills – Yoplait Plant
Dr. Fred Poston (Ex-Officio) - MSU College of Agriculture and Natural Resources
Dave Prouty - Heat Transfer International
Dr. Luke Reese (Ex-Officio)- MSU Department of Biosystems and Agricultural Engineering
Steve Richey - Kellogg Company
Dr. Ajit Srivastava (Ex-Officio)- MSU Department of Biosystems and Agricultural Engineering
Steve Steffes, P.E. - Perrigo
Larry Stephens, P.E. - Stephens Consulting Services, P.C.
Muluken Tilahun - Kraft Foods
Richard (Rick) Woodford, P.E. - USDA-Natural Resources Conservation Service

Project Evaluators

Mr. Ralph Elias - Terumo Cardiovascular Systems
Mr. Bob Ellerhorst, PE - MSU Power Plant
Ms. Danielle Habitz - Kellogg
Mr. Tim Krause, PE - Granger
Mr. Steve Mohr
Mr. Keith Tinsey - Walthers Farms
Mr. Nick Tipper - Techmark

Integrating Water and Energy Engineering with Ecotourism in a Costa Rican Aboriginal Community

(L to R) Gina Masell, Nicole Kruse and Brian Smith

Sponsor – EPA
Faculty Advisor – Dr. Dawn Reinhold
Industry Evaluators – Mr. Larry Stephens, PE and Mr. Rick Woodford, PE

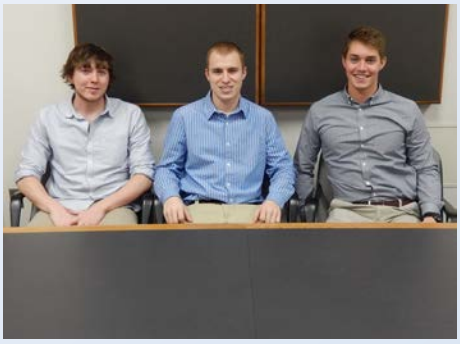
Team "Shuabb Systems" has designed an integrated system to provide potable water, wastewater treatment, and energy production for an ecotourism project led by the Shuabb Aborigine Women Association in Costa Rica. By integrating green technologies such as water filters, anaerobic digestion and constructed treatment wetlands, the project aims to secure clean water for human consumption and treat solid waste and wastewater, while creating renewable energy on site. The project is in cooperation with the Gender Equity Office from the Technological Institute of Costa Rica, and can demonstrate the economic value of such development in a region with limited access to public services.

Optimizing Wastewater Irrigation for Food Industry Application

Sponsor – Major Food Manufacturer
Faculty Advisor – Dr. Steve Safferman, PE and Mr. Steve Miller
Industry Evaluators – Ms. Lisa Buchholz, Mr. Nick Tipper and Mr. Keith Tinsley

The purpose of this project is to identify and address problems encountered in the center pivot irrigation wastewater treatment process of a food production company. This project uniquely combines aspects of the mechanical, chemical, and biological areas as it looks at refining a process as a whole, rather than just a specific point in the process. It is through providing solutions to the identified problems that the team will deliver supported recommendations to better optimize the current process and improve adherence to standards set forth by the appropriate government agencies.

(L to R) Quincy Brissette, Kyle Guyer and Brody Lawrence



(L to R) Alex Whitlow, Chris Ross and Andrew Stoffel

Green Infrastructure Design Project

Sponsor – Tetra Tech
Faculty Advisor – Dr. Pouyan Nejadhashemi
Industry Evaluators – Mr. Andrew Granskog, PE and Ms. Ashley Julien

Project sponsor Tetra Tech is working to reduce stormwater runoff in Detroit in order to mitigate sewer system overflow. Team "Flood Control" is working on a Low Impact Development design to capture and treat runoff at Thomas J. Edison Elementary School.

Best management practices (BMPs) will be introduced to control and limit the flow rate of stormwater runoff entering the sewer system. Stormwater runoff reduction will decrease the amount of raw sewage disposal into local water bodies and have added environmental benefits. Project deliverables include hydrological models proving that BMPs meet project objectives, CAD drawings of BMPs, and a detailed cost analysis of the final design.

Anaerobic digestion: A pre-feasibility study

Sponsor – Granger
Faculty Advisor – Dr. Dana Kirk, PE
Industry Evaluators – Mr. Bryce Feighner, PE and Mr. Tim Krause, PE

Granger is a waste hauling and landfill gas collection company operating throughout the nation. Granger is interested in increasing power production at its Grand River site, and they believe anaerobic digestion could be a potential solution to generate an additional 600kWh. The "Power Grangers" team is conducting a pre-feasibility study of an anaerobic digester to determine whether it can be implemented into their current system. This study includes the formulation of a feedstock blend for optimal methane production, an anaerobic digester design, a recommended use for the digestate, operational and regulatory challenges, and a complete economic analysis of the overall system.

(L to R) Mariana Madrigal Martinez, Taylor Folkertsma and Lauren Prochazka

(L to R) Hannah Pichner, Dimitrius Innis and Andris Grinvalds

Wastewater Treatment Electrocoagulation

Sponsor – Bellingar Packing
Faculty Advisor – Dr. Wei Liao
Industry Evaluators – Ms. Michelle Crook, PE and Mr. Mitch Miller

Team "Meat the Spartans" is working with Bellingar packing, a small-scale meat processing facility in St. Johns, Michigan. The team's objective is to design and construct a system to scale-up to treat 9,000-12,000 gallons of wastewater weekly and comply with MDEQ and EPA discharge standards while producing renewable energy and solid waste fertilizer. The treatment system consists of an anaerobic digester to initiate breakdown of the solids within the wastewater and generate biogas, used to offset natural gas consumed for heating water, followed by an electrocoagulation reactor, which charges solid particles to adhere to one another for easy removal as a concentrated fertilizer.

Torrefaction of Biomass

Sponsor – Heat Transfer International (HTI)
Faculty Advisor – Dr. Chris Saffron
Industry Evaluators – Mr. Bob Ellerhorst, PE and Mr. Dave Prouty

Greenhouse gas emission regulations are increasing thus creating demand for practical energy alternatives. An alternative being studied is torrefied woody biomass pucks that can act as "drop ins" for coal plants. The puck hydrophobicity is the focus of the project. In order to achieve hydrophobicity comparable to coal, different alternatives will be analyzed including hydrophobic coating applications, altering the process conditions and a binding agent. A break-even analysis will be conducted in order to determine the necessary cost of a carbon dioxide tax on coal in order for the biomass pucks to be competitive.

(L to R) Lucas Flynn, Xuhao Dai and Mackenzie Tocco

(L to R) Samantha Walby, Elizabeth Gregory and Andrew Brown

Utilization of Chitosan as a Bio-pesticide Extracted from Sugar Beet Pulp

Sponsor – Michigan Sugar Company
Faculty Advisor – Dr. Yan (Susie) Liu
Industry Evaluators – Mr. Gene Ford, Ms. Danielle Habitz and Dr. Jeff Mathews

Michigan Sugar produces 25,000 tons of sugar beet pulp per year which is predominately used as a low value animal feed. Due to the increasing competitiveness of sugar beet processing, it is critical to develop a more valuable byproduct. Team "Sugar BEets' " project goal is to utilize wet sugar beet pulp by applying the biological method of simultaneous saccharification and fungal fermentation to produce chitosan for use as a bio-pesticide.

Reducing Spoilage Microorganisms in Cherry Pomace

Sponsor – Food Processor (under Non-Disclosure Agreement)
Faculty Advisors – Dr. Kirk Dolan and Dr. Dan Guyer
Industry Evaluators – Mr. Steve Richey, Mr. Steve Mohr and Mr. Muluken Tilahun

Team "Microbe Busters" is to create a design to reduce the amount of spoilage microorganisms in cherry pomace, a byproduct of tart cherry juicing, without degrading positive phytochemical attributes of the pomace.

Client deliverables include a design with optimized operation parameters, testing that demonstrates the design solution's effectiveness, a vendor recommendation, and an economic analysis of operation and capital costs associated with the design.

(L to R) Caleb Bruhn, Kristine Nguyen and Rachel Kurzeja

(L to R) Stephen Jones, Scott Rubin and Danielle Boileau

JBT FoodTech Continuous Freezer Conveyor Belt Cleaning System

Sponsor – JBT FoodTech
Faculty Advisor – Dr. Sanghyup Jeong and Mr. Phil Hill
Industry Evaluators – Ms. Cassaundra Edwards and Mr. Andrew Knowles

The "Clean Freeze" team project is to design a continuous, run cold, external belt rinser and drier for a JBT GC M10 Tight Curve spiral freezer. After frozen food product exits the freezer, the system will clean the belt of built-up frost and food debris with an optional allergen abatement method and then completely dry the belt before food is placed on it.

Client deliverables for this project include a mathematical model of the design, a tested prototype design, a full-scale design recommendation, a complete bill of materials, and an economic feasibility analysis.

Wearable Phototherapy Device for Jaundice Treatment

Sponsor – Biosystems and Agricultural Engineering
Faculty Advisor – Dr. Tim Whitehead and Mr. Steve Marquie
Industry Evaluators – Mr. Ralph Elias and Mr. Steve Steffes, PE

Jaundice, or hyperbilirubinemia, is a medical condition that affects approximately 60 percent of newborns. It is caused by an excessive formation of the product of red blood cell breakdown (bilirubin) in the blood. Current treatments include blue light phototherapy administered in an incubator. This treatment method is expensive and disrupts critical mother and infant bonding time.

A design is proposed for a safe and wearable phototherapy treatment device that prevents the separation of mother and infant. The device is intended to be a portable and affordable treatment method for developing countries where jaundice is prevalent and power sources are limited.

(L to R) Alexis Wloch, Celina Merhi and Sarah Buchholz

BE Showcase - April 16, 2015

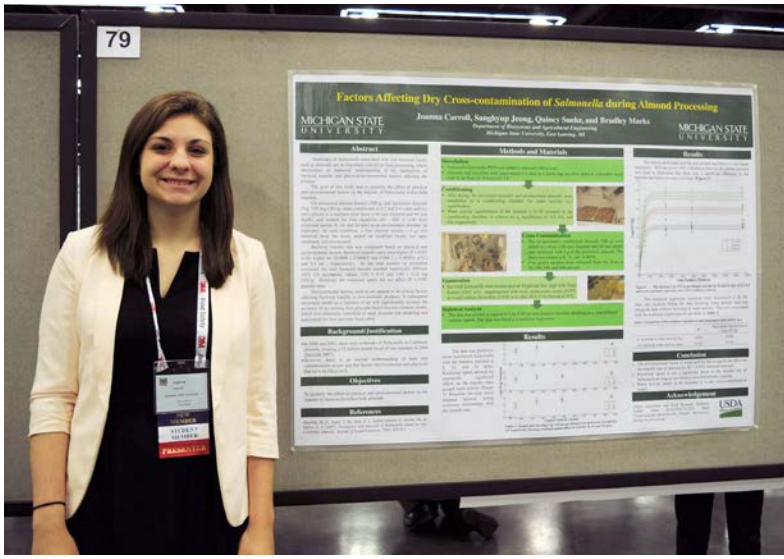
Industry Evaluation

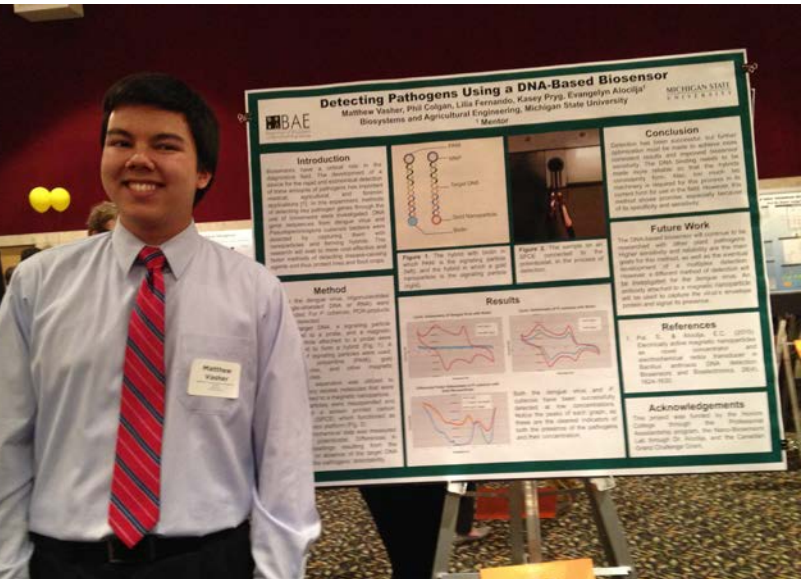
If you are interested in sponsoring a BE 495/487 capstone project for the 2016 Senior Design teams, please contact Dr. Dana Kirk at kirkdana@msu.edu or Dr. Luke Reese at reesel@msu.edu.

Student News

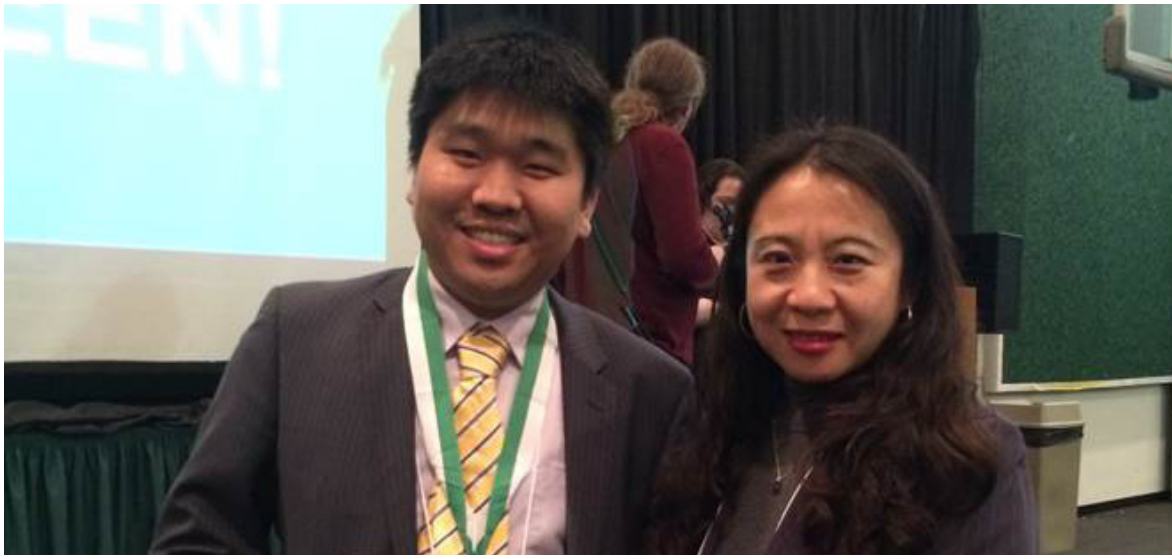
Three MSU BAE students recognized for their academic accomplishments

Joanna M. Carroll, Michigan State University (MSU) Biosystems and Agricultural Engineering (BAE) student and undergraduate research assistant, was awarded second place in the Undergraduate Research Competition at the 2015 Annual Meeting of the International Association for Food Protection held in Portland, Ore., held July 25-28. Her poster, "Factors affecting dry cross-contamination of *Salmonella* during almond processing", was based on findings evolving from an ongoing USDA Agriculture and Food Research Initiative (AFRI)-funded grant titled, "Understanding Bacterial Dry Transfer Mechanism during Nut Processing". Study authors were Caroll, Sanghyup Jeong, Quincy Suehr and Dr. Bradley Marks. Carroll received a plaque and $500 cash award.





MSU biosystems and agricultural engineering student **Matthew Vasher** was selected as the grand prize winner in the Science, Technology, Engineering and Mathematics (STEM) category at the 2015 MSU Undergraduate Research and Arts Forum (UURAF) held April 10. His research poster presentation was based on research he conducted in tandem with his professor mentor Dr. Evangelyn Alocilja and fellow students Phil Colgan, Lilia Fernando and Kasey Pryg. The research project, "Detecting pathogens using a DNA-based biosensor", will lead to more cost-effective and faster methods of detecting disease-causing agents, protecting lives and food crops. Vasher received $500 as the grand prize winner. More than 750 students participated in this year's UURAF and presented 518 different projects, setting a new record.



MSU BAE graduate student **Zhiguo Liu** was presented with a plaque recognizing him as the BAE College of Engineering Outstanding Graduate Student for 2015 at the fourth annual MSU College of Engineering Graduate Research Symposium in June. Pictured is Liu (left) and Dr. Yan "Susie" Liu (right).

King wins 2015 National Academic Advising Association Commission and Interest Group Division Service Award

Dan King, the academic adviser for biosystems engineering, civil engineering, and environmental engineering in the Michigan State University (MSU) College of Engineering, was presented with the 2015 National Academic Advising Association Commission and Interest Group Division (NACADA) Service Award during the organization's 39th annual conference Oct. 4 at Caesar's Palace in Las Vegas.

King has been an academic specialist and advisor at MSU for 20 years. He earned two degrees at MSU, a master's degree in College Student Personnel Administration/Business Management in 1981 and a bachelor's degree in Business Education/Physical Education in 1975. King has been active with national and regional NACADA committees, including serving as regional chair for Indiana, Illinois, Michigan, Ohio, Ontario and Wisconsin for a number of years.

Dan King, the academic adviser in the departments of biosystems and agricultural engineering, civil engineering and environmental engineering within the MSU College of Engineering, is the 2015 recipient of the National Academic Advising Association Commission and Interest Group Division Service Award.

Truman Surbrook: always a Spartan

Honoring 50+ years of BAE teaching and research

Dr. Truman Surbrook

Dr. Truman Surbrook, who recently started his 51st year with the Michigan State University (MSU) Department of Biosystems and Agricultural Engineering (formerly known as the Department of Agricultural Engineering) became inspired by MSU and what the university had to offer thanks to trips to campus for 4-H activities. He recalls that on his first trip to campus and the Agricultural Engineering Building as a youth, the sheep barn and pasture stood at the same location as the current MSU Chemistry building.

Surbrook, today a MSU tenured professor of biosystems and agricultural engineering, registered Professional Engineer (PE) and Master Electrician, attained his Bachelor's and Master's degrees and Ph.D. in agricultural engineering from MSU. He received an honorary certificate in 2010 from the MSU Institute of Agricultural Technology (IAT).

Surbrook has conducted many research projects and is a national expert in stray voltage as it relates to farm livestock. He is also a national leader on energy efficiency in farming operations. Surbrook has authored hundreds of technical bulletins and 10 textbooks, and is currently working on his 11th one. He has served on committees that help write the State of Michigan Electrical Code and National Electrical Code.

In 1970, because qualified electrical personnel were lacking in the rural areas of Michigan, Surbrook helped develop the MSU IAT Electrical Technology program in cooperation with electrical power suppliers and contractors, and served as the program's coordinator for its first 20 years. With limited resources, Surbrook has managed to assemble one of the most advanced electrical technology teaching laboratories in the nation and constructed the country's only program for providing significant agricultural wiring training.

One of Surbrook's most cherished accomplishments of his time in the department is earning the respect from past graduates who have become leaders in their field or places of employment. He also speaks with great pride of the MSU IAT Electrical Technology Program, which continues to maintain the true land grant philosophy that MSU was built upon.

Thank you to Jon Althouse, MSU BAE and IAT electrical technology instructor, for sharing this tribute to Dr. Surbrook.

Alumni News

2015 MSU College of Engineering BAE Distinguished Alumni Award

Elaine P. Scott (Ph.D. '87, Agricultural Engineering, and Ph.D. '89, Mechanical Engineering) is dean of the newly formed School of Science, Technology, Engineering and Mathematics at the University of Washington (UW), Bothell.

Prior to joining UW Bothell in 2012, Scott was a professor of mechanical engineering at Virginia Tech. She has also served on the faculty at MSU, the University of Utah and Seattle Pacific University. At Virginia Tech, she was responsible for the successful planning, development and initial leadership of a new interdisciplinary, multi-institutional school, the Virginia Tech-Wake Forest University School for Biomedical Engineering and Sciences.

Dr. Elaine P. Scott (left) was presented with the 2015 MSU College of Engineering Biosystems and Agricultural Engineering Distinguished Alumni Award. Dr. Ajit Srivastava (right) presented the award.

In addition to her doctorate degrees in agricultural engineering and mechanical engineering from MSU, Scott holds a bachelor's and a master's degree in agricultural engineering from the University of California, Davis.

Singh receives 2015 GCHERA World Agriculture Prize

Professor Emeritus **R. Paul Singh** is the 2015 recipient of the Global Confederation of Higher Education Associations for the Agricultural and Life Sciences (GCHERA) World Agriculture Prize.

Singh is a world leader in food engineering education, having helped establish and evaluate food engineering programs at institutions in more than a dozen countries. His joint-authored food engineering textbook is available in five languages and considered the standard for food science and technology curricula throughout the world.

Dr. R. Paul Singh

2015 MSU Department of BAE Distinguished Alumni Award

Christopher R. Daubert (Ph.D. '96, Agricultural Engineering and Food Science) leads the Department of Food, Bioprocessing and Nutrition Sciences at North Carolina State University (NCSU), where he has been a faculty member since 1997. He holds a bachelor's degree in agricultural engineering from Pennsylvania State University and a Ph.D. in agricultural engineering and food science from MSU.

Daubert is an internationally-recognized expert on food rheology and texture and directs the Food Rheology Laboratory at NCSU. He and his research team have published more than 100 peer-reviewed manuscripts and chapters and mentored more than 20 graduate students and post-doctoral engineers and scientists. Daubert is a member of numerous professional organizations, including the Institute of Food Technologists which will recognize him as a Fellow in 2015.

Dr. Christopher R. Daubert

2015 MSU Department of BAE Outstanding Alumni Award

Eric LaChapelle (B.Sc. '06, Biosystems Engineering) is a senior systems engineer for Lockheed Martin, headquartered in Bethesda, MD. He holds a bachelor's degree in Biosystems Engineering from MSU and a master's degree in systems engineering from George Washington University (2009).

LaChapelle's work with Lockheed Martin has spanned satellite ground system development through vehicle launch and mission operations. In his current role of Technical Lead, he leads teams of engineers in accomplishing program milestones, identifying and mitigating risk, and identifying anomaly/failure root cause while ensuring the technical quality of products and compliance to process and engineering best practices.

Eric LaChapelle

Campus Happenings

Kempel appointed Dean of the MSU College of Engineering

Dr. Leo Kempel

Following a national search, Dr. Leo Kempel assumed the role of Michigan State University (MSU) College of Engineering Dean on July 1, 2014. He has been a faculty member in the MSU Department of Electrical and Computer Engineering since 1998, and served as the associate dean for research from 2008 until becoming acting dean of the MSU College of Engineering in 2013, a role he filled until his appointment as Dean. Previous to this, Kempel served as the inaugural director of the MSU High Performance Computing Center (2004-06) and associate dean for special initiatives (2006-08). He succeeds Satish Udpa, who now serves as MSU executive vice president for administrative services.

Kempel received a Bachelor of Science degree in electrical engineering from the University of Cincinnati in 1989 and a Master of Science degree and doctorate degree in electrical engineering from the University of Michigan in 1990 and 1994, respectively.

Secretary Vilsack visits MSU to announce new climate change initiative

Agriculture Secretary Tom Vilsack and Senior Advisor to the President Brian Deese visited Michigan State University in East Lansing on April 23, 2015. They announced details of a new initiative, "Building Blocks for Climate Smart Agriculture and Forestry", partnering with farmers, ranchers and forest¬land owners to address the threat of climate change by utilizing voluntary, incentive-based conservation, forestry and energy programs to reduce greenhouse gas emissions, increase carbon sequestration and expand renewable energy production in the agricultural and forestry sectors. During their visit, Vilsack and Deese visited the South Campus Anaerobic Digester.
(Photo credit: Sean Houlihan, USDA.)

In Memory

Alfred Murray

Alfred Murray (B.Sc. Agricultural Engineering '57), age 82, passed away unexpectedly Sept. 14, 2015. He worked 40+ years for the Ralston Purina Company. Murray is survived by his wife, Mary Murray; son, Larry (Jill) Murray of GA; grandson's, Matthew Murray of SC, and Garrett Murray of GA; brother, A.J. (Dorothy) Murray of Williamston; numerous nieces and nephews; brother-in-law, James Callahan; and sister-in-law, Pat. He was preceded in death by his parents; brother, Alex Murray; sister, Lorraine Maurer; and nephew, Timothy Murray.

Murray bequeathed $100,000 to the Alfred and Mary Murray Scholarship named scholarship in the MSU Department of Biosystems and Agricultural Engineering.

Kristee Anne Pickard

Kristee Anne Pickard (B.Sc. Biosystems Engineering '98) passed away July 3, 2015, from colon cancer. After graduation, she worked for Consumers Power.

She is survived by her son Alec.

Dr. Richard G. Pfister, Ph.D.

Retired Extension farm safety expert and interim chairperson (1979-1980), Dr. Richard Pfister, passed away at the age of 89 on December 29, 2015. Dick earned a Doctoral degree from MSU in the fields of safety, education and agriculture and was employed by the MSU Agricultural Engineering Department in 1955. He wrote forty bulletins and twenty technical papers before retiring in 1982. One of his finest accomplishments was his primary role in the design and regulations requiring slow moving vehicle signs.

He is survived by his devoted wife, Lydia; daughters Linda Fuller, Mary (Tom) Bradley and Nancy (Randy) Erridge; grandchildren Shaun, Kelly, Brian, Jeff, Nick, Nicole, Matt and Meghan; great-grandchildren Lydia, Samson, Jacob, Clayton and Macy.

Advanced Degrees Conferred

Name	Degree	Major Professor	Thesis Title
Fall 2014			
Emily Loraine Campbell	MS	Steven Safferman	Design Criteria for the Treatment of Milking Facility Wastewater in a Cold Weather Vertical Flow Wetland
Mahlet Tafesse Garedew	MS	Christopher Saffron	Lignin Depolymerization and Upgrading Via Fast Pyrolysis and Electrocatalysts for the Production of Liquid Fuels and Value-Added Products
Matthew Ryan Herman	MS	Amirpouyan Nejadhashemi	Optimization of Environmental Flow to Preserve/Improve Ecological Function
Ryan Michael Julien	MS	Steven Safferman	Evaluation of Organic Loading and Hydraulic Rest Period of Food Processing Wastewater Irrigation to Prevent Mobilization of Transition Metals
Bharathi Murali	MS	Jade Mitchell-Davis	Comparison of the Recovery of Bacillus Anthracis and Bacillus Thuringiensis Spores from Porous Media: Considering Time and Moisture Content
Ahmed Mustafa Rady	PhD	Daniel Guyer	Evaluation of Physiological Status of Potato Tubers Using Spectroscopic and Hyperspectral Imaging Systems
Spring 2015			
Kristen Margaret Henn	MS	Christopher Saffron	An Energy Analysis Comparing Biomass Torrefaction to Wind with Natural Gas Combustion for Electricity Generation - Plan B
Zhenhua Ruan	PhD	Yan Liu	Developing Novel Biological Processes to Convert Lignocellulose into Lipid Based Biofuel
Summer 2015			
Younsuk Dong	MS	Steven Safferman	Enzyme Pretreatment of Fats, Oil and Grease from Restaurant Waste to Prolong Drain Field Effectiveness
Ian Hildebrandt	MS	Bradley Marks	Quantifying sources of Error in Salmonella Thermal Inactivation Models for Meats and Low-Moisture Foods
Valerie Michelle Novaes	MS	Amirpouyan Nejadhashemi	Assessing the Impacts of Post-Construction Best Management Practices on Stormwater Runoff in an Ultra Urban Environment
Li Chai	PhD	Christopher Saffron	Integration of Decentralized Biomass Upgrading Depots and Centralized Catalysis to make Green Aromatics
Muyang Li	PhD	David Hodge	Understanding Plant Cell Wall Phenotypes that Contribute Recalcitrance to Alkaline-Oxidative Pretreatments and Enzymatic Hydrolysis
Xiaoqing Wang	PhD	Wei Liao	Developing a Transgenic Microalga to Enhance Algal Starch Utilization for Fuel and Chemical Production
Sean Alexander Woznicki	PhD	Amirpouyan Nejadhashemi	Development of a Comprehensive Framework to Assess the Impacts of Climate Change on Stream Health

Bachelor of Science Biosystems Engineering Degrees Conferred

Fall 2014
Danielle Nicole Brickner
Nichole Candra Erickson
Andrew William Plouff
David Joseph Stromberg
John Thomas Venn

Spring 2015
Evan Edward Austin
Danielle Kathleen Boileau
Robert Caleb Bruhn
Travis Ryan Collings
Lucas Andrew Flynn
Taylor Joy Folkertsma
Elizabeth Ann Gregory
Andris Karlis Grinvalds
Dimitrius Gordon Innis
Rachel Elizabeth Kurzeja
Mariana Madrigal-Martinez
Celina Merhi
Kristine Jill Nguyen
Julia Leigh Otwell
Lauren Marie Prochazka
Christopher Nicolas Ross
Scott Jeffrey Rubin
Brian Matthew Smith
Andrew William Stoffel
Mackenzie Ann Tocco
Samantha Lynn Walby
Alexander Holt Whitlow
Alexis Erin Wloch

Summer 2015
Stephen Porter Jones
Jacob Michael St. Louis
Allison Anne VanderKolk

2015-2016 Scholarship Recipients

Undergraduate

F.W. Bakker-Arkema Endowed Scholarship
Kayla Cascarilla
Linda Lay
Linnea Riddell

Walter M. & Lillie M. Carleton Endowed Scholarship
Renee Schwartz

DeBoer Family Scholarship/Fellowship Fund
Alexis Baxter
John Blackhurst
Paige Crosset
Nathan Majeski
Gina Masell
Aubrey Proctor
Rebecca Prouty
Jacqueline Thelen

A.W. Farrall Scholarship
Xuhao Dai
Christine Isaguirre

Robert J. Gustafson Scholarship
Anna Nelson

Clarence & Thelma Hansen Scholarship
Daniel Buhr
Robert Munro
Christopher Walker

Howard & Esther McColly Scholarship
Jacob Cochrane
Joseph Kretowicz
Jillian Toaso
Shuman Zhang

John & Julianna Merva Scholarship
Christine Isaguirre

Graduate

College of Engineering Outstanding BE Graduate Student Fellowship
Zhiguo Liu

BAE Endowed Fellowship for Graduate Student Excellence
Rui Chen

Galen & Ann Brown Scholarship
Kaitlyn Casulli

Merle & Catherine Esmay Scholarship
Ronald Esteban Aguilar

Bill & Rita Stout Scholarship
Mahlet Garedew

Outstanding BE Research Fellowship & Fitch H. Beach Award
Sean Woznicki

Left: Scholarship winners pictured with donors during 2015 Showcase Awards Banquet.
Above: Students (Aubrey Proctor and Jackie Thelen, far right) were partially supported by BAE scholarships to go on the Ecological Engineering in the Tropics Costa Rica study abroad program.

Support BAE

Support BAE and a BE student

On the previous pages, you will see the names of 29 students who received financial support from the MSU Department of Biosystems and Agricultural Engineering (BAE) for academics, study abroad, conference participation and other purposes. In addition, you also will see the names of 39 new alumni, many of whom received BAE scholarship support. In 2015-2016, BAE provided $58,000 in scholarships. We have many loyal and generous faculty, alumni and supporters listed below whose investment in the future of BAE helps BE students ensure a clean environment, safe food supply and healthy planet for all. We thank you for your continuing support.

No gift is too small, and this year we are excited to offer a new support option. Over the last five years, the BE take-rate for the Fundamentals of Engineering (FE) exam has trickled to nearly zero. The FE exam is an ABET accreditation benchmark. The BE faculty also believe strongly that the exam is an independent knowledge evaluation and resume builder for all BE students; however, the FE exam costs $220. To encourage students to invest time and money in the FE exam and diminish financial hardships, the department is supporting those students taking and passing the exam with a 50 percent scholarship match. We think this is a good future investment, and we've added a new account to the list below – A10436 BAE FE Exam Scholarship Fund. Please consider donating $110, $220 or more to support BE student(s) – your gift will make a difference to BAE and our students!

A104	Biosystems and Agricultural Engineering Fund
A1043	Biosystems and Agricultural Engineering Endowed Fellowship Fund
A1047	Agricultural Engineering Laboratory Enhancement Endowment Fund
A10426	Biosystems and Agri. Engr. Centennial Endowment Fund
A10416	F.W. Bakker-Arkema Endowed Scholarship Fund in Bio. Engr.
A10424	Galen K. and Ann J. Brown Endowment Fund
A10429	Walter M. and Lillie M. Carleton Endowed Scholarship Fund
A10431	DeBoer Family Scholarship/Fellowship Fund Biosystems Engineering Fund
A10402	Electrical Technology for Agriculture Fund
A10423	Katherine and Merle L. Esmay Endowed Fellowship Fund
A10404	Arthur W. Farrall Endowed Scholarship Fund
A10427	Robert Gustafson Endowed Scholarship Fund
AFF0156	Daniel and Anne Guyer Spartan Cornerstone Scholarship Challenge
A10401	Clarence and Thelma Hansen Endowed Scholarship Fund
A10411	Howard F. and Esther L. McColly Endowed Scholarship Fund
A10412	George E. and Betty L. Merva Endowed Scholarship Fund
A10432	John and Julianna Merva Undergraduate Excellence Fund
A10430	Alfred and Mary Murray Endowed Scholarship Fund
A10428	Deborah and Timothy Spehar Endowed Scholarship Fund
A10422	Bill and Rita Stout Expendable Scholarship Fund
A10436	Biosystems and Agricultural Engineering FE Exam Scholarship Fund

Make checks payable to: Michigan State University

Mail gift check to: Michigan State University Development
University Advancement
Spartan Way
535 Chestnut Road, Room 300
East Lansing, MI 48824

Donations can be made online at: givingto.msu.edu/gift/?sid=858

Faculty and Staff

Mohammad Abouali
Research Associate
mabouali@msu.edu

Umesh Adhikari
Research Associate
adhika12@msu.edu

Evangelyn Alocilja
Professor
alocilja@egr.msu.edu

Jonathon Althouse
Instructor
althous2@msu.edu

Barb DeLong
Secretary III
delong24@msu.edu

Kirk Dolan
Associate Professor
dolank@msu.edu

Darrell W. Donahue, CQE
Chair and Professor
ddonahue@msu.edu

Kathy Dorshimer
Accountant I
dorshim4@msu.edu

Louis Faivor
Research Assistant I
faivor@msu.edu

David Filipiak
Lecturer
filipia9@msu.edu

Aluel (Al) Go
Outreach Specialist
goaluel@msu.edu

Daniel Guyer
Professor
guyer@msu.edu

Nicole Hall
Research Assistant I
zarbnico@msu.edu

Timothy Harrigan
Associate Professor
harriga1@msu.edu

Philip Hill
Specialist
hillphi1@msu.edu

David Hodge
Associate Professor
hodgeda@egr.msu.edu

Amor Ines
Assistant Professor
inesamor@msu.edu

Michael James
Research Assistant II
jamesmi3@msu.edu

Sanghyup Jeong
Assistant Professor
joengsa1@egr.msu.edu

Dan King
Academic Advisor
kingd@egr.msu.edu

Dana Kirk, P.E.
Assistant Professor
kirkdana@msu.edu

Wei Liao, P.E.
Associate Professor
liaow@msu.edu

Yan "Susie" Liu
Assistant Professor
liuyan6@msu.edu

Renfu Lu
Adjunct Professor
lur@msu.edu

Bradley Marks, P.E.
Professor
marksbp@msu.edu

Jamie Lynn Marks
Administrative Assistant I
to the Chair
marksjam@msu.edu

Steve Marquie
Research Assistant I
wb9tow@egr.msu.edu

Steve Miller
Specialist
mill1229@msu.edu

Jade Mitchell
Assistant Professor
jade@msu.edu

Pouyan Nejadhashemi
Associate Professor
pouyan@msu.edu

Fei Pan
Assistant Professor
feipan@msu.edu

Wendy Powers-Schilling
Professor
wpowers@msu.edu

Luke Reese
Associate Professor
reesel@msu.edu

Dawn Reinhold
Associate Professor
reinho17@egr.msu.edu

Joan Rose
Professor
rosejo@msu.edu

Steven Safferman, P.E.
Associate Professor
steves@msu.edu

Christopher Saffron
Assistant Professor
saffronc@msu.edu

Ajit Srivastava, P.E.
Professor
srivasta@msu.edu

Truman Surbrook
Professor
surbrook@msu.edu

Timothy Whitehead
Assistant Professor
taw@msu.edu

Richard Wolthuis
Professional Aide
wolthuis@msu.edu

BIOSYSTEMS AND AGRICULTURAL ENGINEERING
MICHIGAN STATE UNIVERSITY
524 S. SHAW LANE, ROOM 216
EAST LANSING, MI 48824
517-355-4720

Keep up with what MSU Biosystems and Agricultural Engineering researchers and students are doing all over the world.

Connect with us:

Twitter: @MICHIGANSTBAE
Facebook: www.facebook.com/BiosystemsandAgEngineeringatMSU
LinkedIn: www.linkedin.com/BiosystemsEngineeringAlumniandStudents
Website: www.egr.msu.edu/bae