THE DEPARTMENT OF

Agricultural & Biological Engineering

AT
PURDUE UNIVERSITY
PRESENTS:

THE 6th ANNUAL ABE-GSA GRADUATE INDUSTRIAL RESEARCH SYMPOSIUM

Monday March 25th, 2019

#ABESymp2019

PROCEEDINGS OF THE 6TH ANNUAL ABE-GSA GRADUATE INDUSTRIAL & RESEARCH SYMPOSIUM

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We would like to thank the Purdue Office of Campus Master Planning and Sustainability, Ecological Sciences and Engineering Interdisciplinary Graduate Program, Purdue Ideas Festival, Agricultural and Biological Engineering, BioTownAg, Purdue Center for the Environment, Organic Solution Management, Trimble, Danone, and Huff&Huff for their generous support and participation with planning and executing this event.

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This is Day 1 of the 150th Ideas Festival event: SUSTAINABILITY FOR THE 21ST CENTURY.

Please join us for the 12th Annual Ecological Sciences and Engineering (ESE) Symposium on Tuesday, March 26th and Wednesday, March 27th! (QR code is printed below)

This year's Symposium is titled **In Data We Trust: Perceptions of Science in a Post-Truth World** and will be featured as part of the Purdue Sesquicentennial Ideas Festival addressing a Sustainable Economy and Planet.

You are invited to join us for the Symposium events listed below. We expect them to be engaging and exciting!

Visit the ESE Symposium website for more details and to RSVP while spaces are available! All events are free but space may be limited.

Science on Tap presents **Science on Display** combining science and art
Workshop: How to Illustrate Your Science
Panel: The Future of Science Communication
Keynote Address by Dr. Katharine Hayhoe: Science in a Fact-Free World
Poster Session and 3MT Competition through partnership with ABE-GSA.

We are grateful to the following companies for their participation in the event:

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S Y M P O S I U M S C H E D U L E

8:00-9:00am	**Registration & poster set-up – *PMU Hall***	
9:00– 10:10 am	**What will we eat in 2169?** ***KRAN G004***	**How will we travel in 2169?** ***KRAN G023***
	S.Corwin: Lost grain pita pockets **E. Federici**: Zein extrusion to improve gluten-free bread dough **K. Pal:** Process intensification for pharmaceutical and food manufacturing **A. Muniandy:** Application of temperature-dependent thermal properties for food product development in the food industry	**C. Hooker:** Developing genome engineering tools for anaerobic fungi **R. Wen:** Quantifying the life-cycle greenhouse gas emissions of a shared autonomous vehicle system **J. Overton:** Efficient conversion of glucose to platform chemicals **S. Daly:** Development of a model for early prediction of anaerobic digester performance
10:10 – 10:20 am	***Break***	
10:20-11:30am	**Where will we live in 2169?** ***KRAN G005***	**What will we drink in 2169?** ***KRAN G023***
	Y. Zhu: How does thermal remote sensing benefit modern agriculture? **L. Wachs:** Powering our homes: Generation capacity additions to the electric grid in California and the Mid-Atlantic **K. Lee:** Remote sensing data yield prediction based on CNN machine learning **M. Fenton:** Investigating a cereal killer: Exploring quantitative resistance to the parasite *Striga hermonthica* in sorghum	**S. Wang:** Estimating sediment transport capacity for overland flow **S. Ocana:** Development of a pilot smart water irrigation system for Peruvian highlands **V. Schull:** Analyzing FEW Nexus Modeling Tools for natural resource management applications **L. Sekaluvu:** Conservation tillage effects on phosphorus transport in a tile drained agricultural field
11:30 - 1:30 pm	**Poster Session & Networking Session—*PMU North and South Ballrooms*** **Refreshments provided in the North Ballroom**	
1:30 – 3:30 pm	***Break***	
3:30-5:30 pm	**3MT Thesis Competition—*PMU North Ballroom***	

	A. Mistry: Mesoscale interactions in porous electrodes **B. Rachunok:** Big data decisions to improve community resilience **M. Ghavami:** Investigating the need for a drainage layer in flexible pavements **J. Nielsen:** Unlocking the potential of neuropeptides to accelerated bone fractures healing via chemical homing to the bone fracture **J. Huang:** Plant vasculature is critical for phosphate signaling to improve productivity **J. Pecenka:** Integrating pest and pollinator management into Midwest agroecosystems **N. Shetty:** Dry powder inhaler: A game changer **P. Kashyap:** Functional and structural analysis of MRI data of mTBI in youth athletes **A. Reinert:** Detecting human machine interaction fingerprints in continuous event data **F. Cantarero:** Minimizing food loss in aseptic food manufacturing by using a Non-Intrusive Continuous Sensor (NICS) **R. Asadpour:** Cheaper solar energy - A way to secure the future of energy **S. Cleare:** A case study analysis of black female technology students experiences that inform their perceptions about persistence in STEM educational pathways	**M. Moini:** Additive manufacturing and performance of architectured cement-based materials inspired by nature **J. Andler:** Development of Cu_3AsS_4 thin film solar cells from microstructural evolution to environmental design **H. Channa:** Understanding solutions to post-harvest issues in Kenya and Tanzania **R. Ravi:** I-LIVE: Image-LiDAR Interactive Visualization Environment **P. Kashyap:** Functional and structural analysis of 4D MRI data of youth athletes **M. Tahir Patel:** Cost-minimized solar farm designs **K. Pal:** Process intensification in pharmaceutical manufacturing: How to make drugs cheaper? **L. Wachs:** Market acceptance of renewable energy: Forecasting short-term supply **S. Wang:** Estimating sediment transport capacity for overland flow condition **J. Knott:** Exploring four decades of ecological literature **M. Khangura:** Investigating a cereal killer: Exploring quantitative resistance to the parasite *Striga hermonthica* in sorghum
5:30 – 6:00 pm	***Break-Refreshments will be provided in the North Ballroom***	
6:00 – 8:00 pm	**Keynote Speaker, Awards & Concluding Remarks–** ***PMU North Ballroom*** **Dr. Jennifer Wilcox** **James H. Manning Chaired Professor, Chemical Engineering at Worcester Polytechnic Institute**	

KRAN – Krannert Hall, 403 W State St , **PMU** – Purdue Memorial Union, 101 Grant St

SYMPOSIUM GUEST SPEAKER

Keynote Speaker: What if Carbon Capture is the Next Moonshot?

Dr. Jennifer Wilcox is the James H. Manning Chaired Professor of Chemical Engineering at Worcester Polytechnic Institute. Having grown up in rural Maine, she has a profound respect and appreciation of nature, which permeates her work as she focuses on minimizing negative impacts of humankind on our natural environment. Wilcox's research takes aim at the nexus of energy and the environment, developing both mitigation and adaptation strategies to minimize negative climate impacts associated with society's dependence on fossil fuels. This work carefully examines the role of carbon management and opportunities therein that could assist in preventing 2°C warming by 2100. Carbon management includes a mix of technologies spanning from the direct removal of carbon dioxide from the atmosphere to its capture from industrial, utility-scale and micro-emitter (motor vehicle) exhaust streams, followed by utilization or reliable storage of carbon dioxide on a timescale and magnitude that will have a positive impact on our current climate change crisis. Funding for her research is primarily sourced through the National Science Foundation, Department of Energy and the private sector. She has served on a number of committees including the National Academy of Sciences and the American Physical Society to assess carbon capture methods and impacts on climate. She gave a TED talk on the direct removal of carbon dioxide from the atmosphere in 2018 and is also the author of the first textbook on carbon capture, published in March 2012.

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* giving a presentation during the category sessions.

Research Area Key

WWE = What will we Eat in 2169?
WWD = What will we Drink in 2169?
HWT = How will we travel in 2169?
WWL = Where will we live in 2169?
OTH = Others

1 Developing genome engineering tools and understanding gene regulation in anaerobic fungi

Casey Hooker, HWT

Advisor: K. Solomon

Early diverging anaerobic fungi (phylum *Neocallimastigomycota*) encode the largest array of lignocellulose degrading enzymes in the fungal kingdom, and are therefore poised to advance renewable biochemical technologies. However, there is a lack of tools to genetically engineer these organisms and exploit them for biotechnology. We are building a genome engineering toolbox for these organisms using a novel isolate of *Neocallimastix* as a model system (*Neocallimastix* sp. Gf-Ma). We demonstrate that our isolate is naturally competent for fluorescently-labelled nucleic acid probes of RNA and DNA. Natural competence is sufficient to introduce hygromycin resistance via an unstable plasmid that is supplemented every 3-4 doublings. Using this selection marker, we screen a fungal genomic library (~400 bp) to identify autonomously replicating sequences and centromeric sequences, which will be used to design a fungal plasmid for efficient manipulation of gene expression. We also examined the feasibility of gene integration via native homologous recombination systems, and CRISPR/Cas9. In addition to building and exploiting these tools, we are also examining the role of the epigenome on gene expression. Using histone deacetylase inhibitors to control H3K4 and H3K27 trimethylation, among others, we are able to increase xylanase activity by almost 100%. Our studies demonstrate for the first time that anaerobic fungi use epigenetic mechanisms for gene expression and establish their role in lignocellulose hydrolysis. Our work provides insight into the mechanisms that control anaerobic fungal plant-degradation abilities and develops facile tools to enhance activity for efficient plant degradation.

2 A molecular Modeling Approach to Sweetening Sour Natural Gas Using Soybean Oil

Emma Brace, HWT

Advisor: A. Engelberth

Predictive methods for sweetening natural gas using bio-based solvents provide an opportunity to add value to the soybean industry and develop an economical method for cleaning sour gas. Natural gas is a valuable fuel source that releases less CO_2 and fewer greenhouse gases than coal and gasoline. However, natural gas often contains high concentrations of hydrogen sulfide, a corrosive compound that damages processing equipment and is harmful to humans and the environment. Soybean oil is a readily available bioresource, composed of saturated fatty acids that offer binding sites for sulfur. While laboratory experiments can be costly and time-consuming, predictive models that examine interactions at a molecular level can be efficient tools for solvent screening and choosing process parameters. A statistical thermodynamics approach known as the Conductor-like Screening Model for Real Solvents (COSMO-RS) simulated the partitioning of hydrogen sulfide between liquid soybean oil and methane gas phases. Predicted partition coefficients for soybean oil, high-oleic soybean oil, and other combinations of fatty acids are compared. Physical experiments assist this study in providing fundamental proof-of-concept for using soybean oil as a bio-solvent in a new method for cleaning sour gas.

3 Shared Autonomous Vehicle Systems: How Many Are Needed and What Are the Sustainability Implications

Ruoxi Wen, HWT

Advisor: H. Cai

A shared autonomous vehicle (SAV) system has the potential to reduce the number of vehicles in need. However, SAVs may also increase the system's total mileage traveled, due to the extra vehicle repositioning needs. The tradeoffs between the reduced fleet size and the increased vehicle-miles-traveled (VMT) of a SAV system remains unclear. This work aims to fill this gap by building an optimization model to determine the optimal SAV fleet size to satisfy given travel demands, evaluating the increase of vehicle miles traveled (VMT), and estimating the net environmental impacts from the life cycle perspective of a SAV system. Using the taxi fleet in Beijing as a case study, we use real world travel demands data as inputs for our model. The objective function is to minimize the autonomous vehicle (AV) fleet size to meet the known travel demands. The preliminary results show that SAVs can reduce the number of vehicles needed by 15% to 21.2%, but increase the total VMT by 20.4% to 34.3%. Accordingly, we compare the life cycle environmental impacts of the SAV system to that of a traditional system considering the reduced car manufacturing needs, the more frequent turn-over of AVs, the increased VMT, and the potential improvement of fuel economy due to autonomous driving. Insights gained from this study can help understand how the autonomous vehicles may affect sustainable urban system from the life cycle perspective and inform policy decisions for SAV system development and deployment.

4 Improving Modelling in the Biomethane Potential Test

Sarah Daly, HWT

Advisor: J. Ni

There is an increasing concern about water, soil and air pollution from animal wastes. Anaerobic Digestion (AD) is a mature and cost-effective technology that uses a mixed microbial community to convert pre-existing wasted biomass to bioenergy (methane). The Biomethane Potential Test (BMP) can predict the feasibility of a substrate for AD and is performed in batch mode at a lab scale. However, the accuracy of the BMP test to predict methane yields is low and should be improved. My objective is to develop an improved model for predicting substrate biodegradability, hydrolysis, and methane production from the BMP test to better serve large-scale digester application.

5 Anaerobic Digestion of Biodiesel Waste Products: Challenges and Future Research

Jennifer Stevens, HWT
Advisor: N. Mosier

The biodiesel industry produces organic byproducts such as biodiesel wastewater and crude glycerol. These byproducts have little value without additional treatment but disposal can be costly. Anaerobic digestion is one potential disposal method that has the added benefit of producing usable methane gas. Studies have shown that digestion of crude glycerol and biodiesel wastewater is possible. More research is needed to determine if co-digestion with other feedstocks, such as manure, would be more effective and determine quantities of nutrients that would need to be added for effective digestion of the single feedstock.

6 Quantifying the Environmental Benefits of Bike Share Systems.

Zhaoyu Kou, HWT
Advisor: H. Cai

Bike share is an emerging mode of transportation in urban systems. As one type of travel, biking not only can contribute to the sustainability of urban transportation by reducing traffic congestion and emissions, but also help improve human health. However, few studies have evaluated how bike share systems (BSS) are used to quantify their sustainability impacts. This study aims to evaluate the environmental benefits of bike share systems by analyzing real-world trip data collected from the bike share systems in eight cities in the United States, including New York, Chicago, Boston, Philadelphia, Washington D.C., Los Angeles, San Francisco, and Seattle. A stochastic simulation model is proposed to estimate the transportation modes substituted by bike share trips, considering factors including trip distance, trip purpose, and the accessibility of public transits. Our analysis reveals that the annual GHG emission reduction from the eight BSS in year 2016 ranges from 5,145 tons of CO_2eq in New York to 39 tons of CO_2eq in Seattle. The emission reduction from BSS only contributed to less than 0.1% of the total transportation sector emission in these cities. Philadelphia and Chicago have the best performance regarding carbon emission reduction per mile travelled. Bike share stations in the city center reduced more overall GHG emissions than stations away from city center. In contrast, trips starting from the city center generally reduced less emission, compared with trips taken in suburban area.

7 Analysis Of E-Scooter Trips And Their Temporal Usage Patterns

Mingmin Liu, HWT
Advisor: D. Bullock

With the recent rise of e-scooters as an alternative transportation choice, it is critical to understand their utilization trend in the micro mobility and shared use sector. This Poster analyzes three months of data acquired from the City of Indianapolis to provide an overview of temporal patterns and performance metrics of the e-scooter trips. More than 425,000 trips were made on 8400 scooters with a total distance coverage of roughly 475,000 miles. Analysis showed that around 60% of the trips were less than 10 minutes and nearly 65% of trips were less than one mile. On average,85% of scooters active on any given day were in use for less than 1-hour.

8 Estimating Sediment Transport Capacity For Overland Flow.

Shuyuan Wang , WWD
Advisor: *B. Engel*

A reliable estimation of sediment transport capacity is essential for soil erosion modeling. The objective of this study was to evaluate the performances of twelve widely used transport capacity functions with a wide range of hydraulic conditions and soil properties. The observations comparisons to observed data indicated that none of the selected twelve functions gave satisfactory results for transport capacity prediction using overall overland flow datasets in this study, and all of them gave very poor predictions for loess soil. Therefore, a new equation was developed for sediment transport capacity estimation. Among these twelve functions, the Ali equation gave the best fit for the whole dataset, but calibration is was necessary when using it for large sediment grains (>2 mm) or loess soil. The Yalin equation and the simplified Yalin equation worked better for soils than sands, and predictions for smaller sands (~0.2 mm) were acceptable. The Govers equation gave had relatively uniform performances for all datasets. The performance of empirical equations changed dramatically for different datasets. The new function developed in this study was generated based on dimensional analysis and gave good predictions within the range of hydraulic conditions and particle sizes in the datasets considered in this study. The results provided a summary of the transport capacity functions evaluated and suggests an improved function for modeling overland flow sediment transport capacity.

9 Analyzing FEW Nexus modeling Tools for Decision-Making and Management Applications

Val Schull, WWD

Advisor: M. Gitau

Looking at holistic approaches for natural resource management has become essential as estimates demonstrate that the demands for food, energy, and water will increase, indicating a need for assessing current and future stressors with these interdependent sectors of the Food-Energy-Water (FEW) nexus. A literature-based exploratory approach is taken in order to assess available FEW nexus modeling tools to determine the accessibility, knowledge gaps, and potential for including aspects that provide better insight into the nexus such as water quality, futuristic scenarios due to climate change, and varying scales within the nexus. A case study in the Matson Ditch Watershed was conducted using the methodology of The WEF Nexus Tool 2.0 to model the FEW nexus.

10 Responses of Streamflow and Baseflow Hydrology to Climate Variability and Land Use Dynamics in Urban Watersheds

Mohamed Aboelnour, WWD

Advisor: B. Engel

The change in both streamflow and baseflow in urban catchments has received considerable attention owing to their dramatic variation during recent decades. In this research, the impact of separate and combined impacts of land use and climate variability on the Little Eagle Creek (LEC) watershed in Indianapolis, Indiana are investigated by combined usage of statistical tests, hydrological modeling and land use maps. The temporal trends and change in meteorological data during 1980-2017 are detected by using non-parametric Mann-Kendall. Land use changes between 1992 and 2011 are determined by using transition matrix analysis. The Soil and Water Assessment Tool (SWAT) hydrological model is used to investigate the variation of streamflow and baseflow under different land use change and climate variability scenarios. The year 1998 is identified as the dividing year of the study period. Results showed that SWAT performed well in capturing the streamflow and baseflow in LEC; however, it exhibited better performance for the calibration period than for the validation period. During 1992-2011, about 30% of the catchment area was changed, mainly from cultivated agricultural areas to urban. The land use change shows a significant effect on baseflow; however, the combination of land use and climate variability has a greater impact on the variation of baseflow in LEC. Overall, variability in climate seems to strongly drive the variability in the baseflow and streamflow response in comparison to alterations due to land use change. The results obtained in this study provide useful information to improve the current understanding of hydrological components variation and for water resources planning and management as well as soil and water conservation in urban watersheds in Indiana and potentially beyond.

11 Hydrological connectivity structure is one of the driving factors of coastal plant community

Liu Jiakai, WWD

Advisor: B. Engel

Coastal wetlands have attracted much attention from governments, scientists and the public due to their dramatic degradation in recent decades and the consequent loss of their ecological, economic and social value. The coupling mechanisms among hydrology, edaphic factors and vegetation in wetland ecosystems is the key for wetland conservation and restoration. Hydrological connectivity frameworks provide a new perspective to study both hydrological behavior and the relationship with ecological processes. A case study conducted in the Yellow River Delta developed a new comprehensive hydrological connectivity structure index, Topographic Over Field Capacity Index (TOFCI), based on both soil water conditions and topographic characteristics to highlight the effect of hydrological conditions on plant communities among other environmental variables. The results provide three pieces of evidence that hydrological connectivity structures are one of the driving factors of wetland plant communities: 1) according to PCA results, the contribution of hydrological connectivity structure is the highest among all the environmental variables; 2) TOFCI values show significant difference among different plant communities; and 3) TOFCI is also significantly correlated to species composition and distribution according to the CCA and RDA results. Further, TOFCI is also positively linearly correlated to the plant coverage and biomass in intertidal flat wetlands according to linear regression analysis. Salinity, soil total nitrogen and soil total phosphorus are also crucial for plant community distribution and species composition and are also significantly correlated to salinity while none of them show statistical correlation with community structures.

12 Irrigation water management considering canal system conditions

Fan Zhang, WWD

Advisor: B. Engel

For arid and semi-arid regions around the world, one of the main challenges faced by water managers is how to improve the water use efficiency of limited irrigation water. Thus, reasonable water policies need to be planed for avoiding excess water allocation and undesired water leakage when managing limited irrigation water resources. This study aims to develop an interval multiobjective approach considering canal system conditions for helping irrigation-water managers solve the multiobjective problem under interval uncertainty in planning water policies. Irrigation canal system conditions in this study mainly refer to canal distribution reflected by topological relationships between canals and the irrigation district with canal seepage estimated by a multiple linear regression model. The proposed approach could address the conflicting objectives under interval uncertainty and help irrigation-water managers obtain more practical allocation schemes. This approach was applied to the middle reaches of Heihe River basin for allocating limited irrigation water among multiple irrigation districts to demonstrate its applicability and practicality. This approach is valuable for improving the feasibility of optimal results, and it provides a possible way to take these important factors into account for related research in practical water management problems.

13 An index model for load estimation and infrastructure selection in the urban catchment

Xi Luo, WWD

Advisor: B. Engel

Models provide effective ways in assessing hydrological and pollutant load reduction performances of infrastructure practices and can guide infrastructure selection in the design phase. However, most models do not consider the effects of infrastructure on baseflow, the level of participation of multiple stakeholders, and data requirements. We developed a model (LEIC) for infrastructure selection considering the influence on the baseflow, flood risk, water pollution and costs. The model was customized considering engagement levels of stakeholders and did not require much data due to its simplified structure. The model was used to test thirty-five scenarios of infrastructure combinations, by combining two types of infrastructure, two runoff control rates of green infrastructure (GNI), three catchments with imperviousness gradients and three climate conditions. Based on the case study of urban catchmments in Shenzhen, China, the modelling results were validated. The results indicated that optimal choices varied over stakeholders' preferences; when considering the hydrological and pollution reduction functions alone, GNI practices are the optimal scenario; when considering flood risk management, combinations of grey infrastructure (GYI) and GNI are the optimal strategies; while taking multiple factors including economic factor into account, GNIs are the optimal plans. The model offers a novel approach to investigate the impact of infrastructure and provide guidance for sustainable urban drainage systems (UDSs) considering multiple stakeholders.

14 Evaluation and optimization of agricultural water resources carrying capacity in Haihe River Basin

Xin Zi, WWD

Advisor: B. Engel

The shortage and uneven spatial and temporal distribution of agricultural water resources have seriously restricted the sustainable development of regional society and economy. An improved five-element connection number set pair analysis model was constructed to evaluate the agricultural water resources carrying capacity (AWRCC) in the Haihe River Basin. Based on the evaluation results, an optimization model (AROL model) is proposed to optimize the effective irrigation area and groundwater exploitation to achieve a better level of AWRCC. The evaluation result shows that the current AWRCC of Haihe River Basin is relatively low. The AWRCC of Beijing, Tianjin, Hebei, Henan, and Shandong are rated IV and overloaded, among which Shandong has the lowest comprehensive score and the most serious overload. The optimization result shows that the extraction and conservation of groundwater in most areas of the Haihe River Basin are unbalanced, and the effective irrigation area needs to be increased. With different current conditions in different areas, the groundwater exploitation and the effective irrigation area are correspondingly adjusted.

15 Investigating demographic factors that influence the public's involvement in water management practices.

Theresa Ingermann, WWD

Advisor: S. McMillan

There has been an increasing push for public participation and engagement in water management, including stormwater management, pollution regulation, and flood control. Community involvement is important because it engages citizens that are directly impacted by practices that influence environmental quality and it can lead to better outcomes of these practices. Involvement can include reporting actions that negatively impact water quality, actively volunteering to reduce pollution in local waters, and willingness to pay fees to reduce flooding and water pollution. My research aims to gain a better understanding of the social factors that influence participation in water management. Specifically, I am investigating the impacts of race, income, and knowledge on participation in stormwater management in Charlotte, NC. Charlotte-Mecklenberg Storm Water Services (CMSWS) conducts annual surveys on residents' knowledge and awareness of stormwater. Charlotte is the biggest city in North Carolina and is experiencing rapid growth, making it an ideal city for examining urban water management practices. The CMSWS survey data (n = ~400 each year) from 2014, 2016, and 2017 is currently being analyzed using univariate statistics and multiple regression analysis. Preliminary analysis of the 2014 survey showed that higher levels of concern equate with greater participation and that older residents are less likely to participate in volunteering. I will examine how public engagement and the factors affecting engagement change over time. The longitudinal analysis will examine the responses to similar questions spanning the 2014, 2016, and 2017 surveys and relate the responses across the years. The results from this research can be used to help tailor environmentally-centered programs to better appeal to the public and to encourage a higher percentage of public engagement.

16 Spatial Analysis of Environmental Quality for the St. Mary's River Watershed

Garrett Illa, WWD

Advisor: S. McMillan

Water quality in Lake Erie has experienced a resurgence of hypoxia and toxic algal blooms since the 1990s. Water degradation is attributed to excess nutrients supplied from intensive agriculture, as well as livestock waste, failing septic systems, and wastewater from urban areas. The St. Mary's River watershed, part of the larger Maumee River watershed, is an important tributary to the western basin of Lake Erie and is a significant source of contaminants due to its high agricultural productivity. Locating source areas within the St. Mary's River watershed with the greatest potential for improvement enhances understanding of Lake Erie's degradation. To identify the source areas of greatest concern, I conducted a spatial analysis of the St. Mary's River watershed utilizing the ArcGIS platform. I am analyzing this data using an exploratory data analysis approach to identify trends and correlations between spatial data and water quantity and quality data. Relationships will be tested using simple and multiple linear regression models and uni/multivariate statistics. I will use these trends and relationships to assess the current state of the St. Mary's River watershed. This work builds a foundation for modeling the river basin to predict future conditions and develop best management practices to mitigate further nutrient loading. I expect the results will help identify solution opportunities for extension members and for the community within the St. Mary's River watershed.

17 Monitoring Drinking Water Chemical Quality Changes at a Residential Plumbing System

Tolu Odimayomi, WWD

Advisor: A. Whelton

Growing interest for water conservation has led to an increase in water efficient technology such as low flow faucets. However, our water systems where not designed to handle these low flows meaning that water spends more time in our pipes. Source water quality may affect pipe corrosion, contaminant adsorption, and scale formation and dissolution. In this study an innovative residential building was monitored to better understand and predict water quality and health risks posed by declining water usage and low flows. TTHM levels, pH, temperature, dissolved (DOC) and total organic carbon (TOC), and heavy metal concentrations were intensively monitored in a residential building for 1 year (n=50). The home contains four-year-old crosslinked polyethylene plumbing. The water entering the house had an average pH of 7.7 ± 0.1 and temperature of 19.5 ± 3.8°C. Measurements from seven locations in the house had a pH and temperature ranges of 7.3-9.4 and 17.2°C -28.4°C, respectively. The TOC concentration at the service line was 0.50 ± 0.12 mg/L and often was found inside the building at 1.19± 0.62 mg/L (hot water) and 3.65 ± 7.61 mg/L (cold water). DOC represented about 90% of the organic carbon. Results indicate that water entering the house had a TTHM concentration of 1.6± 2.1 μg/L while concentrations reached 36.3 μg/L within the house. As society moves to become more water conscious, we must thoroughly understand the consequences that accompany our growth in water conservation. Study results provide insight into how water quality varies within residential plumbing.

18 Detecting Agricultural Management Practices from Space

Ryan McGehee, WWD

Advisor: B. Engel, D. Flanagan

Agricultural management is one of, if not the most, important driver of non-point source pollution, and it is directly related to crop yield, soil health, and hydrology. Knowing how fields are managed can provide critical insight into all of the following: Crop yield forecasts (prices); Sediment losses and mobility; Nutrient loading and leaching; Eutrophication (algal blooms); Fertility (sustained production); Climate resiliency (adaptation).

19 Development of a Pilot Smart Water Irrigation System for Peruvian Highlands

Santiago Guevara Ocana, WWD

Advisor: J. Garcia

With growing developments in the technology of cloud storage and IoT, smart systems have become the latest trend in irrigation systems around the major agricultural bodies of the world. The Arequipa region located in the southwest section of Peru is one such region which faces an acute problem of low precipitation. Precipitation is minimal, at around 75 mm per year. The area also does not have an electrical grid in many of the agricultural regions which provides limitations on the types of irrigation methods that can be supported in the region. Currently, 20 ponds are used for irrigating approximately 545 hectares of the land in the Arequipa region near Majes. In order to develop optimal techniques for water irrigation in Arequipa and improve the irrigation infrastructure, there is a need to develop a smart water irrigation system applicable to the existing conditions in the region. The current study proposes such a pilot smart water irrigation framework comprising of a drip irrigation module, wireless communication module and a sensor network towards intelligently regulating flow. In this study, a TEROS 12 soil moisture sensor is connected with a Digi Xbee wireless module collecting the metrics of soil moisture, temperature and electrical conductivity of the soil. This collected information is sent through a secure programmable IP gateway to the cloud. A user-friendly web interface is available for end users to access and analyze the real-time data from the information cloud. The proposed framework is easily implementable, and it is predicted to conserve water by 30%, reduces the operational irrigation cost and has a low development cost.

20 Nutrient Transformation and Retention in Floodplains Along the Wabash and Tippecanoe Rivers

Matthew James Baker, WWD

Advisor: S. McMillan

Prolonged inundation of soils can improve water quality by promoting sedimentation of particulate nitrogen and phosphorus, denitrification, and assimilation of nitrogen and phosphorus. This research assessed the impacts of inundation on the transformation, retention and release of nitrogen and phosphorus from floodplain soils and how processes differ across gradients of hydrologic connectivity and management practices. Soil cores were collected along lateral and longitudinal connectivity gradients from four floodplains near the confluence of the Tippecanoe and Wabash Rivers in March 2018. The cores were incubated with river water for 21 days and sampled through time. In floodwaters, soil microbes will consume dissolved oxygen faster than can be replenished, lowering dissolved oxygen, then using nitrate as an electron acceptor. Nitrate concentrations are reduced and N_2 is released. Decomposition of organic matter and lack of oxygen that inhibits nitrification increases the ammonium concentration. High concentrations of metal-bound phosphorus in the soil and low dissolved oxygen can cause reductive dissolution of phosphorus and release the phosphorus back into the water. Based on these assumptions, nitrate concentrations are expected to decrease in the surface water column while ammonium and phosphorus concentrations are predicted to increase. Quantifying and understanding potential release and retention under long-term inundation will assist engineers and floodplain managers in designing and managing floodplains to maximize water quality benefits.

21 Characterization of steel slags in flow-through experiments: an approach to evaluate the potential efficacy of P sorption materials in P removal structures

Isis S P C Scott, WWD

Advisor: L. Bowling, C. Huang

Excessive phosphorus (P) in surface waters is one of the key drivers of eutrophication. P removal structures are an innovative technology developed to reduce excessive dissolved P in runoff, drainage water and wastewater, preventing or mitigating P delivery from urban and agricultural environments to water systems. One of the determining factors for the success of these structures is the type of P sorption material (PSM) being used. Steel slag, a byproduct of the steel industry, is an example of a PSM proven to be efficient in sequestering dissolved P from water. Its P sorption capacity can substantially vary, mostly because different steel-making processes can generate this PSM. Potential impacts of oversimplifying the behavior of slag include over- or under-predicting P removal, leading to the design of inadequate structures or overly expensive structures. In this study, we characterized 18 different slag samples from different plants and steel-making processes. We explored chemical and physical properties, P removal ability and their variability across the different samples. Additionally, we evaluated the efficacy of aluminum-coating, a technology aiming to improve the P sorptive qualities of steel slag. We concluded that P sorption potential and chemical properties of steel slags should not be considered uniform among all steel slag samples. Rather, a specific and careful characterization is necessary for each steel slag sample, since its intrinsic characteristics are master variables in determining its potential for removing P. Al-coating is a substantial aid for those slags that did not show a satisfactory performance.

22 Assessing Social And Biophysical Drivers Of Water Quality Improvement Practices Across Rural-To-Urban Landscapes

Jonathan Mills, WWD

Advisor: S. McMillan

Effective control of nonpoint source (NPS) pollution is critical for both long-term health of freshwater ecosystems and the socioeconomic welfare of human communities. Previous research has focused on water quality management through implementation of best management practices to reduce NPS pollution from agricultural and urban land uses. However, there is a critical need to incorporate individual residents' willingness to adopt conservation practices to more accurately quantify the water quality improvement potential at the watershed scale. Our study integrates water hydrological models with human dimensions data from a survey to assess the biophysical potential and social acceptance of conservation practices to improve water quality. We focus on the East Branch Little Calumet River watershed and the Trail Creek watershed in Northwest Indiana. Our preliminary modeling results show that current N, P, sediment, and *E. coli* loading from the two watersheds to Lake Michigan are unevenly distributed across five resident groups (urban residential, suburban residential, rural residential, small agricultural, medium/large agricultural). The two agricultural groups and the suburban residential group exhibit higher loads of all simulated pollutants. Resident willingness to adopt conservation practices that reduce pollution loading also varies across groups. Results will allow us to project different groups' willingness to adopt conservation practices onto the watershed and to calculate the resulting reduction of pollution loading to Lake Michigan. Our results can be used to help watershed managers and planners to better identify, prioritize and implement conservation practices with the highest water quality improvement potential and social acceptance.

$\boxed{23}$ Understanding the Water-Food-Energy nexus in Colombia: An exploratory study in the Otun River watershed

Camilo Torres, WWD
Advisor: M. Gitau

Transforming our world: the 2030 Agenda for Sustainable Development (the 2030 Agenda) was adopted unanimously by the 193 Member States of the United Nations in 2015. In this agenda, 17 Sustainable Development Goals (SDGs) were defined as a blueprint to achieve a better and more sustainable future for all (United Nations, 2019). Evidence that improved water, energy, and food security can be achieved using a nexus approach was presented in the 2011 Bonn Conference. This nexus approach could help to advance in improving SDG 2 (Zero Hunger), SDG 6 (Clean Water and Sanitation), and SDG 7 (Affordable and Clean Energy). Research projects related to the nexus have been conducted in North America, Europe, Asia, Africa, and Oceania. Unfortunately, research in this area in Latin American and the Caribbean is limited and just a couple of articles have been published in peer-reviewed journals. The work presented in this poster is the first step to understand the nexus in the Otun River basin, a watershed located in the western central part of Colombia. Currently, the relationship between land cover changes and water quality in the Otun River is being analyzed.

$\boxed{24}$ Lost Grain Pita Pockets

Sarah Corwin RD, CD, WWE
Advisor: B. Hamaker

A unique combination of ingredients and processing techniques allows a gluten free flour blend containing ancient grains to form a pita flatbread that retains gas and creates pocket formation. Ingredients are chosen based on sustainability and economic impact.

$\boxed{25}$ Building a Weed Detection System Using Machine Learning Methods on UAV-Based Imagery

Aaron Etienne, WWE
Advisor: Saraswat

The objective of this research was to develop a method to detect the precise location of weeds present in corn and soybean fields at different stages in the growing season. Our goal is to identify four different weed types by their common name, that tend to be the most problematic in Midwest fields. This detection method has the potential to be an important first step for broader Site-Specific Weed Management procedures (SSWM). This research involved: i) collecting color, multispectral, and thermal imagery from UAV based sensors in corn and soybean fields throughout the 2018 growing season, ii) using the normalized differential vegetation index (NDVI) to highlight vegetation in multispectral imagery ii) applying various image segmentation techniques to remove background features and reduce image noise in the processed imagery from the previous step, iii) create bounding boxes and hand label vegetation blobs from the processed imagery using color images as the ground truth, iv) creating a training set of these processed, labeled images that represent weeds at different crop growth stages.

$\boxed{26}$ Process Intensification for Pharmaceutical and Food Manufacturing: how to make drugs and food cheaper?

Kanjakha Pal, WWE
Advisor: Zoltan K. Nagi

Pharmaceutical Manufacturing (PM) is undergoing an era of rapid change. The rising costs of drug discovery has forced pharmaceutical companies to rethink their business model. This has given impetus for manufacturing innovations in PM to reduce the cost of producing new drugs. Process Intensification (PI) is a cost-reduction strategy for PM which reduces the number of unit operations. Traditionally PM first involved purifying the drug by crystallization from the upstream reaction mixture. This was followed by milling and granulation to increase the bioavailability and manufacturing of the Drug Product (DP). Spherical Agglomeration (SA) is a novel PI strategy which combines the three unit operations, thus decreasing capital and operating costs. My research involves process design of SA by gaining a thorough scientific understanding of the mechanistic processes behind in-situ agglomeration within the crystallizer. The US Food and Drug Administration's (FDA) is also encouraging pharmaceutical companies to shift from the traditional Quality by Testing (QT) to a Quality by Control (QbC) framework. My research also involves developing mathematical model-based process control algorithms for SA, coupled with in-situ measurements using Process Analytical Technology (PAT) tools. The combination of Process Intensification and real-time release of pharmaceuticals can dramatically reduce the manufacturing costs for the pharmaceutical and food industries with wide-ranging economic savings which will ultimately benefit the consumer.

27 Formulation of D-limonene CSNPs for plant and crop protection: A rational approach

Pablo Vega, WWE

Advisor: N. Mosier

Both chitosan and D-limonene have potential to be used in agriculture for plant and crop protection due to their immune-stimulant bioactivity.

The bioavailability and bioactivity of chitosan and D-limonene are enhanced when presented as nano-particles.

Chitosan-based carrier and D-limonene droplet size, polydispersion and stability are highly dependent on formulation variations and fabrication methods; therefore making it challenging to mass-produce them.

28 Corn yield prediction by DenseNet (CNN)

Tae Sup Lee, WWE

Advisor: D. Saraswat

Remote sensing data is widely available to the public domain. With machine learning, remote sensing data can be used as a corn yield prediction dataset. DenseNet performed well at extracting features from the input, and it was applied to a large-sized remote sensing image to predict yield for a large area in Indiana. Crops grow over time; therefore, temporal effects need to be taken into special consideration. Accuracy and spectrum of prediction could be further improved with the expansion of location and more images for the dataset.

29 Investigating a cereal killer: Exploring quantitative resistance to the parasite *Striga hermonthica* in sorghum

Megan Khangura, WWE

Advisor: G. Ejeta

"Sorghum (Sorghum bicolor [L.] Moench) is a staple food crop in some of the most food-insecure places in the world throughout Asia and Africa. In these regions where sorghum is grown, it is afflicted by a parasitic weed known as *Striga hermonthica*. *Striga hermonthica* is an obligate hemi-parasite that attaches to the roots of sorghum and can result in a total crop loss. Previously only one gene, low germination stimulant (LGS1) has been identified in sorghum whose loss-of-function confers partial resistance to the parasite by reducing the germination of *S. hermonthica*. The research presented here is the first to demonstrate that lgs1 results in a significant reduction of *S. hermonthica* in a segregating population, the PP37 multi-parent advanced generation intercross (MAGIC). In order to conduct a genome-wide association study, the PP37 MAGIC was phenotyped for two seasons in Northwestern Ethiopia, where *S. hermonthica* infestation is pervasive. In the first season a sub-threshold association with an FDR-corrected p-value of 0.07 was detected on chromosome zero that co-localizes with a QTL that was previously mapped by the only other study that has attempted to map genomic regions conferring resistance to *S. hermonthica* field resistance. This association was not detected when the experiment was repeated in the following season, which eludes to the highly qualitative nature of *S. hermonthica*. Effectively phenotyping remains the primary hinderance in advancing our understanding of the genetic architecture of *S. hermonthica* resistance in host plants such as sorghum and maize.

30 Concentration for the Detection of Food Pathogens from Food Matrices and Contaminated Water

Jessica Zuponcic, WWE

Advisor: M. Ladisch

According to the CDC, about 48 million Americans fall ill with a foodborne illness each year. Although pathogen detection methods may be rapid (*i.e.*, PCR), most food samples will not contain the requisite concentration of pathogens for detection. Before the detection step, lengthy sample preparation and enrichment processes (often > 24 hours) are necessary to bring pathogens to a detectable level. There exists a need for more rapid methods of enrichment to enable quick detection. Hollow fiber filtration has demonstrated ability to quickly concentrate microorganisms from dilute samples of various food matrices. Here, a review of results across several studies is presented to demonstrate each sample's unique challenges during filtration. Differences in sample composition, preparation, and filtration parameters affect the eventual recovery of pathogens from dilute samples.

31 Novel solar drying technologies for small and mid-size growers of specialty crops

Diana Gutierrez, WWE
Advisor: K. Ileleji

Solar dehydration of specialty crops has been studied as an important alternative for produce quality preservation and extension of shelf life. Small and mid-size farms are more price sensitive to energy costs and dehydrating using electric or gas-fired dryers can be quite expensive. Additionally, some of the alternative dehydration methods using fossil fuel denature the vital nutrients of vitamins in fruits and vegetables dried using them. In this paper, we would present the results of two solar dehydration systems that were developed at Purdue and being commercialized for use by small and mid-sized growers in the US and abroad. Studies using the DEHYTRAYTM and a prototype of the DEHYMELEONTM that were carried out in Indiana, Georgia and California drying tomatoes, mint, blueberries and apples in the summer to fall of 2018 will be presented. A set of lab and field experiments with theoretical modeling for these specialty crops, were carried to understand the drying performance of two novel technologies that combine open/closed sun-drying tray (DEHYTRAYTM) and a solar dryer (DEHYMELEONTM). Additionally, tests on color change, microbiology and Vitamin C denaturation were carried to evaluate the impact of the drying technologies on the final product quality. Variables as temperature, relative humidity and weight change were recorded for the modeling of performance and drying times.

32 Trends in Big Data Solutions in Agricultural Decision Support Systems using Twitter Data

Sneha Jha, WWE
Advisor: J. V. Krogmeier

Social Networking applications such as Twitter, Facebook, Linkedin, Instagram have evolved into a direct line of communication between 80 % of the population connected via internet. Twitter is a microblogging site with a 280 character limit. More than 500 million tweets/day are exchanged by 330 million active users globally. Visualization of real-time Twitter data has the potential to develop Decision Support Systems (DSS) for agricultural stakeholders. This research presents a preliminary analysis of Twitter data for keywords commonly used in precision agriculture.

33 Low-Cost User-Friendly Biosensors for Animal Health

Suraj Mohan, WWE
Advisor: M. Verma

Pathogenic bacteria and viruses pose serious health concerns and economic burdens in modern day animal agriculture. Due to the long processing times of traditional diagnostic tests, typical treatment of diseases caused by these biological agents involves trial-by-error antibiotic cocktails. However, this treatment strategy often results in antibiotic resistant bacteria and an increased risk of livestock death before successful care. As such, there is a growing need to develop diagnostic tests that can detect the presence of these disease-causing pathogens at a fraction of the time of traditional assays. This project aims to address such a need by developing a paper-microfluidic biosensor capable of testing animal samples for multiple infectious bacteria and viruses in a matter of hours rather than days. By applying alternative DNA-detection technologies and basic optical recognition, this biosensor will be capable of being more accurate and precise than traditional PCR screenings, while also being field deployable.

34 Hyperspectral characterization of wheat foliar nitrogen: integrating technology into wheat breeding

Raquel Peron, WWE
Advisor: J. J. Couture

Hyperspectral information has emerged at the forefront of data forms available with potential to advance phenotyping efforts. Spectral data represents a measurement approach to rapidly and non-destructively assess genetic variation in plant health, status, and functioning and in response to stress. Information contained in plant reflectance profiles provides the foundation for the retrieval of biochemical and physiological traits using mathematical techniques. Thus, the ability of reflectance spectroscopy to successfully characterize plant status is based on the physical interaction of light with the chemical composition, water content, and physical structure of plant tissue, resulting in reflectance profiles, which is the basis for spectral determination of plant identity and status (i.e., spectral phenotyping).
We tested the ability of hyperspectral data to predict nitrogen content in different wheat hybrids. We collected paired spectral data at leaf and canopy level and developed models using partial least square regression (PLSR). Final models for nitrogen content at leaf and canopy-level utilized the wavelength range 1000-2400nm. Our model very accurately characterized nitrogen content, with average R2 of 0.87, average RMSE of 0.34, average bias of 0.006. The prediction performance of models for nitrogen at canopy level models was slightly lower with R2 of 0.81, average RMSE of 0.35, average bias of 0.006. In conclusion, our project shows that spectroscopy applied to plant phenotyping is very efficient and produces accurate results to predict important plant traits, as nitrogen, that can be applied to predict another trait as nitrogen use efficiency and assist breeding programs.

35 Hydration properties of modified starches and lactose based products

Hector Lozano-Perez, WWE
Advisor: T. Carvajal

In the market there is a wide variety of products, which contain Lactose and Starch as a raw materials. Quality and stability is a matter of control, in the processes of formulating and developing new products. An analysis of the hydration properties of these products is presented, in which certain surface properties were measured, these could be modified to improve the wettability properties, and thus have better final product storage stability.

36 Understanding Market Acceptance of Renewables: Modeling Decision Making for the Addition of Generation Capacity to the US Electric Grid

Liz Wachs, WWL
Advisor: B. Engel

Despite popular support for renewable energy generation and concern over threats related to climate change, fossil fuels are still the mainstay of the electricity sector in the US. Furthermore, over 60% of new generation plants installed in 2018 are powered by natural gas, and this capacity will be online for the foreseeable future. Therefore, market acceptance seems to be an important hurdle for renewable energy. To better characterize the obstacles to the market acceptance of renewables, a framework is proposed to model the decision making process surrounding the addition of new power generation. Ordering of projects is done by multiobjective optimization using genetic algorithms to resolve a bounded knapsack problem, minimizing the levelized cost of electricity, human health costs, and greenhouse gas emissions. Then, net present values of projects are assessed, using two electricity markets, PJM (covering parts of 13 states in the Mid-Atlantic region) and CAISO (primarily California) as testbeds. Preliminary results show that renewables were selected most frequently in the cost optimization, with natural gas also present in ~10% of results. Net present value calculations suggest that capacity payments in PJM offer a higher incentive to fossil-fuel based plants. Lower capacity factors for renewables in PJM also deter their deployment. In CAISO the lack of capacity payments provide less incentive for the development of new capacity, meaning fewer plants get chosen. NPV calculations are highly sensitive to price and capacity factor within the range of possible future values.

37 Enzymatic Process for Soy-based polymers

Elena Robles, WWL
Advisor: N. Mosier

Synthesis of epoxides from alkenes of vegetable oil has been proved to be efficient using lipases from *Candida Antarctica*. Nevertheless, enzyme stability and reusability are critical for industrial applications of this process. Therefore the following research focuses on understanding enzyme kinetics over several runs of epoxidation on a single enzyme load. Results obtained suggest that enzyme activities are performed in 2 distinct reactions, the hydrolysis of triglycerides and the synthesis of peracids for subsequent epoxidation. With half-lives of 32 and 9 hours respectively.

38 Promoting the Expansion of Urban Agriculture and Green Infrastructure by Revealing Relationships between Socioeconomic Data and Green Areas

Megan Casey, WWL
Advisor: L. Snyder

For the first time in history, more people live in cities than in rural areas. Urban sprawl and the world population are both continuing to grow, and this exacerbates environmental issues in cities and the socioeconomic divides between different neighborhoods. In underprivileged areas especially, it is common for impoverished residents to live in a food desert, meaning they have no or poor access to grocery stores. Urban agriculture (UA) provides an opportunity to alleviate some of this pressure while also providing other ecosystem services, including supporting (e.g., nutrient cycling, soil formation), regulating (e.g., water and air purification), and cultural (e.g., aesthetic, educational) services. This paper explores the idea of co-locating the two practices, because both are known to provide ecological and cultural benefits to cities, yet they have not been studied due to data limitations, incompatible scales, and different goals and drivers of implementation by stakeholders. I am currently collecting available data on UA/GI in the city of Indianapolis, IN, by contacting small farm owners, supporting groups and agencies, and publicly available database. I am mapping the collected UA/GI data against social metrics such as race, income, and education level in GIS. My goal is to reveal patterns between UA/GI practices and socioeconomic data, and provide insight on locations at which expansion of UA/GI is needed and feasible.

39 L-moments based bias correction method for extreme rainfall events

Rohith A N, WWL
Advisor: M. Gitau

Bias correction of General Circulation Model (GCM) projected rainfall is prerequisite before using them in the climate impact studies. There has been a number of statistical bias correction methods developed and used for such purpose. However, most of these conventional methods are either sensitive to the presence of outliers, or they alter the GCM simulated trend, and some perform better only when the projected rainfall is within the range of historically observed data.

This study proposes a new L-moments based bias correction method, which can answer the drawbacks above. The developed methodology is demonstrated by correcting the bias of two GCM (MIROC5 and EC-EARTH) simulations at two City stations in India (Chennai and Hyderabad). The results of the bias corrections using the new method are compared with six widely used bias correction methods (Linear Scaling, Quantile Scaling, Power Transformation, Linear Regression, Quantile Mapping, and Distribution Mapping). Based on the performance in the calibration and validation it is observed that the L-moments based method outperforms all the six methods considered in correcting bias of extreme rainfall simulations. Further, a bootstrap sampling technique in the calibration and validation is applied to improve the confidence of the bias correction. It is witnessed that bootstrap sampling has improved the performance of all the bias correction methods. However, L-moments based new method has a better performance of all. These calibrated bias correction methods can be further used to derive bias corrected projections to use in hydrologic impact studies.

40 Region Based T1-MRI Changes in high School Athletes

Pratik Kashyap, OTH

Advisor: T. Talavage

Quantification of brain volume changes is a critical morphometric task when individuals may be at risk of longitudinal exposure to neurotrauma. Current automated tools (e.g,. SIENA-FSL) work only on a whole-brain basis, whereas we here present a novel approach to characterize region-specific volume changes using existing atlases. The new approach exhibits high sensitivity in detecting changes in athletes who experience repetitive subconcussive trauma coupled with a good replication of whole-brain findings from automated tools. The approach also facilitates group-level comparisons for (normalized) region-specific tissue volumes, allowing visualization of brain volume changes on a standard template/atlas. Performance was assessed against SIENA-FSL on a pooled dataset of high school (ages 14-18) collision sport athletes experiencing repeated subconcussive events (CSA: 17 female soccer; 21 male football), and age-matched non-collision athletes (NCA: 14 male; 14 female). CSA (soccer and football) underwent five MRI sessions keyed to the date of onset of collision activities (Pre=before; In1=1-6 weeks after onset; In2=5-9 weeks; Post1=15-20 weeks; Post2=26-29 weeks). NCA were imaged twice, 4-6 weeks apart, once before (Test) and once after (ReTest) training and competition onset. At each session, high-resolution anatomical imaging (1mm isotropic T1-weighted FSPGR; 16-channel Nova Medical Inc. brain array) was performed on a General Electric 3T Signa HDx. Each anatomical scan was registered via affine and high-dimensional nonlinear transformations to MNI152 standard space, and segmented into three tissue classes: gray matter (GM), white matter (WM) and cerebrospinal fluid (CSF). GM, WM volumes were sub-divided in each subject-session using parcellations of 278 and 20 regions-of-interest (ROIs), respectively. For both CSA genders, volumes of brain tissues (WM; GM; CSF) exhibited significant deviations during the season that largely recovered to pre-participation levels at Post2 (4-5 months post-season). Volumetric changes in brain tissues indicated a decrease in both GM and WM, with an increase in CSF. These changes varied longitudinally during continued participation in collision-based activities. All of these within-season changes are consistent with prior studies of acute dehydration, but are here observed in a more chronic form. Concern remains for the well-being of CSA given the relatively long duration of the observed changes in brain volume.

41 Comprehensive Lipid Profiling of Glioma Heterogeneity for Therapeutic Target Identification

Stephen Miloro, OTH

Advisors: K. Clase, J. Rickus

Glioblastoma (GBM) is the deadliest, incurable form of brain cancer. GBM cellular heterogeneity reduces efficacy of available therapeutics and limits clinical utility of molecular biomarkers in areas of diagnosis, treatment, and prognosis. Thus, there exists a critical need to investigate alternative molecules related to GBM heterogeneity, such as lipids, and their interconnections into druggable pathways to improve patient outcomes. Lipids have emerged as promising targets to address the clinical gap in patient treatment due to their prevalence in both normal brain and glioma tissue. Lipid biomarker research has been focused mainly on diagnosis, but there is evidence to suggest targeting lipids has potential to improve glioma disease management and treatment. GBM maintains a distinct lipid composition compared to normal brain, however, lipids remain widely untargeted in glioma treatment. To address the gap, our project will combine laser capture microdissection and mass spectrometry-based lipidomics to better define and capture areas of tumor adjacent brain and glioma tissue. Bioinformatics approaches will then be used to identify druggable lipid pathways and targets. Preliminary experiments revealed distinct lipid profiles in grade-I glioma compared to brain around tumor. Grade-I glioma tumor tissue expressed greater relative abundance of phosphatidylserine lipids compared to brain around tumor that expressed greater free fatty acids and cholesterol-related lipids. Our goal is to characterize the glioma lipidome, throughout glioma progression, to identify novel lipid targets and utilize findings to one day improve glioma treatment with current or novel-lipid modifying drugs.

42 Deterministic Modeling of Transforming Growth Factor-β2 Receptor Formation

Michelle Ingle, OTH
Advisor: D. Umulis

This research paper presents a computationally developed model of how the transforming growth factor (TGF) β2 pathway is activated through the interaction of receptor units on the cell membrane. TGF-β2 is a small secreted signaling protein vital to cell growth and development in the animal kingdom. Its full signaling capability is through a tetrameric complex made up of two TGF-β type I and two type II receptors (TβRI and TβRII, respectively). The TGF-β2 pathway relies on a nonsignaling coreceptor betaglycan in order to facilitate receptor interaction and resulting signal transduction. While it is known that betaglycan is essential to the tetramers formation, the mechanism of its action is not yet understood. With current literature and knowledge about this pathway, we developed deterministic models of betaglycan and TGF-β2 signaling. Through computational screens, we were able to test alternative hypotheses for betaglycans role in the pathway and find biologically relevant parameters for the unknowns in the formation of the receptor. Our early results suggest that betaglycan must function to alter reaction kinetics to confer the measured boost in complex formation and it cannot function as stronger source of available ligand to receptors. This model of the TGF-β2 pathway will enable researchers to exploit the subtle differences in the interaction between receptor species in order to develop effective TGF-beta inhibitors for treatment of cancer or fibrosis.

43 Proteome Characterization Of Mycobacteria-Mycobacteriophage Interaction

Ikenna Okekeogbu, OTH
Advisor: K. Clase

Mycobacteriophages are ubiquitous viruses that infect and kill mycobacteria. They have been reported to have potential uses in the field of biotechnology and medical science with applications ranging from disease diagnosis, through phage typing, phage vaccine and phage therapy. With the high prevalence of antibiotic resistant bacteria-causing infections, there has been a renewed call to exploit the bactericide characteristic of phages in the treatment of these infections. However, recent studies have also shown that mycobacteria are developing defense mechanisms to counter attacks from mycobacteriophages. To better understand this arms race in the phage-bacteria interaction at the molecular level, we used a model Mycobacterium host, *M. smegmatis* and a temperate phage, *Ochi17*, isolated at Purdue, to investigate and characterize the proteins regulated during this interaction using tandem mass spectrometry. A total of 2,129 proteins were identified in both infected and non-infected samples, and about 1800 proteins were common in both. Of these proteins, 331 were significantly upregulated, and 157 were significantly down regulated. Our findings showed that proteins involved in amino acid metabolism, homologous recombination, ABC transporters, nitrogenous base metabolism, fatty acid and vitamin metabolism pathways, were mostly regulated. Enrichment analysis revealed that the upregulated pathways, amino acid metabolism and homologous recombination were significantly enriched. Based on these findings, it seems that mycobacteria vigorously defend themselves against mycobacteriophages. This study provides the first investigation into the proteomics analysis and characterization of any phage-infected bacteria, and results provided can serve as a rich source for further molecular studies of phage-bacteria interactions.

44 Monitoring manure storage, handling, and transport cases by using coding and classification system

Mahmoud Nour, OTH
Advisor: G.Narsimhan

As part of ongoing surveillance of fatalities and injuries involving agricultural confined spaces by Purdue University's Agricultural Safety and Health Program, nearly 300 cases involving manure storage, handling, and transport equipment and facilities have been documented over the past 30 years. With the exception of a summary of 77 fatalities published by Beaver and Field1, these cases have not been previously analyzed or published due to a lack of resources and the limitations of the Purdue Agricultural Confined Spaces Incident Database (PACSID) which was designed primarily for analysis of grain-related cases. These limitations included differences in terminology used to code case information in the PACSID and dissimilar causative and contributing factors. To develop a consistent and more useful approach to process and analyze data, 28 U.S. manure-related incidents involving 39 victims documented as having occurred in 2017 were examined for type of incident, victim characteristics, primary contributing factors, and nature of injuries. A review of literature was conducted to identify previously reported contributing factors, and a coding rubric was developed and reviewed by a panel of experts. It was determined that the rubric provided a consistent way to code and analyze descriptive information available on each case. A pilot analysis was completed of the 39 cases using the new tool, and the results were summarized. The final methodology will be used to analyze all historically documented incidents, as well as future incidents. Findings presented include a review of relevant literature, discussion of the methods used in case documentation, classifications developed from sample data, and a summary of incidents in 2017. Anticipated outcomes include: 1) consistent strategy to document, code, and summarize manure-related incidents; 2) means of classification of key contributing factors; 3) identification of new or emerging trends; and 4) completion of previously documented incidents.

45 Determining the optimal traffic opening time using piezoelectric based sensors

Yen-Fang Su, OTH

Advisor: L. Lu

The very early age (the first 4 to 8 hours) strength of concrete is an important parameter to optimize the opening time for many construction projects such as concrete pavement and patching. During this period where the cementitious materials rapidly hydrates, rigorous monitoring is required to track strength gain. However, the current methods for monitoring strength gain are very inefficient. As such, it is a critical need to develop efficient nondestructive testing methods to monitor the strength gain of cementitious materials, especially their early age properties. In this study, the electromechanical impedance (EMI) method coupled with a piezoelectric sensor was applied to monitor the strength gain at the very early age to the early age. We systematically investigated the feasibility of using the EMI method in monitoring the compressive strength gain of mortar with five different common industry-used water-to-cement ratios from 0.38 to 0.46. The EMI admittance signatures were recorded for each sample at the testing period. Two frequency ranges were identified to be potentially optimal for impedance measurement based on the Root Mean Square Deviation (RMSD) index. A linear least squares regression analysis was employed to examine the correlation between the compressive strength obtained by conventional mechanical testing and the EMI-RMSD index. Fitting with our hypothesis, all of the mixes exhibit a linear correlation of R2 greater than 0.90 at both frequency ranges. The R2 of the frequency range 100-400 kHz even exceeds 0.95 and is recommended for conducting the EMI method at the early age. The experimental results reveal the promising capability of the piezoelectric-based EMI technology in in-situ monitoring of strength gain of cementitious materials.

46 Hyperstructured Illumination with Metamaterial Disorder

Emroz Khan, OTH

Advisor: E Narimanov

Hyperstructured illumination, a super-resolution method employing structured illumination on a hyperbolic medium, must account for disorder arising from material defects. We show that even without any information on disorder the imaging method allows for accurate image reconstruction with feature details 20 times below the diffraction limit.

47 Optimization of Ultrasound-assisted Extraction of Phenolic Compounds from Walnut Shells by Response Surface Method and Test Their Antioxidant Activity

Wenyi Fu, OTH

Advisor: Q.Xu

Walnut shells are rich in phenolic compounds, which have great antioxidant properties. They are not only plays an important role in reducing lipid oxidation in plant and animal tissues, but also maintain the quality of food, and reduce the risk of certain diseases. Ultrasound treatment significantly increase the efficiency of extraction, because it able to disrupt the cell wall, and increase the mass transfer of the cell content to the solvent by collapsing the bubbles produced via cavitation. Response surface method is used to optimize the process of ultrasound-assisted extraction of phenolic compounds from walnut shells. DPPH assay is (2,2-diphenyl-1-picryl-hydrazyl-hydrate) free radical method that used to test the antioxidant activities of phenolic compounds that extracted from walnut shells.

48 Bone Fracture-Targeted Dasatinib Conjugate Enhances Fracture Repair In Vivo

Mingding Wang, OTH

Advisor: P. S. Low

Approximately 6.3 million bone fractures occur annually in the USA, resulting in considerable morbidity, deterioration in quality of life, loss of productivity and wages, and sometimes death (e.g. hip fractures). Although anabolic and antiresorptive agents have been introduced for treatment of osteoporosis, no systemically-administered drug has been developed to accelerate the fracture healing process. To address this need, we have undertaken to target a bone anabolic agent selectively to fracture surfaces in order to concentrate the drug's healing power directly on the fracture site. We report here that conjugation of dasatinib to a bone fracture-homing oligopeptide via a releasable linker reduces fractured femur healing times in mice by ~60% without causing overt off-target toxicity. Thus, achievement of healthy bone mechanical properties at the fracture site is realized after only 3-4 weeks in dasatinib-targeted mice, but requires ~8 weeks in PBS-treated controls. We conclude that targeting of dasatinib to bone fracture surfaces can significantly accelerate the healing process at dasatinib concentrations that are known to be safe in oncological applications.

49 Three-dimensional strain engineering in epitaxial vertically aligned nanocomposite thin films with tunable magnetotransport properties

Xing Sun, OTH

Advisor: H. Wang

Three-dimensional (3D) frameworks have been successfully constructed by interlayering La0.7Sr0.3MnO_3 (LSMO)–CeO_2 based epitaxial vertically aligned nanocomposite (VAN) thin films with pure CeO_2 (or LSMO) layers. Such 3D interconnected CeO_2 scaffolds integrate the lateral film strain by the interlayers with the vertical strain in VAN layers, and thus achieve the maximized strain tuning in LSMO. More importantly, by varying the types of the interlayers (i.e., CeO_2 or LSMO) and the number of interlayers from 1 to 3 layers, such 3D framework nanostructures effectively tune the electrical transport properties of LSMO, e.g., from a 3D insulating CeO_2 framework with integrated magnetic tunnel junction structures, to a 3D conducting LSMO framework, where the magnetoresistance (MR) peak values have been tuned systematically to a record high of 66% at 56 K and enhanced MR properties at high temperatures above room temperature (∼325 K). This new 3D framed design provides a novel approach in maximizing film strain, enhancing strain-driven functionalities, and manipulating the electrical transport properties effectively.

50 Robot-based Environment Monitoring: Application to Sediment Monitoring

Jun Han Bae, OTH

Advisor: B-C. Min

Sediment has a significant impact on social, economic, and environmental systems. Thus, the importance of the effective sediment monitoring system is increasing and the baseline of the system is sediment sampling. Recently, automated bed sediment sampling systems based on Remotely Operated Vehicles (ROVs) have been developed in order to perform sediment sampling more frequently and effectively. The main goal of this research is to develop a robust bed-sediment sampling robot based on the understanding of the sediment and sediment sampling techniques for more effective sediment monitoring. In addition, we extend our approaches to Unmanned Aerial Vehicle (UAV) based sediment sampling system.

51 Unlocking the Potential of Neuropeptides to Accelerated Bone Fractures Healing Via Chemical Homing to the Bone Fracture

Jeffery Nielsen, OTH

Advisor: P. Low

Delayed fracture healing is a major health issue involved with aging, and strategies to improve the rate of repair and prevent non-union will substantially improve patient outcomes and lower healthcare costs. Here, we demonstrate that neuronal regulation of fracture repair can be utilized to accelerate fracture healing. All existing pharmacological strategies rely on invasive surgical implantation. Non-invasive drug therapies are not available for bone fractures, which represents a problem for the elderly. It has been observed that nerves that express substance P, vasoactive intestinal peptide (VIP), Amylin, and pituitary adenylate cyclase-activating peptide (PACAP) innervate the bone and respond to trauma. These peptides have been shown to have powerful osteogenic effects in vitro. However, these peptides have not been developed as therapies, because their receptors also play roles in the so many systems throughout the body. We have demonstrated that acidic oligopeptides can be used to selectively localize both small molecules and peptides to bone fractures, allowing for a noninvasive systemic administration via subcutaneous injection. We found that these bone-fracture-targeting ligands could be used to limit these peptides' localization just to the fracture site, thus minimizing their toxic off-target effects and increasing their efficacy to improve fracture healing. They all show promise as future therapies, as they all significantly improve the healing rate of bone fracture in a relevant in vivo models of bone fracture repair. This opens the possibility for the development of these compounds and other related potent bone anabolic neuropeptides as therapeutics for bone fracture repairTr

52 Do Heavy Metals Accumulate More on Cross-linked Polyethylene (PEX) or Chlorinated Polyvinyl Chloride (CPVC) Hot Water Plumbing Pipes?

Qi Wang, OTH

Advisor: A. Whelton

To reduce drinking water heavy metal concentrations, some metal piping system components are being replaced with crosslinked polyethylene (PEX) and chlorinated polyvinylchloride (CPVC) pipes. Evidence from plumbing studies indicate that heavy metal contaminants can accumulate on PEX pipe surfaces, but none was found for CPVC pipes. Bench-scale testing was conducted to better understand heavy metal deposition onto one brand of CPVC pipe and PEX pipe under hot water conditions where metals originated from brass couplings. PEX pipe and CPVC pipe rigs with and without brass fittings were prepared. For nine sequential 3-day exposure periods, rigs were filled with water pH 4, 100 mg/L as $CaCO_3$ water. After each exposure period, total organic carbon (TOC), pH, and total metal concentration were determined. During the first migration period, both PEX and CPVC pipes released a low level of organic carbon, 0.5-1.0 mg/L. Brass fittings leached Cu, Fe, Ni, and Zn to the water. After the nine migration periods, pipe sections were exposed to a 2% HNO_3 for 48 hr to extract deposited metals from the surface. Surface analysis of the PEX and CPVC pipes indicated similar Cu, Fe, Ni and Zn loadings. Pb loadings were greater for CPVC pipes (153 + 29 µg/m2) than PEX pipes (49 + 38 µg/m2) in brass coupling rigs, though Pb was not detected by XRF in the brass component. Evidence suggests that metals leached from brass fittings can deposit onto PEX and CPVC pipes. Additional work is needed to examine more realistic drinking water conditions.

53 Food Waste Improvements for Purdue

Madeleine L. Henderson, OTH
Advisor: L. Payne

Food and agriculture are some of the top contributors to greenhouse gas emissions, and production will only increase as world population increases. Decreasing food waste and making the food system more efficient will help make feeding the world more sustainable. At Purdue, some infrastructure exists for recovering some food waste; however, there was no centralized information about the various sources and destinations. The goal of this independent study was to map food waste streams at Purdue University, quantify existing practices, and to identify areas for feasible improvement. The resulting map comprehensively covers the campus and recommends short, mid, and long-term goals for implementation.

54 Solar Pico Crop Dryer (POD) for farm-level grain drying for smallholder farmers

Mingyuan Chen, OTH
Advisor: R. Stroshine

Maize is one of the principal food sources in sub-Saharan Africa. Adequate drying of maize is critical to prevent losses from the development of aflatoxin. The USAID funded Food Process Innovation Lab has determined a market need among smallholder farmers in Africa for on-farm grain dryers that cost less than $100, can be disassembled and transported at the back of a motorcycle, and can dry 90 kilos of grain in one day. We developed the Pico solar crOp Dryer (POD) to address this need with high energy efficiency. In the POD, the material to be dried is placed in plastic trays which are covered with plastic sheets that absorb solar radiation. Seven small fans of the type used for cooling electronics are used to move air through the dryer. In contrast with other dryers, in the POD heated air diffuses from above the maize to below it aided by evaporative cooling. Power is supplied by a 12-volt 20 Watt Solar Panel and a 12 volt 7-ampere hour lead acid battery. Preliminary tests conducted at Purdue in 2018 on freshly harvested maize at 30.5% mc, demonstrated that the POD could dry the maize to the safe storage moisture content of 13% in 25 hours which is 4 hours faster than the tarp drying. Tests were conducted at Kakamega, Kenya with the Kenyan Agricultural and Livestock Research Organization (KALRO). Recent efforts have focused on improving the performance of POD and modeling.

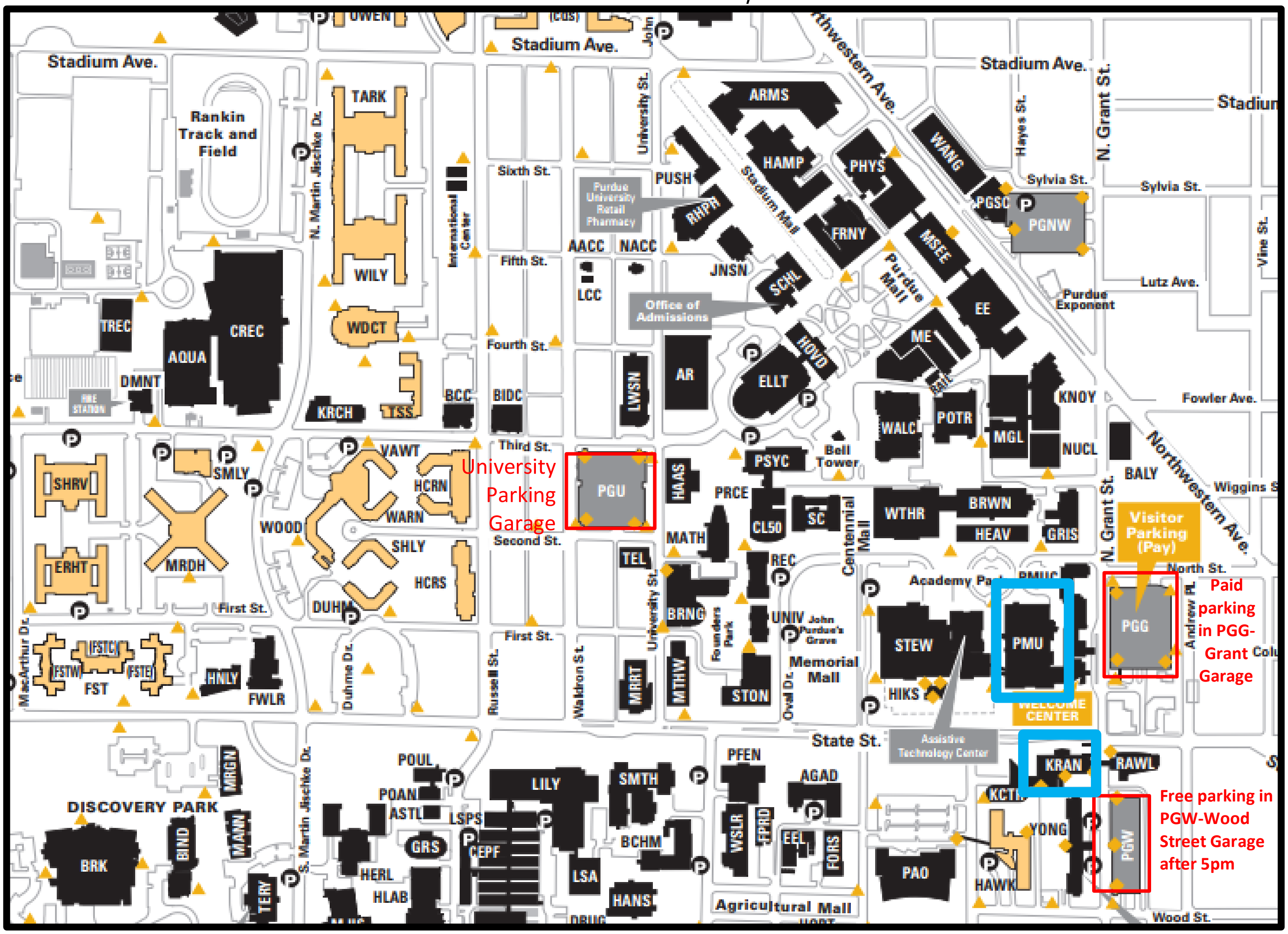
55 A Novel Paper-Based Diagnostic for the Detection of *Candida albicans*

Julianne Dejoie, OTH
Advisor: J. Krotz

Candida albicans is an opportunistic fungal pathogen responsible for a host of illnesses with severities ranging from irritating to lethal. Two such *Candida*-related illnesses are exceptionally notable for their prevalence and lethality, respectively: Vulvovaginal Candidiasis and Invasive Candidiasis. Vulvovaginal Candidiasis, commonly referred to as yeast infections, impacts almost 75% of women during their lifetimes. Current tests are prone to falsely diagnose bacterial vaginosis; this not only unnecessarily prolongs patient suffering but can lead to the inappropriate prescription of antibiotics, subsequently propagating antibiotic resistance. While less common, invasive *Candidiasis* is prevalent in immunocompromised patients and has a mortality rate of approximately 30%. Current culture-based diagnostics are simply too time consuming. To improve detection accuracy and timeliness, Purdue iGEM has worked to create a cell-less system utilizing a split horseradish peroxidase enzyme, which functions to produce a dramatic shift in color solely in the presence of *Candida*-specific biomarker

Purdue Campus Map with Symposium Locations Highlighted

KRAN – Krannert Hall, 403 W State St
PMU – Purdue Memorial Union, 101 Grant St



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