THE DEPARTMENT OF

Agricultural & Biological ENGINEERING

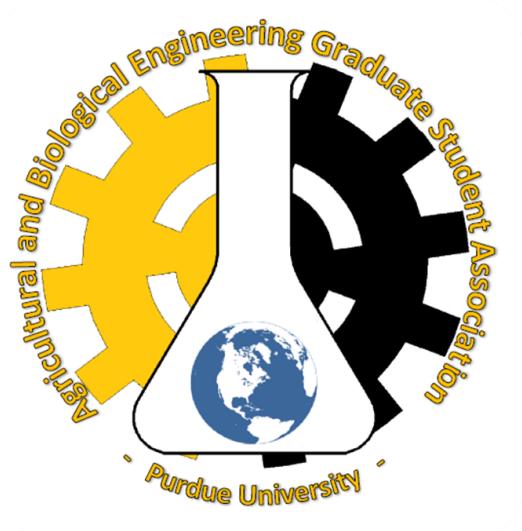
AT

PURDUE UNIVERSITY

PRESENTS:

THE 1ST ANNUAL ABE GRADUATE SYMPOSIUM

Thursday, March 6th, 2014



PROCEEDINGS OF THE INAUGRUAL ABE GSA GRADUATE SYMPOSIUM

Published by:
Department of Agricultural & Biological Engineering
College of Engineering, College of Agriculture
Purdue University

SYMPOSIUM ORGANIZERS

Symposium Chair:
Necla Mine Eren

Symposium Coordinators:
Garett Pignotti
Md. Shariar Karim

Session Chairs:

Erin Chichlowski	Environmental & Natural Resources Engineering
Jen Khan	Biological and Food Processing Engineering
Salah Issa	Fluid Power & Machine Systems Engineering.
Iman Beheshti	Bioenergy

Speaker Chair:
Natalie Chin

Poster Chairs:
Guy Bou Lahdou
Quingyu Feng

Food Service Chairs:
Emily Stewart
Andi Hodaj

Marketing Chair:
Anne Dare

Recruitment Week Liaison:
Carl Littrell

Faculty Chair:
Dr. Abigail Engelberth

The symposium organizers would like to thank to the College of Agriculture and the Department of Agricultural & Biological Engineering for their generous support of this event.

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

SYMPOSIUM SCHEDULE

Location – MRGN (Discovery Park) & *ADM Agricultural Innovation Center*

7:30 AM – 10:00 AM	*Breakfast (MRGN 102 – Café)*
08:00 AM – 9:00 AM	*Research Presentations 1 & 2* ***Environmental & Natural Resources*** *(MRGN 129)* Fushcia Hoover Joseph Trotochaud Rebecca Logsdon Anne Dare ***Fluid Power & Machine Systems*** *(MRGN 206)* Mike Sprengel Daniel Skelton Enrique Busquets Shaoping Xiong
9:15 AM – 10:15 AM	*Research Presentations 3 & 4* ***Bioenergy*** *(MRGN 129)* Mahdieh Aghazadeh Shane Clingenpeel Hu Shi Barron Hewetson ***Biological & Food Process Engineering*** *(MRGN 206)* Raymond Red Corn Necla Miné Eren Basudev Chowdhury Marisol Herrera-Perez
10:30 AM – 11:30 AM	*Industry Panel (Q&A) (MRGN 102 – Café)*
12:00 PM – 01:30 PM	*Plenary Speaker & Lunch (MRGN 121)*
02:00 PM – 03:00 PM	*Break*
03:00 PM – 05:00 PM	*Poster Session (ADM Building)*
05:30 PM – 07:00 PM	*Keynote Speaker & Dinner (ADM Building)*

SYMPOSIUM GUEST SPEAKERS

Plenary Speaker: Dr. Sonny Ramaswamy

Dr. Sonny Ramaswamy was appointed to serve as director of the USDA's National Institute of Food and Agriculture (NIFA) on May 7, 2012 by President Barack Obama. Dr. Ramaswamy has received research grants from many federal agencies, including USDA, National Science Foundation, National Institutes of Health, Environmental Protection Agency, and the United States Agency for International Development, as well as from state agencies, commodity groups, and industry. He has published nearly 150 journal articles, book chapters, and a book. He has received a number of awards and honors as a scientist and department head, including being named a Fellow of the American Association for the Advancement of Science; Fellow of the Entomological Society of America; and Distinguished Graduate Alumnus of Cook College, Rutgers University <usda.gov>.

Keynote Speaker: Dr. Lalit Verma

Dr. Lalit Verma, head of the Department of Biological & Agricultural Engineering at the University of Arkansas at Fayetteville, is the president elect of the American Society of Agricultural & Biological Engineers. Dr. Verma served as the head of the department of biological engineering at Louisiana State University before relocating to the University of Arkansas in 2000. He has gained international recognition through his research in post-harvest engineering and technology <arkansasbusiness.com>.

POSTER DIRECTORY

Poster #	Student Name	Research Area	Poster #	Student Name	Research Area
1	Wei-Zhen Liang	ASM	32	Anne Dare	ENRE
2	Matthew Koester	ASM	33	Anthony Hearst	ENRE
3	Mahdieh Aghazadeh	BIOE	34	Garett Pignotti	ENRE
4	Jinsha Li	BIOE	35	Joseph Trotochaud	ENRE
5	Shane Clingenpeel	BIOE	36	Ahmed Abdelnaby	ENRE
6	Leyu Zhang	BIOE	37	Andi Hodaj	ENRE
7	He Zhang	BIOE	38	Ruoyu Wang	ENRE
8	Hu Shi	BIOE	39	Qingyu Feng	ENRE
9	Ja Kyong Ko	BIOE	40	Rebecca Logsdon	ENRE
10	Ximing Zhang	BIOE	41	Erin Chichlowski	ENRE
11	Iman Beheshti Tabar	BIOE	42	Fushcia Hoover	ENRE
12	Barron Hewetson	BIOE	43	Amanda Montgomery	ENRE
13	David Orrego & Daehwan Kim	BIOE	44	Emily Stewart	ENRE
14	Necla Mine Eren	BFPE	45	Tian Guo	ENRE
15	Seockmo Ku	BFPE	46	Raymond Red Corn	ENRE
16	Carl Littrell	BFPE	47	Youn Shik Park	ENRE
17	Malithi Wickramathilaka	BFPE	48	Young Gu Her	ENRE
18	Ning Xiang & Yuan Lyu	BFPE	49	Natalie Chin	ENRE
19	Amudhan Ponrajan	BFPE	50	Cibin Raj	ENRE
20	Leah Liston	BFPE	51	Igor Lopes	ENRE
21	Xuan Li	BFPE	52	Sam Noel	ENRE
22	Basudev Chowdhury	BFPE	53	Shule Liu	ENRE
23	Xi Wu	BFPE	54	Carlington Wallace	ENRE
24	Leyla Kahyaoglu	BFPE	55	Caroline Hughes	ENRE
25	Nur Damayanti	BFPE	56	David Wilson & Jeremy Robinson	FP/MS
26	Md. Shahriar Karim	BFPE	57	Guido Francesco Ritelli	FP/MS
27	Shivangi Kelkar	BFPE	58	Shaoping Xiong	FP/MS
28	Marisol Herrera-Perez	BFPE	59	Daniel Skelton	FP/MS
29	Tzu-Ching Wu	BFPE	60	Enrique Busquets	FP/MS
30	Jen Kahn	BFPE	61	Mike Sprengel	FP/MS
31	Wei-Chih Chen	ENRE			

Research Area Key

ASM = Agricultural Systems Management
BIOE = Bioenergy
BFPE = Biological and Food Process Engineering
ENRE = Environmental and Natural Resources Engineering
FP = Fluid Power

1 Flock model for high-rise layer houses

Wei-zhen Liang, ASM

Ammonia emission rates from high-rise layer houses are influenced by flock factors. Different hen stages, e.g. molting would affect hen activity, inventory, and hen weight. The goal for part of my dissertation is to develop an improved flock model for predicting inventory, hen weight and hen activity in high-rise layer houses. The data of National Air Emission Monitoring Study (NAEMS) was used to develop the three sub-models, compare the results with our proposed model, and apply it to other layer houses.

2 A farm management information system with task-specific, collaborative mobile apps and cloud storage services

Matthew Koester, ASM

Modern production agriculture is beginning to advance beyond deterministic, scheduled operations between relatively few people to larger scale, information-driven efficiency in order to respond to the challenges of field variability and meet the needs of a growing population. Since no two farms are the same with respect to information and management structure, a specialized farm management information system (FMIS) which is tailored to individual farms is likely to be more effective than generalized FMIS available today. This approach resulted in the creation of the OpenAgToolkit (OpenATK) and a suite of task-specific, collaborative Android apps.

3 Solvent selection for the recovery of acetic acid; Comparison of simulated and laboratory results for liquid-liquid extraction

Mahdieh Aghazadeh, BIOE

Acetic acid is a well-known fermentation inhibitor for the conversion of biomass to ethanol. Liquid-liquid extraction was used to assess the ability of a solvent to extract acetic acid from the solution prior to fermentation. The solvents were selected based on their ability to extract the acetic acid at a lower solvent consumption rate while not extracting water and sugars from the raffinate. Experimental verification is necessary to determine which property method best aligns with the simulation. The three property methods evaluated demonstrated that they were compatible with the laboratory experimental results for different solvents at the three examined loading rates.

4 Adding value to bioethanol production: Quantification and recovery of Lutein and zeaxanthin from DDGS

Jinsha Li, BIOE

This research investigated the recovery and purification of lutein and zeaxanthin from Dried Distillers Grains with Solubles (DDGS), a byproduct of corn ethanol production. Lutein and zeaxanthin were extracted via Soxhlet and verified with High Performance Liquid Chromatography (HPLC). Further purification was carried out using a centrifugal Partition Chromatography (CPC), a liquid-liquid countercurrent chromatography technique. This process could add a revenue stream to the biorefinery. Further experimentation can be performed to test for specific biological activity in the body.

5 Developing an Unstructured Model to Investigate the Effect of Ethanol on Product Yields for the Co-fermentation of Glucose and Xylose in *Saccharomyces cerevisiae* 424A (LNH-ST).

Shane Clingenpeel, BIOE

Production of bio-ethanol via fermentation from cellulosic biomass requires the efficient fermentation of the major hexose and pentose sugars. A model was created for Saccharomyces cerevisiae 424A (LNH-ST), a genetically modified strain of yeast capable of cofermenting glucose and xylose. The differential equations were developed based around sugar consumption, and the product yield coefficients were then investigated to see how each were effected by ethanol. Validation of this model suggests that this approach is sound, but requires optimization.

6 Effect of Phenol concentration and temperature on β-glucosidases and hemicellulases

Leyu Zhang, BIOE

Phenols are strong inhibitors of microbial enzyme production as well as enzyme activities. There are a wide range of phenolic monomers and oligomers derived from the plant cell wall that inhibit cellulases and hemicellulases. We report data for several representative phenols on different purified enzymes, and show the impact of phenols on reducing enzyme activity through the combination of higher incubation temperature and phenol concentration.

7 Using Molecular Structure of Predict Purification of Hemicellulose Polymers

He Zhang, BIOE

Solvent selection is the initial step in separations using centrifugal partition chromatography. This research explores the purification hemicellulose oligomers using CPC. The solvent system is selected based on how the compounds partition between the two

liquid phases in the CPC. Currently, solvent systems are determined by trial and error experiments, which requires a significant amount of time. This research uses a computer simulation to calculate the partition coefficient of a compound based on its structure and the phase equilibria in the solvent system.

8 Reduction of Mycotoxins in corn from pre-cleaning and sorting

Hu Shi, BIOE

Test the physical differences (size, shape, density) between sound and moldy corn kernels, and test whether this difference could be utilized by grain facility to separate the moldy kernels out and reduce overall aflatoxin levels

9 Characterization of lignin isolated from liquid hot water pretreated hardwood and its effect on the enzymatic hydrolysis

Ja Kyong Ko, BIOE

The conversion of lignocellulosic biomass to biofuels has shown the difficulties in the efficient enzymatic hydrolysis of cellulose due to its recalcitrant structure. The pretreatment of biomass is required to alter or remove the structural barriers and make cellulose more susceptible to cellulases. Mixed hardwood was pretreated with liquid hot water at different severities. Pretreated hardwood retained almost 80-90% of the initial lignin which may play an inhibitory role on the enzymatic hydrolysis of cellulose. In order to understand the changes of lignin properties during pretreatment, lignins were isolated from pretreated hardwoods. We measured changes in chemical structure of the lignin using fourier transform infrared spectroscopy (FTIR) analysis, glass transition temperature, and enzyme hydrolysis of cellulose.

10 Kinetics of 5-(hydroxymethyl) furfural Production from Aqueous Glucose solution by Using $AlCl_3$ Combined with Brönsted acid catalysts

Ximing Zhang, BIOE

5-Hydroxymethyfurfural (HMF) is a platform chemical for producing a variety of fuels and polymers that can be manufactured from lignocellulose. This study focuses on the Lewis and Brönsted acid effect on rehydration and degradation of HMF. We report the use of hydrochloric acid and maleic acid separately mixed with a Lewis acid (aluminum chloride) to catalyze the conversion from Glucose to HMF and from HMF to Levulinic acid at 180°C. A kinetic analysis of rehydration/degradation reaction is presented. Maleic acid is found to be effective in prevention of humins production and can redistribute the product distribution.

11 Ozone treatment of lignocellulosic material to improve bioenergy feedstock characteristics

Iman Beheshti Tabar, BIOE

Lignocellulosic biomass has potential as an alternative renewable energy source and there are numerous efforts to improve the efficiency of ethanol production from this material. Prior to hydrolysis and fermentation processes the biomass undergoes treatment to enhance the access of enzymes to cellulose. Ozone gas as an effective oxidizer as well as a disinfectant has proven efficacy in breakdown of lignin while not affecting the cellulose content of lignocellulosic biomass, both of which are favorable to the conversion process. This study focuses on the commercial applicability of ozone gas treatment. Large scale treatment is simulated using viable industrial scale ozone concentrations and biomass structure to find optimum treatment parameters which enhance biomass quality for further processing to ethanol.

12 Biomimetic Catalyst: Maximizing Yields Of Hydroxymethylfurfural From Whole Biomass

Barron Hewetson, BIOE

The future of hydroxmethylfufrfural (HMF), aims to add value through a green sustainable product pathway utilizing waste products while concurrently decreasing petroleum dependency. A thermochemically catalyzed condensed phase reaction was carried out using various biomass feedstocks. This biphasic green solvent system increases product yields through extraction of HMF into the organic layer. Furthermore, HMF yields are maximized by subjecting the biomass to a phosphoric acid swelling that changes the crystalline structure of cellulose within the intact biomass. This change within the hydrogen bonding of cellulose allows for more sugars to be hydrolyzed into product. Continuing research suggest that HMF yields of 90% or higher are achievable if the recalcitrant biomass undergoes a lignin removal process before being introduced to the cellulose swelling.

13 Preliminary Engineering Economics of Retrofitting Corn to Ethanol Plant for Cellulose Conversion

David Orrego & Daehwan Kim, BIOE

Corn to ethanol plants produce 14 billion gallons/year fuel ethanol in the U.S. The feedstock, corn, is also used as a source of food and feed. Consequently, retrofitting of corn to ethanol plants to utilize corn stover instead of corn is one approach that would reduce the amount of corn used for non-food purposes. This poster presents a preliminary process analysis and process costs that might be

involved in operating a corn to ethanol facility as a cellulose to ethanol plant.

14 Physicochemical Consequences of alpha-Lactalbumin interactions with nano-Silica Surface

Necla Miné Eren, BFPE

Incorporation of nanosize particles into colloidal hosts imparts unique mechanical, electrical, thermal and optical properties to the host. Understanding the physicochemical behavior of these colloidal-nanoparticle systems is essential to design and develop new biomaterials for biological and food engineering applications. The objective of the current research is to investigate colloidal nanoparticle interactions with a view on both macroscopic and microscopic scales. As the bridge between macroscopic structure and microscopic interactions is built, not only the scientific gaps are expected to be filled but also industrial applications are expected to be inspired under the light of the current and similar studies.

15 Rapid Concentration and separation of Salmonella from various food samples by Continuous Cell Concentration Device (C3D)

Seockmo Ku, BFPE

The purpose of our research is to concentrate and separate Salmonella from food samples by a Continuous Cell Concentration Device (C3D) based on the principle of cross-flow microfiltration previously designed and developed by our research group in accordance with the requirement of a real time tool to rapidly detect Salmonella.

16 Industrial Processing Properties and Attributes of Genetically Modified Fruit Pectin

Carl Littrell, BFPE

Pectin is a primary component of plant cell walls and is used extensively in the food industry as a thickening and gelling agent. Currently there exists only two reliable sources for industrially-viable pectin due to the nature of changes in pectin chemistry caused by naturally-occurring enzymes present in the fruit. Genetic engineering allows for the reduction of a primary pectin enzyme in vivo, thereby creating a novel source and technique for industrially viable pectin. The present work seeks to characterize the relationship of genetic modification on the chemistry and processing attributes of tomato fruit pectin.

17 Bioconjugation techniques: Linking DNA and peptides

Malithi Wickramathilaka, BFPE

The ultimate goal in this study is to create synthetic DNA-protein conjugates via covalent, or non-covalent coupling. Initial investigations are focused on EDC crosslinking mediated by imidazole, to attach a chemically synthesized DNA ultramer to a peptide segment with a Lysine residue. The expected result is a phosphoramidate bond in between the open 5' phosphate group in the DNA, and the amine in Lysine residue. Furthermore, subsequent studies will investigate a polymer-immobilized DNA model, where the high specificity of DNA base pairing will be exploited to conjugate an immobilized ssDNA with its complementary strand attached to an enzyme of desire.

18 Identification of antimicrobial peptides from soy protein

Ning Xiang & Yuan Lyu, BFPE

The objective of this research is to produce antimicrobial peptides (AMPs) from soy protein for use in food safety and human health as a replacement for antibiotics. AMPs are usually cationic and amphipathic, and kill microbial cells through insertion and damage/permeabilization of the cytoplasmic cell membranes. Peptides were identified as potential antimicrobial peptides (AMPs) from soy β-conglycinin (7S) and glycinin (11S) based on positive charge, hydrophobicity and hydrophobic moment, etc. MD simulation was used to simulate the peptide conformation change on the lipid bilayer to mimic the permeation action of AMPs on the membrane of microorganism.

19 Rheological Modelling of Full Fat Soy Flour Using a Capillary Rheometer

Amudhan Ponrajan, BFPE

The objective of this research was to understand the impact of temperature and moisture content on the rheological behavior of full fat soy flour (SF) and to develop a model to predict the apparent viscosity of SF, using a capillary rheometer (Rosand RH2000 Bohlin Instruments). A full factorial design with three moisture contents (15, 20 and 25% wet basis) and four temperatures (60, 80, 100 and 120 C) was used. The method of reduced variables was used to create a model with R^2 = 0.98. Shift factors for temperature and moisture content were found to be independent.

20 Investigating the Use of Phase Change Materials in Concrete Pavements to Reduce the Need for Anti-Icing

Leah Liston, BFPE

Phase change materials (PCMs) are used as an effective way of storing thermal energy. Thermal energy is absorbed/released when PCMs undergo a phase change. Incorporating PCMs into concrete at airports has been suggested as a means of preventing surface ice formation on runways. Potential benefits of using lipid-based PCMs are the ability to control the PCM's melting temperature through their fatty acid

composition, their biodegradability, and the relatively low manufacturing costs. The present work seeks to investigate the use of vegetable oil fatty acid methyl esters as a potential PCM as a method of anti-icing on airport runways.

21 Rapid sample processing for foodborne pathogen detection via crossflow microfiltration

Xuan Li, BFPE

This poster reports an approach to enable rapid concentration and recovery of bacterial cells from aqueous chicken homogenates as a pre-analytical step of detection. This approach includes biochemical pretreatment and prefiltration of food samples and development of an automated cell concentration instrument based on crossflow microfiltration.. This approach begins to address the critical need for the food industry for detecting food pathogens within 6 hours or less.

22 DNA epigenetic signatures-Quantification, Next Generation Sequencing and Applications

Basudev Chowdhury, BFPE

5-methylcytosine is an epigenetic marker traditionally implicated in regulation of gene expression across the animal kingdom from bacteria to humans. Aberrations in global 5-methylcytosine patterns are frequently observed in diseases like cancer. Recently three other epimarks, namely 5-hydroxymethylcytosine, 5-formylcytosine and 5-carboxylcytosine, have been discovered. The precise biological functions of these modifications have still not been uncovered, but it is believed that like 5-methylcytosine, these epimarks also impart unique transcriptional potential to genes. By engineering tools to quantify and adapting Next Generation Sequencing technologies, we are decoding the mystery of these epigenetic markers to identify novel applications.

23 Antimicrobial Activity of Mutant Melittin-I17K against Listeria and *E. coli* O157:H7

Xi Wu, BFPE

Antimicrobial peptides (AMP) belong to a large and varied class of relatively short peptides family, which usually are largely positively charged, and constitute host-defense system in many living organisms, capable of killing inter alia, Gram negative and Gram positive bacteria. In order to better design AMP mimic for specific microorganism, it is necessary to understand the mechanism of permeabilization of cell membrane. In this study, the antimicrobial activity of Mutant Melittin-I17K (higher charge) against Listeria and E. coli O157:H7 has been characterized from the measurements of plate coutn, fluorescence, bioassay and OD and compared with the results for native melittin.

24 Fluorescence resonance energy transfer (FRET)-based optrode for in vivo sucrose monitoring in plants

Leyla Kahyaoglu, BFPE

Currently, sucrose is either imported, or extracted from beets, mostly in the far north by a declining number of farmers, or from sugarcane in a very small section of the southern US. Current methods used to breed and develop these lines as well as to determine optimal management and harvesting time are extremely slow, relatively inaccurate, labor intensive and destructive to plant. Our main objective is to design and develop optrode based sensors through photopolymerization techniques which would be used to obtain in planta sucrose measurements over time to compare the sucrose accumulation on germplasm and to establish optimal harvesting times.

25 Seizing the moment: Phosphorylation Detection in Living Cells by Fluorescence Lifetime Imaging

Nur Damayanti, BFPE

Protein phosporylation govern most of basic cellular aspect in human such as cell proliferation and differentiation. Disregulation of protein phosphorylation has been related to diseases such as cancer. In this work novel strategy to detect and visualize phosporylation in living cell was developed. This technology will give insight to study the molecular mechanism of protein phosporylation in cells and to monitor the activity of phosporylation regulatory enzyme.This application of this work will be useful for early diagnosis of cancer, and cancer drug screening.\

26 Quantitative analysis of morphogen-mediated pattern formation in development

Md. Shahriar Karim, BFPE

Morphogen, a secreted group of signaling molecules, dictates the tissue and pattern formation both in vertebrate and invertebrate development. Patterns created by morphogen-mediated signaling are highly reproducible and robust to perturbations. To understand how the morphogen signaling is controlled and to identify the underlying mechanisms of robustness of patterns, we developed quantitative models to test hypotheses regarding the role of extracellular regulators, receptor binding kinetics, surface reactions and others. From the quantitative analysis, a number of hypotheses were identified that can contribute to ensure the reproducibility and robustness in patterns during development.

27 Direct Determination of Food Density using X-ray Imaging

Shivangi Kelkar, BFPE

Density of foods is an important physical property, which depends on structural properties of food. For porous foods such as baked food products, accurate measurement of density is challenging. Traditional techniques are operator-dependent and give variable results. Due to limitations of traditional density measurement techniques, x-ray imaging was used to directly determine density of foods. Among different non-destructive techniques, computed tomography (CT) and digital radiography (DR) utilizing x-ray imaging show superior capability for evaluation of food density. X-ray linear and mass attenuation coefficients of fundamental foods were used to effectively determine density of porous foods.

28 Scaffold composition alters the morphology and migration characteristics of glioblastoma stem cells in 3D culture

Marisol Herrera-Perez, BFPE

Glioblastoma multiforme (GBM) is the most deadly type of brain cancer and is characterized by high invasiveness and invariable reappearance of the tumor following therapeutic treatment. Understanding of the invasion mechanisms of GBM has been limited by the use of in vitro cultures that fail to recapitulate microenvironment-induced responses. To elucidate how the mechanical and chemical properties of the microenvironment influences the migration-invasion of GBM we have developed a brain-like 3D scaffold of collagen-hyaluronan that is used along with other types of extracellular matrices to study the morphology, migration rate and migration mechanisms of GBM in 3D culture.

29 Development of a new approach for early Drosophila embryos BMP signaling pathway identification using Fuzzy logic based optimization and Fuzzy inference system.

Tzu-Ching Wu, BFPE

Bone morphogenetic proteins (BMPs) have been identified as important morphogens and signaling molecules in regulating the development. We developed a comprehensive framework consisted of fuzzy logic based image processing which transform the data and modeling outputs into common scales, the fuzzy inference unit which integrates the comparison between different datasets, conditions, and between data and model output as fuzzy if-then rules. The combination of fuzzy inference and optimization search the best fitting BMP signaling pathway. Finally we will apply it into the Drosophila wing disc patterning and BMP signaling pathway.

30 Collagen matrix templating for increased nano and microstructure of silica thin layers deposited at the cell surface

Jen Kahn, BFPE

Sol-gel derived silica encapsulation presents a promising alternative to current microencapsulation methods for biological applications. However, silica produced using this technique lacks long-range microstructural order. Tunable collagen polymers can provide a physical and biological template for controlling silica condensation. A series of collagen templates varying in fibril density, interfibrillar branching, and material stiffness were exposed to silica precursors for varying periods of time. Scanning electron microscopy (SEM) and elemental analysis by energy dispersive x-ray spectroscopy (EDX) demonstrate collagen's ability to template silica at the level of individual collagen fibrils such that silica material properties are dependent upon collagen matrix properties.

31 Assessment of irrigation use on crop yield and water supplies in the midwestern U.S.

Wei-Chih Chen, ENRE

The overall goal of this research is to assess the effect of changing wind speed on hydrological processes and the effect of water use on crop yield and hydrological processes by applying irrigation to the historically rain-fed crops in the Midwestern Region to manage increased risk to crop yields in the future. Three objectives will be finished to address the hypotheses: 1) analyze the effect of changing wind speed on the hydrological processes and investigate which hydrological variable that is affected most than the others, 2) Parameterize the VIC-CropSyst model for the Midwestern Region, and calibrate the model, and 3) Quantify the effect of irrigation scheme on the crop yield, water use, and stream flow.

32 Applications of treated wastewater reuse in the Middle East and North Africa

Anne Dare, ENRE

The overall goal of this research is to consider the limitations facing communities with regard to integrating treated wastewater in agricultural production schemes. This research, in collaboration with local partners and development practitioners, considers unique communities in Palestine, Tunisia, Qatar, and as a comparison, the state of Indiana in the United States, and evaluates the limitations which technology, policy, and farmer perceptions place on the potential for treated wastewater reuse in agriculture. A mixed methods approach has been be employed to evaluate the specific limitations of treated wastewater reuse in each study location.

33 Introduction to an Unmanned Aerial Vehicle (UAV) Imaging System – Data Management and Research Applications

Anthony Hearst, ENRE

This May 2013, Dr. Keith Cherkauer's research group acquired two Unmanned Aerial Vehicles (UAVs) and three imaging sensors; 1) a digital camera (rgb), 2) a 4-band multispectral camera (rgb+NIR), and, 3) a thermal camera (7-15 μm). Other sensors are being used to collect ground reference data during surveys, including field spectrometers, soil moisture and temperature probes, etc. Surveying capabilities are currently being tested by imaging corn and soybean fields at the Agronomy Center for Research and Education (ACRE). A strong data management plan is crucial for successful research applications of UAV imagery.

34 Assimilation of Remotely Sensed Soil Moisture Products in Water Quality Modeling: A Proposed Approach

Garett Pignotti, ENRE

Remotely sensed observations are utilized in land surface and hydrologic models as they provide gridded, repetitive measurements, integrated over large areas; however methodology and optimal approaches are not fully developed, especially beyond weather forecasting and streamflow prediction. Soil moisture, in particular, is of great interest as it plays a prevalent role in a multitude of energetic and hydrologic processes and phenomena. Merging the remotely sensed soil moisture data products with models is commonly achieved via data assimilation techniques. Therefore, this poster focuses on a proposed approach to assimilate remotely sensed soil moisture data products into a distributed SWAT model, termed SWAT grid. Principal challenges in using remotely sensed soil moisture include coarse spatial resolution and limited sensing depth.

35 Simple Method for Obtaining Future Climate Inputs for the WEPP Model

Joseph Trotochaud, ENRE

The lack of impact studies examining future climates can be explained by the difficulty of retrieving and downscaling future climate data. Significant time is required to develop future climate inputs for a single location using multiple models and emission scenarios. Presented here is a method for quickly obtaining future climate data to be used by CliGEN within the WEPP model. A comparison in relative terms can be made using the MarkSim regression output as the historical baseline in WEPP simulations. Time for obtaining downscaled data is significantly reduced, with the entire process taking less than 15 minutes with little learning curve.

36 Development and Validation of Mathematical Model for Calculating Daily Reference Evapotranspiration

Ahmed Abdelnaby, ENRE

The main objective of this work is development of a mathematical model to accurately calculate daily Reference Evapotranspiration (ETo) as a first step for accurate calculation of irrigation water requirements. The reference evapotranspiration model was built using the Food and Agricultural Organization of the United Nations Penman- Monteith equation with the SIMULINK tool in MATLAB software. The model was validated through estimation of evapotranspiration using Class A-pan evaporation in both Egypt and United States. The results indicated that there was a good fit between daily ETo calculated by the model and observed from Class A-pan in Egypt and USA. This model is the first step to calculate accurate irrigation water requirements.

37 Two-stage ditch as a conservation practice to improve water quality and fish habitat

Andi Hodaj, ENRE

Agricultural drainage ditches are essential for the removal of excess surface and ground water to help crop production in poorly drained agricultural landscapes. However, ditches are primary conduits for drainage and therefore carry pollutants from agricultural ecosystems to downstream water bodies, impacting the quality of these waters with results as far as the Gulf of Mexico. At Purdue, we are studying a practice that has great potential in improving the quality of the water that is conveyed by these drainage ditches. The practice is called two-stage ditch because the ditch is modified to have extended benches on both sides of it.

38 Assessing the impact of climate variability and change on crop production in the Midwestern USA

Ruoyu Wang, ENRE

Inter-annual variability of crop yield in the Midwestern USA is closely related to extremes in spring and summer moisture conditions. Therefore, when applying physically-based models to predict crop yield, soil moisture dynamics and physiological stresses must be correctly represented, especially under future climate scenarios where spring and summer moisture are projected to increase and decrease, respectively, over much of the Midwest. In this research, we have explored and improved the ability of an existing ecohydrology model (SWAT 2009) to simulate corn yield with respect to current climate and soil moisture variability. The calibrated model is run with down-scaled and bias-corrected CMIP5 data to quantify

future climate change impacts on crop yield due to excess/deficit moisture.

39 Identification of Marginal Land Potential for Perennial Biofeedstock Production in Wildcat Creek Watershed

Qingyu Feng, ENRE

Marginal lands may be suitable locations for biofeedstock production, to avoid competition for lands currently in use for other products, and for potential environmental benefits. An effort has been made on the global scale to estimate marginal land areas for potential biofeedstock production. Since the Midwestern states are expected to play a major role in biofeedstock production, there is need to identify marginal lands and the associated biofeedstock production capability of these lands. We have used a geospatial method to identify location and distribution of marginal lands in the Wildcat Creek watershed in Indiana.

40 Development and Application of Quantification Methods for Ecosystem Services

Rebecca Logsdon, ENRE

Ecosystem services are benefits that humans receive from the environment, such as food, water, climate regulation, and even aesthetics. Currently, there are few methods which can assess ecosystem service quantities from the landscape. This research focuses on integrating biophysical models, and field and lab data to quantify ecosystem services. Secondary objectives of this research includes applying methods to multiple watersheds and assessing the applicability of the concept of ecosystem service in agricultural management.

41 Nitrate removal from subsurface drainage with denitrifying bioreactor

Erin Chichlowski, ENRE

Limited data is available quantifying the effectiveness of bioreactors in removing nonpoint source pollutants from agricultural runoff. The objectives of this study include evaluating the nitrogen removal rate in a nonpoint source and quantifying the effects of temperature, hydraulic setting and organic matter degradation on the bioreactor's efficiency. In September 2012, Purdue University's first woodchip bioreactor was installed at the edge of an agricultural field in Tippecanoe County, IN. Results indicate seasonal variations in nitrate removal are similar to values reported in literature. The bioreactor, however, was found to increase the concentration of soluble reactive phosphorus in the effluent- prevalent even after the start-up "flushing" of organics. This research project combines continuous fieldwork and observations with literature that can be used as a benchmark to evaluate effectiveness of this innovative conservation practice in removing nonpoint source pollutants from agricultural runoff.

42 An Integrative Analysis of an Extensive Green Roof System: A Case Study of the Schleman Green Roof

Fushcia Hoover,ENRE

The objective was to determine the stormwater retention, water quality impact and net present value for a 165 m^2 extensive green roof. The results from the water balance analysis revealed retention rates on average of 58% of precipitation per rain event. Nitrate-Nitrite (NO_2-NO_3), Orthophosphate (PO_4), Ammonia–Ammonium ion (NH_3-NH_4), Sulfate (SO_4), and pH were used to evaluate the water quality. Sulfate and PO_4 results yielded higher concentrations and loads in the green roof runoff compared to precipitation samples. Nitrite-Nitrate, NH_3-NH_4 concentration, and loads however, were reduced by the green roof when compared to the control output and precipitation. The green roof decreased the yearly energy demand by 75 KWH and when combined with carbon pricing, storm water fees, grants and other metrics, a net present value of $32,350 was achieved.

43 Water quality effects of cellulosic biofuel crops grown on marginal land

Amanda Montgomery, ENRE

The production of bioenergy crops could potentially affect hydrology and water quality. Very few studies have been done measuring effects on marginal lands. This research works to quantify losses of nutrients and sediment via surface and subsurface pathways as an effect of growing different biofuel crops on marginal lands. The crops being grown for this research include: switchgrass and Miscanthus, hybrid poplar trees, and dual-purpose sorghum. The control plot for this study is corn. Surface and subsurface water samples are being collected in each plot. Preliminary data suggests differing nutrient losses, both surface and subsurface flows.

44 Hydrologic impacts due to land cover change in Yellowwood Lake watershed

Emily Stewart, ENRE

The Yellowwood Lake watershed, located in Southern Indiana, has experienced significant land use change since the early 1900's, specifically focused on changes in forest cover and residential expansion. The Distributed Hydrology Soil Vegetation Model (DHSVM) is employed in this study to identify the impacts and better understand the hydrologic response of vegetation change at the watershed scale. The

overall objective of the study is to utilize the Yellowwood Lake watershed to evaluate the role of land cover change on stream flow characteristics. Results from the experiments will be used to aid in the creation of future watershed drainage strategies.

45 Development of Simulation of Short Rotation Woody Crops- Hybrid Poplars in SWAT Model

Tian Guo, ENRE

In this study, Soil and Water Assessment Tool (SWAT) modeling was employed to simulate the water and soil impacts of the hybrid poplar. In SWAT, fast growing tree growth parameters for hybrid poplar (*P. tristis Fisch.* x *P. bulsamisera L. cv. Tristis* #l (NC 5260)) in the Midwest were established and improved based on growth and climate data. Sensitivity analysis was used to see what effects of hybrid poplar parameters on biomass production, hydrological output (water yield) and tree growth outputs (plant uptake of Nitrogen and Phosphorus). The most sensitive parameters are: optimal and base temperature, radiation-use efficiency, light extinction coefficient, leaf area development and leaf stomatal conductance.

46 Enhancing the Resource Potential of Anaerobic Digestion

Raymond Red Corn, ENRE

Anaerobic Digestion can provide a renewable source of acetic, propionic and butyric acids. Prior research into anaerobic digestion of sludge and food waste has focused on maximizing methane production. This research aims to study the conditions for optimal organic acid production from sludge and food waste. These acids have existing markets in the production of plastics, solvents, fuels, and pharmaceuticals and their values range from 4 to 16 times that of methane per unit mass if purified. The outcome of this research is pending. The data collected will be used to evaluate recovery methods for organic acids from a renewable source.

47 A Web-based Tool for STORET/WQX Water Quality Data Retrieval and Best Management Practice Scenario Suggestion

Youn Shik Park, ENRE

A web-based LDC Tool was developed to facilitate development of flow duration curve and load duration curve as well as to support other hydrologic analyses. However, users were required to prepare water quality data, as water quality data are an essential input in LDC development. Therefore the web-based tool has been upgraded: 1) to use the USGS water quality data for the entire U.S. via web access, 2) to upload water quality data downloaded from the EPA My WATERS Mapper, and 3) to use water quality data from STORET/WQX for the entire U.S. via web access.

48 Simple parallel computing methods for improving efficiency of parameter calibration of SWAT and its application to spatial optimization

Young Gu Her, ENRE

Many heuristic algorithms for solving optimization problems have been proposed and great efforts have been made to improve their efficiency and effectiveness. Nonetheless, the sampling-based search strategies of the algorithms still require excessive time to locate optima in the hyper-dimensional parameter space of a distributed hydrologic model. This study proposed parallel computing methods using the 'spmd' and 'parfor' commands of MATLAB with the purpose of providing simple ways to improve computational efficiency of solving optimization problems using sampling-based algorithms. The proposed methods were applied in calibrating hydrologic simulation of the SWAT model and identifying the optimum spatial distributions of corn stover removal rates using the AMALGAM optimization algorithm.

49 Assessing the Impacts of Climate Change on Tourism Destination Communities in the Great Lakes

Natalie Chin, ENRE

The purpose of this research is to determine how existing data and models can be used to predict the potential impacts of climate change on tourism. Future climate projections and extreme weather metrics have been used to measure the vulnerability of several Great Lakes tourism destination communities to extreme weather events. Results show that the potential impacts of climate change vary at the local scale and could require different adaptation strategies for different communities and sectors of the tourism industry. Next steps in this research include working with tourism managers to determine how to make these findings useful for decision-making.

50 Watershed scale environmental sustainability analysis of biofuel production in changing land use and climate scenarios

Cibin Raj, ENRE

The possible land use and land management practice changes induce concerns over the environmental impacts of these bioenergy crop production scenarios both in terms of water availability and water quality, and these impacts may be exacerbated by climate variability and change. This study aims to evaluate environmental sustainability of various plausible land and crop management scenarios for biofuel production under changing climate scenarios for a Midwest US watershed. The study considers 12 environmental sustainability indicators related hydrology and water quality

with thirteen plausible biofuels scenarios in the watershed under nine climate change scenarios.

51 Poultry Manure Application as Fertilizer in Indiana - Survey Results

Igor Lopes, ENRE

Poultry production in Indiana has increased over the last years. As a result, the state has also increased manure production (1.9 million tons in 2007, 27% more than 2002). In order to better understand the use of poultry manure as fertilizer in Indiana, crop producers in the state were questioned about use, transportation, and concerns related to poultry manure. The survey was conducted on-line and at extension meetings. Results from 161 responses were summarized and are presented in the poster. A better understanding of poultry manure production and use can benefit manure management applications in the state as well as the growing poultry industry.

52 Watershed Management Apps Center

Sam Noel, ENRE

Current practice for watershed management field workers commonly involves the following: 1) meet with the land owner, 2) return to the office to make use of desktop software, consult engineering staff, or dispatch surveyors, and 3) return to meet again with the land owner. This process may be repeated several times until the desired solution is reached, and along the way it is common for these field agents to make use of a variety of paper maps, and other non-digital notes. We propose a series of user-oriented, task-specific apps to streamline any of these steps—taking notes, performing preliminary BMP estimations, or communicating information between colleagues and clients.

53 Analysis of Ammonia Concentrations from Layer Housing using Time Series Data Mining

Shule Liu, ENRE

Emissions in confined animal buildings are of great concern to animal welfare and local air quality. In this study, a time series data mining method, Distributed Lag Non-linear Model (DLNM), will be applied to study one of the National Air Emissions Monitoring Study (NAEMS) site of a high-rise layer hen house in Indiana using the one-year continuous observational data with the expectation to investigate the non-linear and non-constant relationship between emissions and ambient influencing factors. By using distributed lag non-linear model (DLNM), the lagged effects for airflow rate, outside temperature, outside relative humidity has been identified.

54 Quantifying the Effects of Multi-Scale Calibration of the SWAT Model for Streamflow and Chemical Losses

Carlington Wallace, ENRE

The Soil and Water Assessment Tool (SWAT) is a lumped, semi-distributed model developed for simulation of hydrology, plant growth, pesticide transport, nutrients losses, and sediment transport processes at the basin scale. SWAT is often used to quantify the impact of agricultural practices in very complex watersheds, and in assessing the environmental efficiency of best management practices. However, there are several issues concerning the application of SWAT at different watershed scales, especially when the model is being used to assess alternative land management policies. This study assesses the influence of 'scale' on SWAT model calibration parameters by performing a quantitative analysis of the uncertainties in SWAT calibration parameters for streamflow, and chemical losses at four scales.

55 Estimating Nutrient Loads with WRTDS

Caroline Hughes, ENRE

The Mississippi River/Gulf of Mexico Nutrient Task Force has set a goal of reducing the Hypoxic Zone in the Gulf of Mexico to a size of 5000 km^2 by 2015, which will require a reduction by 45% of nutrient levels in tributary bodies of water. The first step for the state of Indiana is to calculate an estimate of nutrient TMDLs. A new statistical method for calculating loads is being implemented to obtain a more reliable estimate of daily loads from monthly data collection.

56 Affordable Transportation and Agricultural Mechanization in Sub-Saharan Africa

David Wilson & Jeremy Robinson, FP/MS

The lack of affordable transportation and appropriate agricultural mechanizing technologies in Sub-Saharan Africa limits productivity and adds to the cycle of poverty. The Practical Utility Platform (PUP) is the outcome of efforts to address these issues. The vehicle is made to carry heavy loads (900 kg), traverse rough roads, and be manufactured locally, making it sustainable and affordable. Testing of the PUP has proved its durability. The vehicle also acts as a platform for powering other machinery such as threshers, pumps, and generators. It can also be used in the field as a tractor.

57 Innovation and Research towards Quieter and More Efficient Hydraulic Actuation Systems

Guido Francesco Ritelli, FP/MS

Overview of the research conducted at Maha Fluid Power Research Center of Purdue University. The poster focuses on the effort put by Prof. A. Vacca and Prof. M. Ivantysynova in the research of quieter and more efficient hydraulic

actuation systems, such as DC systems, power trains, active vibration damping and noise reduction.

58 High Efficiency, High Bandwidth, Actively Controlled Variable Displacement Pump/Motor

Shaoping Xiong, FP/MS

Current state-of-the-art variable displacement pump/motors have high efficiencies when operating at high displacements. However, as the displacement is reduced, the efficiency significantly decreases. Digital pump/motors aim to increase the efficiency by minimizing leakages, friction and compressibility losses. It is based on the concept of actively controlling high-speed on/off valves connected to each cylinder displacement chamber. This work involves the development of a coupled dynamic model that is crucial for understanding the design tradeoffs and operating characteristics of the digital pump/motor. The model can analyze different operating strategies and characterize the effects on pump/motor efficiency and flow ripple. A three-piston unit was used to experimentally validate the model. The results show that the sequential flow limiting strategy yields the lowest power loss.

59 High Performance Valves Enabled by Kinetic Energy

Daniel Skelton, FP/MS

This poster introduces a new valve actuation mechanism to enable high performance, high speed valves. The actuation principal is to momentarily couple a moving component (kinetic energy source) with translational valve components, which is enabled by a coupling/clutch system. The kinetic energy source is intermittently clutched to produce linear motion of valve components to control valve opening or closing. Initial research is investigating an energy coupler actuator (ECA) using an MR fluid clutch. A multi-physics coupled model was developed to evaluate the ECA performance and study the design tradeoffs in terms of actuation force, response time and energy consumption. Modeling work predicts the ECA can achieve a 1.5mm stroke in less than 3ms, equivalent to a flow rating of 100 l/min @ 5bar. The modeling results are being validated using experimental data on a prototype ECA.

60 Highly Efficient Fluid Power Systems for Agriculture and Construction Equipment

Enrique Busquets, FP/MS

Modern trends in fluid power technologies emphasize the design of efficient fluid power systems. Although improvements to individual hydraulic component efficiencies can increase total system efficiency, the demand for even higher system efficiencies has forced researchers to move away from traditional valve-controlled actuation. Pump-controlled actuation (PCA) is one such alternative under investigation by the Maha Fluid Power Research Center through the NSF Engineering Research Center in Compact and Efficient Fluid Power (CCEFP). Since January of 2006, the Maha research group has investigated and implemented PCA architectures and control strategies for a 5-ton excavator prototype. To date, the research group at Maha has demonstrated up to 50% fuel savings, 50% reduction in cooling capacity and 50% engine downsizing for this prototype. The concepts developed for this prototype set a new standard for agricultural and construction equipment.

61 An Advanced Hydraulic Hybrid System Architecture for Working Machines

Mike Sprengel, FP/MS

Rising fuel prices and dimensioning oil reserves requires working machines to operate as efficiently as possible. However many machines employ highly inefficient hydraulic throttling valves whose losses account for up to 1/3 of the machine's total power consumption. Further working machines with heavy driving cycles dissipate considerable kinetic energy through their friction brakes. In this presentation a novel system architecture will be shown that addresses these issues by eliminating throttling losses with displacement controlled actuation while enabling regenerative braking through a hydraulic hybrid transmission. An energetic analysis of a reach stacker will be presented that demonstrates energy savings of up to 73% are possible with the new system architecture.