2015 Graduate Research Colloquium

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Oral Presentation Session - Thursday, February 26, 2015

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Poster Session Schedule

POSTER SESSION

Advances in Biology, Biochemistry, and Bioengineering

MUB Ballroom A1, 9:00 AM - 11:00 AM

Title	Name	Department
Photocrosslinking alginate microfluidic encapsulation of mammalian cells	Shuo Wang (1), Bruce P. Lee (2), Chang Kyoung Choi (1)	1- Department of Mechanical Engineering and Engineering Mechanics, 2- Department of Biomedical Engineering
Anticancer effectiveness of mesenchymal stem cells transfected with thymidine phosphorylase for colorectal cancer cells	Nasrin Salehi (1) and Ching-An Peng (1, 2)	1-Biochemistry and Molecular Biology Program, 2- Department of Chemical Engineering
Barium Concentrations in Rock Salt by Laser Induced Breakdown Spectroscopy	Kiley Spirito	Department of Physics
Effect of surfactant on droplet size and stability in a microfluidic T-junction device	Jeana Collins and Adrienne Minerick	Department of Chemical Engineering
Anticancer effectiveness of mesenchymal stem cells transfected with thymidine phosphorylase for colorectal cancer cells	Nasrin Salehi (1) and Ching-An Peng (1, 2)	1- Biochemistry and Molecular Biology Program, 2- Department of Chemical Engineering

POSTER SESSION

Computing, Sensing and Signal Processing

MUB Ballroom A1, 9:00 AM - 11:00 AM

Title	Name	Department
Systematic Evaluation of Object Based Classification of Remotely Sensed Images Using Machine Learning	J. Bialas (1), T. Oommen (2), U. Rebbapragada (3), and E. Levin (1)	1- School of Technology, 2- Geologic and Mining Engineering and Sciences, 3- Jet Propulsion Laboratory, California Institute of Technology
Towards Using Smartphones to Refine Sunrise and Sunset Time Models	Teresa Wilson (1), and Jennifer Bartlett (2)	1 - Department of Physics, 2 - United States Naval Observatory

POSTER SESSION

Environmental Studies and Advances in Environmental Protection

MUB Ballroom A2, 9:00 AM - 11:00 AM

Title	Name	Department
Freeze/Thaw Effects on Fecal Coliform Reduction in Dewatered Biosolids	Christa Meingast, Jennifer Becker, and Eric Seagren	Department of Environmental Engineering
Assessing the drivers of vertical chlorophyll distribution in the Bering Sea	Brice Grunert and Colleen Mouw	Department of Geological & Mining Engineering & Sciences
Modeling the impacts of climate change on water quality for inland lakes in the Great Lakes Basin	Kaitlin Reinl (1), Joseph Wagenbrenner (1), and Noel Urban (2)	1- School of Forest Resources and Environmental Science, 2- Civil & Environmental Engineering
Spectroscopic Characterizations and Soil Jar Decay Test of The Chemically Modified Rice Husk Reinforcement on Urea Formaldehyde Composites	Soha Albukari (1,4), Fei Long (2), Dana Richter (3) and Dr. Patricia Heiden (1)	1- Department of Chemistry, 2- Department of ME-EM, 3- School of Forest Resources and Environmental Science, 4- Department of Chemistry, KAU
Evaluation and application of AERMOD for estimating environmentalimpacts of PM emissions from a steelcomplex	Hossein Tavakoli (1) and Aryandokht Azari (2)	1- Department of Environmental Engineering, 2- Faculty of Environment, University of Tehran
Does Agrilus planipennis detection success at low density vary with distance from roads?	Karen Cladas, Tara L Bal, and Andrew J Storer	School of Forest Resources and Environmental Science
Integrated Seasonal Drought Forecast-Adaptive Management System for the Lower Colorado River Basin in Texas	Jonathan Witham and David Watkins	Department of Civil and Environmental Engineering
Biomediation of Fugitive Dust Hazards in Mine Tailing Impoundments through Microbially Induced Calcium Carbonate Precipitation	Noah Buikema (1), Bonnie Zwissler (1), Eric Seagren (1), Stanley Vitton (1), and Thomas Oommen (2)	1 - Department of Civil and Environmental Engineering, 2 - Department of Geological and Mining Engineering and Sciences
Assessment on Ethanol as an Alternative Foaming Agent for Low Emission Asphalt Technology	Mohd Rosli Mohd Hasan and Zhanping You	Department of Civil and Environmental Engineering

POSTER SESSION

Human Impact

MUB Ballroom B1, 9:00 AM - 11:00 AM

Title	Name	Department
Data Mining Social Media and Natural Language Processing Applications for Rapid Crisis Response	Sam Aden, James Bialas, and Dr. Eugene Levin	School of Technology
Mesenchymal Stem Cell Spheroids for Therapy Following Axillary Lymph Node Dissection	Emily R Shearier, Qi Xing, Lijun Zhang, and Feng Zhao	Department of Biomedical Engineering
Acute oral ingestion of alcohol modulates muscle sympathetic neural activity differently in Caucasians and African Americans	Ida T. Fonkoue, Qing-Hui Chen, and Jason R. Carter	Department of Kinesiology and Integrative Physiology

POSTER SESSION

Measurement Techniques and Analysis Methodology

MUB Ballroom B1, 9:00 AM - 11:00 AM

Title	Name	Department
Low Cost Infrared and Near Infrared Sensors for UAVS	Samuel T. Aden (1), James P. Bialas (1), Zachary Champion (1), Eugene Levin (1), and Jessica L. McCarty (2)	1 - Michigan Technological University, 2- Michigan Technological Research Institute, Ann Arbor Michigan
Seismic Performance Assessment Considering Aftershock Hazard	Ruilong Han (1), Yue Li (1), and John van de Lindt (2)	1- Dept. of Civil & Environmental Engineering, 2- Dept. of Civil and Environmental Engineering, Colorado State Univ.
Identifying Mental Models of Search in a Simulated Flight Task Using a Pathmapping Approach	Brandon S Perelman and Shane T Muelle	Department of Cognitive and Learning Sciences
Gamma-Ray Emission from Pulsar Wind Nebulae	Hao Zhou	Department of Physics

POSTER SESSION

New Materials and Transport Phenomena

MUB Ballroom B1, 9:00 AM - 11:00 AM

Title	Name	Department
Electrospinning 3D Scaffolds for use in Neural Tissue Engineering	Rachel Martin (1), M. E. Mullins (1), F. Zhao (2), and Zichen Qian (2)	1-Department of Chemical Engineering, 2-Department of Biomedical Engineering
Light transport in PT-invariant photonic structures with hidden symmetries	M. H. Teimourpour (1), R. El-Ganainy (1), A. Eisfeld (2), A. Szameit (3), and D. N. Christodoulides (4)	1- Dept. of Physics, Michigan Technological University, 2 - Max Planck Institute for the Physics of Complex Systems, 3 - Institute of Applied Physics, Friedrich Schiller University, 4 - College of Optics & Photonics – CREOL, University of Central Florida
Effect of Silica Micro/Nano Particle on Mechanical Properties, Gelation, and Bioactivity of Dopamine Functionalized Poly(ethylene glycol)-Gluratic Acid Hydrogels	Rattapol Pinnaratip and Bruce Lee	Department of Biomedical Engineering

POSTER SESSION

Power and Energy

MUB Ballroom B2, 9:00 AM – 11:00 AM

Title	Name	Department
Modeling Flap-Enabled HAWT Blades using Spinning Finite Elements via Warping Effects	Antonio Velazquez and R. Andrew Swartz	Department of Civil and Environmental Engineering
Performance of leachate-fed Microbial fuel cells under different leachate aging time	Zhimin Song and Jenifer G. Becker	Department of Civil and Environmental Engineering
Time-Domain Simulation for Voltage Collapse Prediction	Zagros Shahooei (1), Bruce A. Mork (1), Mandar Kavimandan (2), Leonard J. Bohmann (1)	1- Department of Electrical Engineering, 2- Black & Veatch
Stochastic Optimization of Electric Vehicle Charging Load	Abhay Kumar and Dr Sumit Paudyal	Department of Electrical & Computer Engineering
Combustion, Emissions, and Performance Optimization in a DI/PFI-RCCI Diesel/Natural Gas Turbocharged Engine	Ehsan Ansari and Jeffrey Naber	MEEM
Effect of Lignin Content on Pyrolysis Bio-Oil Properties	Bethany Klemetsrud (1), Jordan Klinger (1,2), Adrien Steinhurst (1), David Shonnard (1,3), and Ezra Bar-Ziv (2)	1- Department of Chemical Engineering, 2-Department of Mechanical Engineering and Engineering Mechanics, 3- Sustainable Futures Institute

POSTER SESSION

Sustainability

MUB Ballroom B2, 9:00 AM – 11:00 AM

Title	Name	Department
Estimating the ROI on rooftop solar under different policy scenarios	Abhilash Kantamneni (1), Edward Louie (2)	1- Department of Computer Science, 2- Department of Social Sciences
Carbon Footprint Analysis of Hydrotreated Renewable Jet (HRJ) from Rapeseed in Rotation with Wheat	Suchada Ukaew (1), David R. Shonnard (1,2), Kristin C. Lewis (3), David W. Archer (4), and Joon Hee Lee (4)	1- Department of Chemical Engineering, 2- Sustainable Futures Institute, 3- U.S. Department of Transportation, John A Volpe National Transportation Systems Center, 4- U.S. Department of Agriculture, Agricultural Research Service
Land-use Change Implications for Large-scale Cultivation of Algae Feedstocks in the Southern United States	Rui Shi, Robert Handler, and David Shonnard	Sustainable Future Institute

Oral Presentation Session Schedule

ORAL PRESENTATIONS

Advances in Biology, Biochemistry, and Bioengineering

MUB Ballroom A1, 9:00AM – 11:20PM

Title	Name	Department
miR-483, a Novel MicroRNA Highly Expressed in Pancreatic β-cells	Ramkumar Mohan, Yiping Mao, Shungang Zhang and Xiaoquing Tang	Department of Biological Sciences
Genetic Differentiation between Quercus rubra provenances at gene-based and non-genic microsatellite markers	Sirikorn Khumwam and Oliver Gailing	School of Forest Resources and Environmental Science
MicroRNAs and the Development of Colorectal Cancer	Li Chen	Department of Biological Sciences
Diversifying Drug Development through Scaffold Engineering: A Proposed New Strategy	Melanie L. Talaga (1), Ni Fan (1), Ashli L. Fueri (1), Robert K. Brown (1), Yoann M. Chabre (3), Purnima Bandyopadhyay (2), Rene Roy (3), Tarun K. Dam (1)	1- Laboratory of Mechanistic Glycobiology, Department of Chemistry, 2- Department of Biological Sciences, 3- Department of Chemistry, Universite Du Quebec a Montreal
Simultaneous Detection and Quantification of Water and Fat-Soluble Vitamins with Liquid Chromatography and Tandem Ion Trap-Mass Spectrometry	Maryan Khaksari (1), Lynn R. Mazzoleni (2), Chunhai Ruan (3), Peng Song (4), Neil D. Hershey (4), Robert T. Kennedy (4), Mark A. Burns (5), Adrienne R. Minerick (1)	1- Deparment of Chemical Engineering, 2- Department of Chemistry, 3-Metabolomics Core BRCF, 4- Department of Chemistry, 5- Department of Chemical Engineering
A New Carbohydrate-binding Hemolysin from the HelyX Family	Ni Fan, Robert Brown, Melanie Talaga, Tarun K. Dam	Department of Chemistry

ORAL PRESENTATIONS

Computing, Sensing and Signal Processing

MUB Ballroom A1, 1:00 PM – 2:40 PM

Title	Name	Department
Thermal Remote Sensing for Dust Susceptibility Characterization at Mine Tailings Impoundments	Bonnie Zwissler (1), Noah Buikema (1), Thomas Oommen (2), Eric Seagren (1), Stan Vitton (1)	1- Department of Civil and Environmental Engineering, 2- Department of Geological and Mining Engineering and Sciences
Highly Linear Electro-Optics Modulators for Microwave-Photonic Applications in Millimeter Frequency Ranges	Arash Hosseinzadeh and Christopher Middlebrook	Department of Electrical and Computer Engineering
An initio study of the structural and electronic properties of MGV2O4 in its cubic phase	Kevin Waters and Ravindra Pandey	Department of Physics
Diffuse Gamma Radiation in our Galaxy	Hugo Alberto and Ayala Solares	Department of Physics
Emotional Expression and Recognition in Robots for Children with Autism Spectrum Disorders	Myounghoon Jeon (1), Ruimin Zhang (1), William Lehman (1), Seyedeh M. Fakhrhosseini (1), Jaclyn Barnes (1) and Chung Hyuk Park (2)	1- Michigan Technological University, 2- New York Institute of Technology

ORAL PRESENTATIONS

Environmental Studies and Advances in Environmental Protection

MUB Ballroom A2, 9:00 AM – 10:20 AM

Title	Name	Department
Quantification of CO_2 emission from Crater Hills, Yellowstone	Peipei Lin and Chad Deering	Department of Geological and Mining Engineering and Sciences
Impacts of Land Cover Change on Biomass Burning Emissions of Mercury	Aditya Kumar (1,2), Shiliang Wu (1,2,3) and Yaoxian Huang (1)	1- Department of Geological and Mining Engineering and Sciences, 2- Department of Civil and Environmental Engineering, 3- Atmospheric Sciences Program
Photosynthetic temperature responses within temperate and tropical forest canopies	Alida Mau and Molly Cavaleri	Department of Forest Resources and Environmental Science
Development of a Computational Tool to predict the Degradation Fate of Organic contaminants in Aqueous Phase Advanced Oxidation Processes	Divya Kamath, and Dr. Daisuke Minakata	Department of Civil and Environmental Engineering

ORAL PRESENTATIONS

Human Impact

MUB Ballroom A2, 10:20 AM – 12:00 PM

Title	Name	Department
Economic and sustainable development of the Landlocked developing countries	Enkhtsog Damba	School of Business and Economics
Lyricons (Lyrics + Earcons) Improve Identification Performance of Auditory Cues	Yuanjing Sun and Myounghoon Jeon	Department of Cognitive Learning Science
Sorry I'm Late; I'm Not in the Mood: Negative Emotions Lengthen Driving Time	Myounghoon Jeon (1,2) and Jayde Croschere (1)	1- Cognitive and Learning Sciences, 2- Computer Science
Music as an Intervention for Angry Drivers	Maryan Fakhrhosseini and Myounghoon Jeon	Department of Cognitive Learning Science
Comparative cancer risk Assessment due to Inhalation of Asbestos in Tehran, Iran: A Case Study	Hossein Tavakoli (1) and Aryandokht Azari (2)	1- Department of Environmental Engineering, 2- Faculty of Environment at University of Tehran

ORAL PRESENTATIONS

Measurement Techniques and Analysis Methodology

MUB Ballroom A2, 9:00 AM – 1:00 PM

Title	Name	Department
Improving World Food Productivity Through Improved Tractor Tire Design to Reduce Soil Compaction: The Use of Photogrammetry to Measure Soil Compaction	Amaneh Eslami Kenarsari and Stanley Vitton	Department of Civil Engineering
Identification of a Horizontal Axis Wind Turbines via Non-Stationary Parametric and Stochastic Identification Models	Antonio Velazquez and Andrew R. Swartz	Department of Civil and Environmental Engineering
Using Topological Data analysis in Scientific Visualization: Two Examples	Jun Tao, Ching-Kuang Shene	Department of Computer Science
Parallel Processing of Image Reconstruction from Bi-spectrum Through Turbulence	Solmaz Hajmohammadi, Saeid Nooshabadi	Department of Electrical and Computer Engineering
Bi-level Optimization Approach for Building to Grid Integration	Meysam Razmara, Guna R. Bharati, Mahdi Shahbakhti, Sumit Paudyal, and Rush D. Robinett III	Department of Mechanical Engineering-Engineering Mechanics
Cross-Cultural Study of Human Visual Attention Between Easterners and Westerners in Global-Local Task	Yin-Yin Tan and Shane T. Mueller	Department of Cognitive and Learning Sciences
Design Issues and Consideration for Dance-Based Sonification	Steven Landry, Myounghoon Jeon, Joseph Ryan	Department of Cognitive and Learning Science
Modularity Maximization using Completely Positive Programming	Sakineh Yazdanparast, Timothy C. Havens	Department of Electrical and Computer Engineering
Joint Neighbor Discovery and Time of Arrival Estimation in Wireless Sensor Networks via OFDMA	Mohsen Jamalabdollahi, Seyed (Reza) Zekavat	Department of Electrical and Computer Engineering
Prediction of Oxygen Distribution in the Land-Channel Direction of Proton Exchange Membrane Fuel Cell (PEMFC)	Udit N. Shrivastava and Kazuya Tajiri	Department of Mechanical Engineering and Engineering Mechanics
Computation of Spontaneous Emission Dynamics in Colored Vacua	M. H. Teimourpour and R. El-Ganainy	Department of Physics
Development of the Intelligent Graphs for Everyday Decisions Tutor	Margo Woller-Carter (1), Edward Cokely (1,2), and Rocio Gracia-Retamero (2,3)	1- Department of Cognitive and Learning Sciences, 2- Max Planck Institute for Human Develoment, 3- University of Granada

ORAL PRESENTATIONS

New Materials and Transport Phenomena

MUB Ballroom B2, 9:00 AM – 12:00 PM

Title	Name	Department
Two-Phase Flow Analysis in a Microfluidic Groundwater Model	Lindsey M. Watch	Department of Civil and Environmental Engineering
Kinetic Modeling and Neutron Imaging Experiments of Evaporation in Cryogenic Propellants	Kishan Bellur, Ezequiel Medici, Jeffrey Allen, and Chang Kyoung Choi	Department of Mechanical Engineering-Engineering Mechanics
Visualization of Drop Coalescence During Condensation and Evaporation Using Surface Plasmon Resonance (SPR) Reflectance Microscopy	Vinaykumar Konduru, Dong Hwam Shin, Chang Kyoung Choi and Jeffrey Allen	Department of Mechanical Engineering
On the Formation and breakup of Viscoelastic Droplets at a microfluidic T-Junction	Olabanji Shonibare, Kathleen Feigl, Franz Tanner	Department of Mathematical Sciences
pH Responsive, Reversibly Adherent Hydrogels Based on Boronic Acid Catechol Interaction	Ameya Narkar, Brett Barker, Matthey Clisch, Jingfeng Jiang and Bruce P. Lee	Department of Biomedical Engineering
Hydrogen Peroxide Generation and Biocompatibility of Hydrogel-Bound Mussel Adhesive Moiety	Hao Meng (1), Yuting Li (1), Madeline Faust (1), Shari Konst (2), Bruce P. Lee (1)	1- Department of Biomedical Engineering, 2-Department of Chemistry
Recoverable High Strength Hydrogel Based on Polymer-Laponite Interfacial Binding as Potential Tissue Adhesive	Yuan Liu, Bruce P. Lee	Department of Biomedical Engineering
Fluorine Functionalized Boron Nitride Nanotube for Spintronics	Kamal B. Dhungana, Ranjit Pati	Department of Physics
A Critical Assessment of Flow Boiling Heat Transfer Models in Microfin Tubes	Reem Merchant, Sunil Mehendale	Department of Mechanical Engineering

ORAL PRESENTATIONS

Power and Energy

MUB Ballroom B2, 1:00 PM – 2:20 PM

Title	Name	Department
Integrated HCCI Engine Control Based on a Performance Index	Mehran Bidarvatan and Mahdi Shahbakhti	Mechanical Engineering-Engineering Mechanics Department
Experimental Investigation Into The Particulate Matter Oxidation and NOx Reduction Performance of a Diesel Engine After Treatment System	Krishnan Raghavan, Erik Gustafson, Vaibhav Kadam	Department of Mechanical Engineering
Effects of Torrefaction Severity on the Product Distribution of Two-Stage Pyrolysis	Jordan Klinger (1), Bethany Klemetsrud (2), Miron Perelman (1), Ezra Bar-Ziv (1), David Shonnard (2,3)	1- Department of Mechanical Engineering, 2- Department of Chemical Engineering, 3- Sustainable Futures Institute
Experimental and Numerical Study on Surrogate Fuel Formulation for ULSD Diesel	Meng Tang, Le Zhao, Seong-Young Lee, Jeffrey Naber	Department of Mechanical Engineering-Engineering Mechanics

ORAL PRESENTATIONS

Sustainability

MUB Ballroom A2, 1:00 PM – 2:40 PM

Title	Name	Department
Heritage-led Community Development in Mining areas: Possibility or utopia	Leonor Medeiros	Department of Social Sciences
Developing a Sustainable Process for Removal of Synthetic Hormones in Wastewater Treatment	Jennifer L. Fuller	Department of Civil and Environmental Engineering
The Subaltern Woman: The most othered other?	Fatimata Wunpini Mohammed	Department of Humanities
Techno-Economic Analyses and Life Cycle Assessment of Two Stage Fast Pyrolysis for Bio-oil Production from Wood	Olumide Winjobi (1), David Shonnard (1), Wen Zhou (1), Ezra Bar Ziv (2)	1- Department of Chemical Engineering, 2-Department of Mechanical Engineering
The Residues of Industry: Identifying and Evaluating Mine Waste in Michigan's Copper Country	Sean M. Gohman	Department of Social Sciences
Making Connections: Mobility, Accessibility, and Policy Failure	Ronesha Strozier	Social Sciences Department

Poster Abstracts

Advances in Biology, Biochemistry, and Bioengineering

MUB Ballroom A1 9:00 AM – 11:00 AM

Photocrosslinking alginate microfluidic encapsulation of mammalian cells

Shuo Wang (1), Bruce P. Lee (2), Chang Kyoung Choi (1)
1- Department of Mechanical Engineering and Engineering Mechanics,
2- Department of Biomedical Engineering

Alginate is one of the favorable materials to culture cells as a 3D scaffold. Microfluidic encapsulation technique using alginate provides various possible biomedical applications, such as drug delivery, cell therapy and tissue engineering. The controllable microenvironments that microencapsulation endows are critical to improve metabolism of encapsulated mammalian cells. However, traditional alginate needs divalent ions, i.e. Ca2+, to polymerize the liquid alginate micro-droplets into micro-beads during the microfluidic encapsulation process. This additional step results in a complex system with low robustness for manufacturing alginate microencapsulation. Calcium can also negatively affect thein-vitro metabolism for some of mammalian cells (e.g. chondrocytes). More importantly, the degradation of traditional ionically crosslinked alginate is too long (over a year) as an implant material or a cell culturing scaffold and is uncontrollable. We employed a modified oxidized methacrylated alginate (OMA) to encapsulate A549 cells in order to solve these issues. We applied 365 nm UV to photocrosslink liquid OMA micro-droplets at a relatively low intensity (~10 mW/cm2) for 3 min. By controlling the fluidic configuration, the size of OMA microbeads was less than 100 um. The viability of cells was confirmed. This study can potentially shift the employment of traditional alginate into OMA in tissue engineering and our new photocrosslinking encapsulation approach can be highly useful for culturing cells in a controlled microenvironment.

Anticancer effectiveness of mesenchymal stem cells transfected with thymidine phosphorylase for colorectal cancer cells

Nasrin Salehi (1) and Ching-An Peng (1, 2)
1-Biochemistry and Molecular Biology Program, 2- Department of Chemical Engineering

Gene-directed enzyme prodrug therapy (GDEPT) is an approach that delivers a suicidal gene to cancer cells for the expression of prodrug-activating enzyme which converts prodrug into cytotoxic drug. One of the major impediments of GDEPT is to have the therapeutic gene specifically target on cancer cells prior to the administration of prodrug. Suicide gene therapy mediated by mesenchy mal stem cells with their ability to engraft into tumors makes these therapeutic stem cells an attractive tool to activate prodrugs directly within the tumor mass. In this study, MSCs was engineered to express thymidine phosphorylase (TP) which has the capability of converting the prodrug doxifluridine into toxic 5-fluorouracil. TP expression in the MSCs post-transfection of TP cDNA was confirmed by immunoblotting analysis and its activity was determined by spectrophotometric assay. Our results showed the anticancer effectiveness of human HT29 colorectal adenocarcinoma cells co-cultured with TP-expressing MSCs was enhanced with the addition of various dosages of doxifluridine.

Barium Concentrations in Rock Salt by Laser Induced Breakdown Spectroscopy

Kiley Spirito, Department of Physics

Time Resolved Laser Induced Breakdown Spectroscopy (TRLIBS) was used to determine the elemental composition of rock salt from Texas salt domes. The second harmonic of a 10 ns pulsed Nd:YAG laser was focused at a sample's surface causing an electrical breakdown and creation of hot plasma. Subsequently, the high energy electrons from plasma ablated, ionized, and dissociated most molecules in the plume into atomic elements. Shortly after the breakdown, electronically excited atoms and recombined atomic ions emitted characteristic spectral lines. We measured temporal evolution of the atomic emission lines and optimized signal-to-noise ratios for spectral features from elements other than sodium and chlorine. The optimal optical signal was determined to occur at a 15 microsecond delay with a 5 microsecond gate width. Peaks at characteristic transition wavelengths of Calcium and Barium were both observed. The intensity of the Barium feature will be compared to that of the nearby Sodium doublet. These results will be calibrated with a sample containing known amounts of Barium and Sodium, and the absolute concentration of the Barium in the rock salt will be determined.

Effect of surfactant on droplet size and stability in a microfluidic T-junction device

Jeana Collins and Adrienne Minerick, Department of Chemical Engineering

For many applications, precise control of the size and monodispersity of aqueous in oil droplets is critical due to the need for well-defined volumes and compositions. Many factors affect droplet size including channel size, viscosity, interfacial tension, and hydrophobicity. A parametric study investigating interfacial tension was completed by comparing the weight percent of surfactant and the resulting droplet size and coalescence. Surfactant molecules migrate to the droplet interface, altering the interfacial tension and thus stabilizing the droplets while c hanging the average droplet size.

Computing, Sensing and Signal Processing

MUB Ballroom A2 9:00 AM – 12:00 PM

Systematic Evaluation of Object Based Classification of Remotely Sensed Images Using Machine Learning

J. Bialas (1), T. Oommen (2), U. Rebbapragada (3), and E. Levin (1)
1- School of Technology,
2- Geologic and Mining Engineering and Sciences,
3- Jet Propulsion Laboratory, California Institute of Technology

Object-based approaches to the segmentation and supervised classification of remotely-sensed images yield more promising results compared to traditional pixel-based approaches. However, segmentation and classification methods present challenges in terms of algorithm selection and parameter tuning. Subjective methods and trial and error are often used, but are time consuming and yield less than optimal results. Objective methods are warranted, especially for rapid deployment in time sensitive applications such as earthquake induced damage assessment. Our research takes a systematic approach to developing an image segmentation and classification hierarchy for evaluation of post-event aerial and satellite imagery of the 2011 earthquake in Christchurch, New Zealand. Evaluation points are incorporated in the process to analyze the results achieved by segmentation, sample selection, feature space optimization and training operations. In doing so, we can evaluate the effectiveness of the chosen parameters in segmentation and classification of buildings, earthquake damage, vegetation, vehicles and paved areas, and compare different levels of multi-step image segmentations. The image classification results can then be systematically improved in incremental steps until the desired final accuracy is achieved. Results indicate at least 90% accuracy across the sample class when using up to 10x crossfold validation.

Towards Using Smartphones to Refine Sunrise and Sunset Time Models

Teresa Wilson (1), Jennifer Bartlett (2)
1 - Department of Physics, 2 - United States Naval Observatory

Current atmospheric models that predict the times of sunrise and sunset have a minimum error of about one minute. Particularly at higher latitudes, slight changes in refraction may result in even larger errors by causing the Sun to appear to set prematurely or remain continuously above the horizon for an unexpectedly long time. Atmospheric model parameters involving air stability, refraction, and transparency could be better constrained by a substantial collection of the observed sunset times. We report on the development of a project recording the necessary data with a few smartphones which will then be the groundwork of a citizen science project.

Environmental Studies and Advances in Environmental Protection

MUB Ballroom A2 9:00 AM – 11:00 AM

Freeze/Thaw Effects on Fecal Coliform Reduction in Dewatered Biosolids

Christa Meingast, Jennifer Becker, and Eric Seagren
Department of Environmental Engineering

Sewage sludge must be adequately treated or disposed of to reduce the spread of pathogens and pollutants. However, sewage sludge contains many beneficial components, such as nutrients and organic materials, and treating this resource for re-use as a fertilizer and soil amendment is a sustainable practice. Unfortunately, many small wastewater treatment plants (WWTPs) across the U.S. lack the resources to create Class A biosolids, which have fewer restrictions on application then Class B biosolids. As a result, the majority of land-applied biosolids are treated to the Class B level. Accordingly, there is a growing need for low-cost, low-technology sludge storage treatment options for WWTPs struggling to meet Class A level standards. A number of factors may affect the reduction of indicator organisms and pathogens in biosolids during long-term storage. Because application of biosolids during winter is undesirable, in many locations biosolids must be stored until spring thaw. As a result, the biosolids stored at WWTPs during winter generally undergo at least one freeze-thaw cycle (FTC).The specific objectives of this research were to: (1) monitor in situ temperature, and changes in fecal coliforms (FC), and total solids (TS) levels over the course of a year in a stored biosolids pile at Portage Lake Water and Sewage Authority (PLWSA, Houghton, MI, USA); and (2) perform a laboratory study to determine a relationship between TS/moisture content and FC reduction in dewatered biosolids subjected to a FTC. The results of this study indicate there is a strong correlation between freeze/thaw and FC reduction in dewatered biosolids. These data help explain FC reduction in biosolids during winter storage. Thus, WWTPs that experience freezing temperatures have the option of creating better quality biosolids via long-term storage, without significant expense and infrastructure changes, thereby minimizing the transport of pathogens to surface and ground water resources.

Assessing the drivers of vertical chlorophyll distribution in the Bering Sea

Brice Grunert and Colleen Mouw
Department of Geological & Mining Engineering & Sciences

Sea ice dynamics and physical mixing in the Bering Sea are variable processes that impact phytoplankton abundance and community composition. The Bering Sea is also characterized by a distinct sub-surface chlorophyll maximum across much of the eastern shelf during the summer (post-bloom) season. These characteristics, in turn, strongly regulate food web structure, with subsequent impacts on annual seafood landings for the U.S. Trends in surface chlorophyll have been well characterized using remotely-sensed data. However, the vertical structure of chlorophyll has not been well-described, particularly in relation to local hydrography, nutrient distribution and other optical constituents. In situ data for the 2008 season will be analyzed to determine the vertical structure of optical constituents at each station. This data will then be mapped to the local hydrography and nutrient concentrations (nitrogen- and phosphorus-based compounds) to determine the effects of the physical, chemical, and optical structure of the water column. These findings will aid in satellite algorithm development for the region, particularly efforts to characterize phytoplankton size structure from satellite imagery.

Modeling the impacts of climate change on water quality for inland lakes in the Great Lakes Basin

Kaitlin Reinl (1), Joseph Wagenbrenner (1), and Noel Urban (2)
1- School of Forest Resources and Environmental Science, 2- Dpeartment of Civil and Environmental Engineering

Concerns regarding lakes' physical, biological, and chemical responses to global and regional environmental stressors such as climate change and land use/cover changes have increased in recent years. Lakes in the Great Lakes Basin (GLB) are subject to large seasonal variations in temperature that result in stratification during the summer and winter months and turnover or mixing in the spring and fall. Results from similar studies suggest th at warmer winters will lead to shorter periods of ice cover in winter months and longer periods of stratification in summer months, causing increased eutrophication and algal blooms, and thus resulting in decreased dissolved oxygen levels. Additionally, runoff from urbanized and agricultural areas delivers nutrients to lakes, further stressing the chemical imbalances and degrading water quality. The primary objective of this study is to determine the impacts of climate change on physical and chemical properties of inland lakes in the GLB. To meet this objective, we are developing a database of lake attributes that will allow grouping by physical, climatic, and land use/cover conditions. We will use these data as well as extant lake water quality and meteorological data to select and validate a lake model. The lake model will be used to predict current conditions for lakes with no observed data and future conditions for lakes in the GLB, and hypotheses will be developed to te st the impacts of climate change on specific physical and chemical conditions. The hypotheses will address: altered seasonal mixing regimes, increased surface water temperature with increasing air temperature, decreased ice cover and thickness, increased eutrophication, and interactions between land use/cover and climate. The results of the simulation for each group of lakes will be summarized to identify the extent and magnitude of impacts to aquatic ecosystems in inland lakes in the GLB.

Spectroscopic Characterizations and Soil Jar Decay Test of The Chemically Modified Rice Husk Reinforcement on Urea Formaldehyde Composites

Soha Albukari (1,4), Fei Long (2), Dana Richter (3) and Dr. Patricia Heiden (1)
1- *Department of Chemistry,*
2- *Department of Mechanical Engineering-Engineering Mechanics,*
3- *School of Forest Resources and Environmental Science,*
4- *Department of Chemistry, KAU*

Rice husk (RH) is an abundant and inexpensive agricultural residue in most parts of the world where wood resources are limited. The purpose of this study was to investigate the moisture resistance and mechanical properties of the inexpensive, but brittle, urea-formaldehyde (UF) thermoset resin reinforced with unmodified and chemically modified RH. Chemical modifications were designed to modify the interface properties and to enhance moisture resistance and toughness, and to determine how thick an interface is required to accomplish this. In order to answer these questions we used atom transfer radical polymerization (ATRP) that allowed us to test the effect of using a hydrophobic interface for moisture resistance "topped" by a polar monomer to adhere to the UF resin and promote enhanced mechanical properties. The RH was modified by polymerizing specific numbers of Methyl Methacrylate monomers (MMA), and Acrylonitrile monomers (AN), for the following grafted RH modifications: RH-g-PMMAa (for moisture only) and RH-g-PMMAa-g-PANb (for moisture and toughness), where the subscript a represents a target of 25 or 75 monomer units long, and the subscript b

represents a target of 106 monomer units long. UF-grafted-RH composites were prepared with (66.66 %) UF and (33.33 %) RH. Mechanical and moisture properties were measured on these composites. The interface modifications were analyzed by Fourier transform infrared spectroscopy (FTIR), X-ray photon spectroscopy (XPS), Field emission scanning electron microscopy (FE-SEM), and Atomic force microscopy (AFM). FE-SEM images were taken for the composite surface fracture at failure mode of all composites before and after freeze-thaw cycles. AFM gave both qualitative and quantitative information on the surfaces of modified and unmodified RH. XPS calculated the elemental surface composition (%) on the rice husk surface. The biological stability of the composites was tested against the fungi G. trabeum and T. versicolorin soil jar decay tests.

Evaluation and application of AERMOD for estimating environmental impacts of PM emissions from a steelcomplex

Hossein Tavakoli (1) and Aryandokht Azari (2)
1 - Department of Environmental Engineering
2 - Faculty of Environment, University of Tehran

This paper aims to analyze the dispersion of particulate matter (PM) emitted from an steel complex in South-west of Isfahan, Iran, affecting the surrounding urban area. Three approaches, including dispersion modeling using AERMOD modeling system, PM measurement in 11 site, and chemical mass balance (CMB) model have been used in order to perform the analysis. Evaluation of AERMOD has been carried out according to the EPA's recommended guidelines of the model. Also, a CMB-8.2 receptor model has been implemented to quantify the share of the steel complex in the pollution of region among other sources. Simulated values of PM have been further compared with those obtained during an 8-hr continuous measurement at 11 receptors. The evaluation of the model and observed versus modeled values of pollutant concentrations plots (Q-Q plot) indicates that the model predictions are near 45 degree reference line which shows a good performance of the AERMOD model. The results of CMB model show that the share of the steel complex in PM pollutant of the region is 27 percent. In addition, the dispersion modeling results show that the annual average concentration of PM in urban area near to steel complex is affected 5-15 by steel complex stacks.

Does Agrilus planipennis detection success at low density vary with distance from roads?

Karen Cladas, Tara L Bal, and Andrew J Storer
School of Forest Resources and Environmental Science

Agrilus planipennis (Coleoptera: Buprestidae, Emerald Ash Borer) is a destructive invasive pest that has caused mortality of millions of Fraxinus spp. trees in North America. The interval between insect establishment, detection and management has allowed this pest to spread to large parts of North America. A purple prism trap that is hung in the tree canopy is used in a national program to detect populations of Emerald Ash Borer. We evaluated the effect of distance from roads on the likelihood of detecting this insect at low population densities using purple prism traps. In 2013 and 2014, transects of purple prism traps were set at 0m, 25m, 50m and 200m from roads near Houghton, Michigan. We hypothesized that trap success is influenced by proximity to roads, and that traps placed closer to roads may be more likely to detect Emerald Ash Borer. Preliminary analysis of data suggest a connection between road proximity and trap success, with traps closer to roads catching more insects. This suggest that efforts to detect this insect should employ traps near roads rather than further into the forest.

Integrated Seasonal Drought Forecast-Adaptive Management System for the Lower Colorado River Basin in Texas

Jonathan Witham and David Watkins
Department of Civil and Environmental Engineering

The Lower Colorado River Authority (LCRA) of central Texas manages reservoirs along the Lower Colorado River to provide water for 1.1 million residents, for rice farms in the Gulf Coast region, and hydropower for a 55-county area. However, ongoing drought is challenging the LCRA's water management efforts, leading to irrigation water cut-offs in each of the last three years. The LCRA wishes to incorporate seasonal forecasting and reservoir level projections within its management models. It is hypothesized that seasonal streamflow forecasts will improve planning and water management allocations, specifically during future periods of drought. Our approach to seasonal forecasting uses the Variable Infiltration Capacity (VIC) hydrologic model with meteorological inputs from general circulation models (GCMs) combined with statistical forecast models to form an ensemble hydrologic forecasting model for the LCRA. In the VIC model, the Lower Colorado River Basin is divided into 1/8th degree cells, with each cell representative of meteorological and soil moisture data recorded from 1949 through 2010. Following a water balance calculation in each grid cell, a simple linear routing model generates streamflows at key locations in the basin which are matched to historical flow records. After calibration, the routing model can be used with observed soil moisture data to generate seasonal streamflow forecasts tailored to LCRA management purposes.

Biomediation of Fugitive Dust Hazards in Mine Tailing Impoundments through Microbially Induced Calcium Carbonate Precipitation

Noah Buikema (1), Bonnie Zwissler (1), Eric Seagren (1), Stanley Vitton (1), and Thomas Oommen (2)
1 - Department of Civil and Environmental Engineering,
2 - Department of Geological and Mining Engineering and Sciences

Mining operations produce massive volumes of mine tailings, which are deposited as a slurry into permanent tailings disposal impoundments. Shear stresses from wind events have the potential to erode the top layer of the tailing impoundments in both cold and warm weather conditions, resulting in significant dusting events which are hazardous to the human health, while also reducing visibility and increasing the risk for accidents in nearby road traffic. Conventional approaches for control of the hazard associated with dust emissions from tailings impoundments have several limitations and potential negative side effects such as runoff into local vegetative and aquatic systems and potential exposure of humans to carcinogens from petroleum-based methods. Recent research using biomediated techniques for ground improvement has shown that the utilization of microorganisms has the potential to be an effective technique for improvement of the engineering properties of granular soils. The use of bioengineering on materials such as mine tailings, however, presents many significant challenges such as the micron and submicron particles, techniques for application, distribution methods, and potential long-term water quality issues. Therefore, the overall goal of this project is to develop and test novel, sustainable, low-impact biogeoengineering practices for stabilization of mine tailings for mitigation of dust emissions. Specifically, it is hypothesized that the use of microbially mediated biocementation via calcium carbonate precipitation (biocalcification) will improve the shear strength of the mine tailings and, thus, reduce the potential for fugitive dust emissions and mitigate the associated hazards to human and environmental health. The microorganism Sporosarcina pasteurii is a potential candidate for application in mine tailing

impoundments due to its ability to promote biocalcification via ureolysis. The resulting calcium carbonate crusts will be used to: (1) improve the surface shear strength of tailings impoundments, and (2) mitigate fugitive dust emissions from tailings impoundments. However, urea is expensive, and thus the effectiveness of S. pasteurii applied to mine tailing s must be analyzed extensively. The specific objective of this work is to perform bench-scale laboratory box model evaluations of the potential for stimulating biocalcification via ureolysis in hematite and magnetite mine tailings. This research will improve our understanding of naturally-occurring biogeochemical processes and methods for engineering these processes as a novel technique for strengthening mine tailings in situ.

Assessment on Ethanol as an Alternative Foaming Agent for Low Emission Asphalt Technology

Mohd Rosli Mohd Hasan and Zhanping You
Department of Civil and Environmental Engineering

With growing environmental awareness in pavement industries over the past decade, Warm Mix Asphalt (WMA) was invented to permit Hot Mix Asphalt (HMA) to be produced at a lower temperature, to help lower the energy demand and greenhouse gas emissions. A few WM A technologies were introduced to develop low emission pavements concept, including foaming methods, organic additives, and chemical additives. The energy savings, emissions reductions and lower construction costs could be enhanced if the production process is conducted at lower temperature settings, especially by using WMA foaming methods. The objectives of this study are to 1) evaluate the efficiency of ethanol as a foaming agent to lower the asphalt binder viscosity and, 2) compare this to the viscosity property of asphalt binder foamed using water. Prior to testing, the foamed asphalt binders were prepared using water and ethanol at two different temperatures for each foaming agent. The ethanol foamed asphalt binders were prepared at 80oC and 100oC, while the water foamed asphalt binders were prepared at 100oC and 120oC. Additionally, the Rolling Thin Film Oven (RTFO) was used to generate short term aging of the foamed asphalt binders. The aging process was performed in accordance with the AASHTO T 240 standard protocol. Each foamed asphalt binder was exposed to temperatures similar to what were used for the preparation of the foamed asphalt binder. The rotational viscometer was used to determine the viscosity of asphalt binders at 80oC, 100oC, 120oC, 140oC and 160oC. The test was conducted on un-aged and RTFO-aged ethanol foamed asphalt binder and compared to the results of the water foamed asphalt binder at similar aging condition. All samples were tested using spindle #27. During the sample preparation, the foamed asphalt binder was preheated at the foaming process temperature to avoid excessive aging on the binder and avoid the loss of foaming agent from the asphalt binder. Overall, ethanol can function in the same manner as water but requires less energy to foam, due to its lower boiling point, 77˚C. Through the rotational viscosity test , the application of water as a foaming agent does not help to reduce the viscosity of the asphalt binder. Ethanol has performed better in lowering the viscosity of asphalt binders, which is essential to allow production processes at low temperatures, as well as better workability and aggregate coating. Ethanol can be expelled at a higher rate from the foamed asphalt binder due to a lower boiling point and the latent heat of ethanol, based on the computed ageing factor. Further study and modification are vital in order to improve its overall performance.

Human Impact

MUB Ballroom B1   9:00 AM – 11:00 AM

Data Mining Social Media and Natural Language Processing Applications for Rapid Crisis Response

Sam Aden, James Bialas, Dr. Eugene Levin
School of Technology

A vast quantity of text is posted on social media during catastrophic events. Information that can be extracted from this data may document real and immediate human needs, which if detected can provide critical help in directing the efforts of emergency responders. With natural language processing techniques and statistical algorithms performed on a database of social media posts made in relation to or in the vicinity of an event, that large quantity of data may be expeditiously processed and an y information parsed may be rapidly addressed. Using geolocation metadata and timestamps in conjunction with the natural language processing can also produce maps that highlight key aspects of a crisis. Students at Michigan Tech have been working with Future Concepts in Los Angeles to develop techniques for gathering and parsing data from social media en masse, and visualizing the linguistic patterns discerned with geospatial software.

Mesenchymal Stem Cell Spheroids for Therapy Following Axillary Lymph Node Dissection

Emily R Shearier, Qi Xing, Lijun Zhang, and Feng Zhao
Department of Biomedical Engineering

Axillary lymph node dissection is the removal of lymph nodes and lymphatic collecting vessels that is performed during a mastectomy (removal of breast tissue usually carried out to remove cancerous tissue). This removal of lymph tissue can lead to secondary lymphedema of the arm, which causes chronic swelling, inflammation, secondary infections, and pain. The most common therapy for lymphedema is complete decongestive therapy, which includes bandaging, compression garments, manual lymphatic drainage, exercise, and self- care. Unfortunately, this therapy must continue for many years, and usually the rest of the patient's life. Because lymphedema is difficult to treat, researchers are now investigating therapies to prevent the lymphatic damage. Attempts to minimize scar tissue formation and encourage functional lymphatic growth post-operatively have been shown to be critical to treatment. In the research presented, a preemptive cellular therapy is explored. Human mesenchymal stem cells (MSC) are well known for their ability to differentiate into multiple cellular linages and provide a milieu of trophic factors that can help to regenerate tissue. This ability is enhanced when these cells are cultured in their native three-dimensional (3D) and physiologically low oxygen environment and can improve their efficacy. MSC spheroids have great potential to reduce scar formation and enhance lymphangiogenesis in the wound area post-axillary lymph node dissection, which could lead to a reduction in lymphedema occurrence.

Acute oral ingestion of alcohol modulates muscle sympathetic neural activity differently in Caucasians and African Americans

Ida T. Fonkoue, Qing-Hui Chen, and Jason R. Carter
Department of Kinesiology and Integrative Physiology

Recent studies consistently report that acute alcohol consumption increases muscle sympathetic nerve activity (MSNA) in humans. Despite the increased prevalence of hypertension and alcohol consumption in African Americans (AA), no studies have compared MSNA responses to alcohol consumption in AA and Caucasians (C). We hypothesized that alcohol consumption would increase MSNA in both AA and C, but that sympathoexcitatory respo nses would be augmented in AA. Five minutes of supine heart rate (HR), blood pressure, MSNA, and forearm blood flow were recorded in 8 AA (age, 23±1 yr) and 8 C (age, 22±1 yr) before and 45 min after consumption of 2.5ml of vodka per kg body mass. Increases in estimated blood alcohol content (BAC) were greater in AA (0.105%) compared to C (0.087%; $P<0.05$). Alcohol elicited similar increases of HR in AA (62±5 to 70±4 beats/min; $p<0.001$) and C (62±5 to 68±5 beats/min; $p<0.001$). Contrary to our initial hypothesis, alcohol consumption increased MSNA in C (14±3 to 27±5 bursts/100 heart beats; $P<0.05$), but did not alter MSNA in AA (28±7 to 29±6 bursts/100 heart beats). Forearm vascular conductance (FVC) was not altered by alcohol consumption in AA or C. However, when sympathetic vascular transduction was calculated (i.e., FVC/MSNA), alcohol consumption reduced sympathetic vascular transduction in C (2.4±0.4 to 1.1±0.2 units; $p<0.01$), but not AA (1.3±0.4 to 1.3±0.4 units). These findings suggest acute alcohol consumption influences resting MSNA and MSNA-vascular coupling differently in AA and C, but it is unclear if the different levels of estimated BAC, and perhaps rates of alcohol metabolism, are contributing to these racial differences.

Measurement Techniques and Analysis Methodology

MUB Ballroom B1 9:00 AM – 11:00 AM

Low Cost Infrared and Near Infrared Sensors for UAVS

Samuel T. Aden (1), James P. Bialas (1), Zachary Champion (1), Eugene Levin (1), and Jessica L. McCarty (2)
1 - Michigan Technological University, 2- Michigan Technological Research Institute, Ann Arbor Michigan

Thermal remote sensing has a wide range of applications, though the extent of its use is inhibited by cost. Robotic and computer components are now widely available to consumers on a scale that makes thermal data a readily accessible resource. In this project, thermal imagery collected via a lightweight remote sensing Unmanned Aerial Vehicle (UAV) was used to create a surface temperature map for the purpose of providing wildland firefighting crews with a cost-effective and time-saving resource. The UAV system proved to be flexible, allowing for customized sensor packages to be designed that could include visible or infrared cameras, GPS, temperature sensors, and rangefinders, in addition to many data management options. Altogether, such a UAV system could be used to rapidly collect thermal and aerial data, with a geographic accuracy of less than one meter.

Seismic Performance Assessment Considering Aftershock Hazard

Ruilong Han (1), Yue Li (1), and John van de Lindt (2)
1-Dept. of Civil & Environmental Engineering, 2- Dept. of Civil and Environmental Engineering, Colorado State Univ.

Current seismic performance methodologies such as FEMA P-58 already have the ability to estimate the direct loss, downtime, and fatalities of buildings due to earthquakes using performance based earthquake engineering (PBEE). However, the earthquake aftershocks which have the potential to cause additional damage to buildings are still not considered in these methodologies. On the other hand, previous seismic performance assessment considering aftershocks cannot account for various post-quake decisions (e.g. evacuation, safety evaluation, and repair), and they were based on simplified models which do not have the capacity to simulate many details. In this study, the effects of aftershocks and post-quake decisions on seismic performance are discussed, and an assessment methodology in accordance with other PBEE based methods but also with the ability to consider aftershocks is developed. An illustrative example is also presented using two reinforced concrete frame buildings. 18 near-fault and 60 far-field recorded mainshock-aftershock sequences are employed in the example. The result shows significant difference may occur in seismic performance when comparing the scenario with and without considering aftershocks.

Identifying Mental Models of Search in a Simulated Flight Task Using a Pathmapping Approach

Brandon S Perelman and Shane T Mueller
Department of Cognitive and Learning Sciences

In missions such as intelligence, surveillance, target acquisition and reconnaissance, and search and rescue, aerial assets are often used to explore search spaces. The pilot must make decisions concerning which locations to search, and how to reach those locations. These decisions produce a flight trajectory that reflects the pilot's mental model for the search space, which includes characteristics such as target prioritization, distance-reward evaluations, and path optimization criteria. To investigate differences in these mental models, we created a synthetic task environment in which participants

piloted a simulated aircraft to search for targets representing missing persons, and recorded participants' flight trajectories during the task. Distances and characteristics of possible target locations were parametrically varied to test pilots' mental models of the search space. Determining similarity among flight trajectories is a challenge. To accomplish this, we used a new tool (Pathmapping, a package in the R statistical computing language; Mueller, Perelman, & Veinott, 2014) to determine area-based path similarities among the test subjects' flight trajectories, and cluster modeling to analyze those similarities. The results indicate that an area-based measure of path similarity can be used to infer mental models from flight trajectories produced during a simulated search task.

Gamma-Ray Emission from Pulsar Wind Nebulae

Hao Zhou, Department of Physics

A pulsar wind nebula (PWN) is a perfect astronomical laboratory where very high energy processes can be investigated. It is powered by a rapidly rotating neutron star (pulsar), and emits electromagnetic radiation in a broad range from radio and optical to x-ray and gamma-ray energies. Geminga is the first example of a radio-quiet pulsar and the PWN around Geminga has been considered as the origin of an as-of-now unexplained positron excess in cosmic rays.High Altitude Water Cherenkov (HAWC) is a TeV gamma-ray observatory under construction in Mexico at 4100m a.s.l. HAWC will collect the most sensitive data set to study the spectrum and morphology of PWNe at the highest energies. A partial array of HAWC has been operating since summer 2013 and the full array is expected to come online in early 2015.I will discuss Geminga and other PWNe measured by HAWC and their significance in providing clues for the understanding of our universe.

MUB Ballroom B1 9:00 AM – 11:00 AM

Electrospinning 3D Scaffolds for use in Neural Tissue Engineering

Rachel Martin (1), M. E. Mullins (1), F. Zhao (2), Zichen Qian (2)
1-Department of Chemical Engineering, 2-Department of Biomedical Engineering

Polymer nanofiber scaffolds for use in neural tissue engineering have been fabricated via electrospinning of poly-L-lactic acid (PLLA) directly onto a 3D printed support. Previously, the investigators have shown success in promoting the directed growth of neural axons on highly aligned PLLA substrates both in vitro and in vivo. However, one criticism of the earlier in vitro studies is that by spinning fibers on a flat, two-dimensional surface, the growth of the axons is restricted to one plane. Thus the axon-to-fiber attachment may not be the sole mechanism for aligning the growth of the axons along the fibers, and the channels between the fibers and the substrate could contribute to the results. Using 3D-printing, elevated or "bridge" spinning stages were made with supports at varying heights, allowing the fibers to be suspending 2 to 5 mm above the substrate surface in many different configurations. This 3D structure promotes better access of in vitro cell cultures on the fibers to the growth media during incubation, reduces substrate effects, allows more degrees of freedom for axonal growth, and more closely simulates the growth environment found in vivo. Using these 3D stages, we have electrospun highly aligned fiber scaffolds of two types: pure PLLA fibers, and coaxial fibers with a PLLA sheath and a second core polymer. These coaxial fiber scaffold structures offer additional opportunities for in situ delivery of growth agents and/or electrical stimulation for improved axonal growth results.

Light transport in PT-invariant photonic structures with hidden symmetries

M. H. Teimourpour (1), R. El-Ganainy (1), A. Eisfeld (2), A. Szameit (3), and D. N. Christodoulides (4)
Department of Physics, Michigan Technological University, 2 - Max Planck Institute for the Physics of Complex Systems, 3 - Institute of Applied Physics, Abbe School of Photonics, Friedrich Schiller University, 4 - College of Optics & Photonics – CREOL, University of Central Florida

We introduce a recursive bosonic quantization technique for generating classical parity-time (PT) photonic structures that possess hidden symmetries and higher-order exceptional points. We study light transport in these geometries and we demonstrate that perfect state transfer is possible only for certain initial conditions. Moreover, we show that for the same propagation direction, left and right coherent transports are not symmetric with field amplitudes following two different trajectories. A general scheme for identifying the conservation laws in such PT -symmetric photonic networks is also presented.

Effect of Silica Micro/Nano Particle on Mechanical Properties, Gelation, and Bioactivity of Dopamine Functionalized Poly(ethylene glycol)-Gluratic Acid Hydrogels

Rattapol Pinnaratip and Bruce Lee
Department of Biomedical Engineering

Adhesives hydrogels are an interesting research topic as they could be used as substitute of surgical closures such as sutures, staples, and clips. The main benefit of this type of material is that it can reduce complications, improve recovery, and can function both ex vivo and in vivo. The hydrogel can be functionalized to introduce unique properties such as osteognic, microvascularization and many more properties.

However, main drawbacks of this material are including relatively bioinert, poor mechanical property and performs poorly under mechanical stress. This research investigates the effect and potential of mechanical improvements and microvascularization property through incorporation of micro/nano silica particle (MSiP/NSiP) in dopamine functionalized poly(ethylene glycol) (PEG) hydrogels. The composite of dopamine modified PEG-glutaric acid (PEG-GA-D) hydrogels were formed by mixing 1%wt, 2%wt, and 10%wt of MSiP and/or NSiP during hydrogel formation. In order to allow the gel to be used in situ, gelation time of the composite have to be determined. Effect of pH and PBS concentration over gelation has also been studied. The data suggested that 7.4 pH value provided the shortest gelation time. PBS concentration data suggested that higher PBS concentration reduces the gelation time significantly. The best gelling condition to achieve desirable particle dispersion is 1xPBS solution with pH 7.4. Water content data shows reduction in composite hydrogel which progress over increasing of particle incorporation in both MSiP and NSiP. Rheometry data suggested that incorporation of both MSiP and/or NSiP yield slightly stiffer gels. FE-SEM images suggested that MSiP leads to significant increases in network pore size. In conclusion, incorporation of micro/nano silica particle in PEG-GA-D gel resulting in better control over mechanical properties, gelation time, and bioactive property.

Power and Energy

MUB Ballroom B2 9:00 AM – 11:00 AM

Modeling Flap-Enabled HAWT Blades using Spinning Finite Elements via Warping Effects

Antonio Velazquez and R. Andrew Swartz
Department of Civil and Environmental Engineering

Horizontal-axis wind turbines (HAWTs) are growing in size and popularity for the generation of renewable energy to meet the world's ever increasing demand. Long-term safety and stability are major concerns related to the construction and use-phase of these structures. Braking and active pitch control are important tools to help maintain safe and stable operation, however variable cross-section control represents another possible tool as well. To properly evaluate the usefulness of this approach, modeling tools capable of representing the dynamic behavior of blades with conformable cross sections, including warping effects, are necessary. In this study, a modeling method for representing turbine blades as a series of interconnected spinning finite elements (SPEs) is presented where the aerodynamic properties of individual elements may be altered to represent changes in the cross section due to conformability (e.g., use of a mechanical flap or a "smart" conformable surface). Such a model is expected to be highly valuable in design of control rules for HAWT blades with conformable elements. Sensitivity and stability of the modeling approach are explored.

Performance of leachate-fed Microbial fuel cells under different leachate aging time

Zhimin Song and Jenifer G. Becker
Department of Civil and Environmental Engineering

In microbial fuel cells (MFC), bacteria that respire by transferring electrons to a solid anode are used as catalysts to oxidize organic compounds and generate electricity. Leachate collected from landfilled waste contains high concentrations of organic compounds, and we have shown that bacteria can produce electricity from this leachate in MFCs. However, as landfills age, the concentrations of organic compounds in the leachate undergo significant changes. This is important because as the substrate concentration being treated in a MFC increases, power production generally increases as well, but the fraction of substrate converted to electricity, i.e., the coulombic efficiency, decreases. In addition, the fraction of substrates that is biodegradable decreases as landfill leachates age. Thus, designing a MFC that will optimize power production and coulombic efficiency while treating landfill leachate with variable composition is very challenging. In this study, a laboratory-scale bioreactor landfill was built and used as a source of leachate. The leachate is being collected at different times, and its biochemical properties are characterized as the leachate ages. The effects of leachate properties and the substrate concentration on coulombic efficiency, internal resistance, and output power density are measured to determine the effects of leachate age and composition on MFC performance and design.

Time-Domain Simulation for Voltage Collapse Prediction

Zagros Shahooei (1), Bruce A. Mork (1), Mandar Kavimandan (2), Leonard J. Bohmann (1)
1- Department of Electrical Engineering, 2- Black & Veatch

Dynamic changes in the power system and subsequent cascading contingencies after a disturbance are the main causes of voltage instability. In general, the power system is nonlinear, frequency dependent, and time-varying. Most especially, voltage collapse is a nonlinear phenomenon as a result of constant changes in power system, load dynamics, nonlinearities such as transformers and FACTS devices, and control strategies. Power-voltage (P-V) curves have been used extensively to analyze voltage stability with respect to active power demand. This method relies on phasor analysis, which ignores frequencies other than the system fundamental frequency. Most methods found in literature use steady-state power-flow analysis for predicting voltage collapse. Static approaches use linearized equations and the Jacobian matrix of the system for analysis of voltage collapse. Thus, nonlinearities and resultant harmonics are not addressed, nor are frequency-dependencies or natural responses to step-changes in the system. This poster proposes and develops an EMTP-based time-domain approach for voltage collapse simulation. Load models which can be slowly ramped have been developed in EMTP/ATP to conduct time domain simulations. The load models include time variant resistive, inductive, and capacitive loads. The MODELS language within EMTP/ATP has been used. Different load blocks can be combined to define the load level, power factor, and aggregate nature of the load. This method is used to plot P-V curves and benchmarked against traditional phasor-based methods. The simulations are carried out and verified for both dc and ac systems, comparing to both continuous power flow methods and dynamic equations of the system. Simulation models developed in this paper enable us to include nonlinear models and frequency dependent circuits in voltage collapse analysis. The power system simulation model developed is more complete than the phasor analysis counterparts, and provides a platform for investigating detailed FACTS and wide-area control possibilities for high-speed emergency control.

Stochastic Optimization of Electric Vehicle Charging Load

Abhay Kumar and Dr Sumit Paudyal
Department of Electrical & Computer Engineering

Integration of electric vehicles into the electric grid by tapping into its underutilized potential during off peak hours while minimizing the cost of charging by controlled scheduling has been a subject of discussion of many publications in the past. On similar lines, this paper explores the stochastic nature of the electric vehicle charging load demand by application of basic principles of Probability, radial power flow analysis and constrained optimization to aid a distribution system operator. A probabilistic load model of EV charging has been proposed based on Central Limit Theorem that is then utilized in probabilistic power flow calculations in order to achieve an optimized schedule of EV charging that mitigates the risk of unexpected system peaks when energy prices are low while ensuring that system parameters stay within standard limits without overloading of system components.

Combustion, Emissions, and Performance Optimization in a DI/PFI-RCCI Diesel/Natural Gas Turbocharged Engine

Ehsan Ansari and Jeffrey Naber
MEEM

For light to heavy duty vehicles, Internal Combustion Engine (ICE) has been the main power source for over 100 years, with the expectation that they will continue for the foreseeable future [NRC 2013]. There are however, still significant opportunities and requirements, to improve brake thermal efficiency and reduce emissions.There are several technologies recently employed for improving efficiency including, downsizing and down speeding. Improved fuels and increasing in-cylinder motion and turbulence are other methods. Beyond spark-ignition gasoline and compression-ignition diesel engines, alternative low temperature combustion system including Homogeneous Charge Compression Ignition (HCCI) and Reactivity Controlled Compression Ignition (RCCI) are methods which show significant promise. Along with improve efficiency, these combustion system reduce NOx emission up to 87% and PM emissions up to 95% in comparison to conventional diesel engines.The main difference in new combustion models such as HCCI and RCCI with conventional compression ignition and spark ignition combustion models is fuel-air mixture condition. The hypothesis is ultra-low NOx RCCI combustion mode will be achieved by optimizing the controllable parameters including, diesel injection timing, etc. Initial results show that multiple injection for DI fuel (diesel) instead of single injection in diesel only mode will increase the fuel conversion efficiency. Using EGR as dilution to reduce the peak in cylinder temperature will reduce NOx. 95% reduction of PM concentration is achievable in RCCI combustion model due to less diesel fuel. The goal of the proposed research is to develop and apply reactivity control compression ignition (RCCI) on a 1.9L I4 VW turbo charged engine with EGR and then optimize the input parameters with genetic algorithm to meet Tier 3 Bin 20 for light duty vehicle.

Effect of Lignin Content on Pyrolysis Bio-Oil Properties

Bethany Klemetsrud (1), Jordan Klinger (1,2), Adrien Steinhurst (1), David Shonnard (1,3), and Ezra Bar-Ziv (2)
1- Department of Chemical Engineering, 2-Department of Mechanical Engineering and Engineering Mechanics, 3-Sustainable Futures Institute

Bio-oil generated from the fast pyrolysis of woody biomass can be upgraded to a renewable transportation fuel or directly used as an alternative energy source. Woody biomass is composed of three main components: cellulose, hemicellulose and lignin. The interactions of these structural carbohydrates and lignin during pyrolysis, and how feedstock variations effect product distribution is not well understood. This research aims to see how the product distribution changes when the lignin content changes. As lignin increases, it is expected that there would also be an increase in the elemental C/O ratio, and a reduction in chemically formed water - leading to an overall higher quality of bio-oil. The thermochemical breakdown of the lignin component is known to produce energy dense products, such as higher carbon-number molecules and polyphenolic compounds. To quantify that point, this poster aims to show a positive correlation between the lignin content of poplar and the energy density of bio-oil. Key polyphenolic compounds will be identified using GC-MS. Quantitative changes in the product distribution can then be interpreted in the context of an alternative fuel, and subsequent upgrading stages to produce renewable transportation fuels. Five genetically different poplar samples (1.0 mg and 500 μm) of varying composition (lignin content) will be pyrolyzed using a micro-pyrolysis unit (CDS 5200HP) in a high purity helium atmosphere. Species analysis will conducted using a Trace GC coupled with a DSQII MS (ThermoFisher).

Sustainability

MUB Ballroom B2, 9:00 AM – 11:00 AM

Estimating the ROI on rooftop solar under different policy scenarios

Abhilash Kantamneni (1), Edward Louie (2)
1- Department of Computer Science, 2- Department of Social Sciences

Residential solar energy market in America is supported by net-metering policies that allow customers that self-generate their own electricity to use the grid to bank excess production. The surge of rooftop solar installations is starting to pose a disruptive challenge to traditional utility market structures, prompting calls for policy reform by both industry and consumer advocates alike. This poster will examine different net-metering policies currently being proposed and their impacts on the economics of renewable self-generation for representative locations across America.

Carbon Footprint Analysis of Hydrotreated Renewable Jet (HRJ) from Rapeseed in Rotation with Wheat

Suchada Ukaew (1), David R. Shonnard (1,2), Kristin C. Lewis (3), David W. Archer (4), Joon Hee Lee (4)
1- Department of Chemical Engineering, 2- Sustainable Futures Institute, 3- U.S. Department of Transportation, John A Volpe National Transportation Systems Center, 4- U.S. Department of Agriculture, Agricultural Research Service

Hydrotreated Renewable Jet (HRJ) is a hydrocarbon "drop-in" biofuel derived from plant oils or fats through a catalytic hydroconversion process. Rapeseed (Brassica Napus) is a favored candidate feedstock for HRJ because of its high quality oil, high oil content, and the potentially attractive agroeconomic benefit to replace the fallow period in wheat/fallow rotations in the Great Plains. The goal of this research is to conduct a carbon footprint analysis of rapeseed HRJ in multiple locations in 10 U.S. states with a "cradle to grave" scope based on the function unit of 1 MJ of energy content in the HRJ fuel. In this study, a set of software tools are being used to simulate processes over the biofuel life cycle; soil biogeochemical processes and supply chain transportation logistics, while other inputs are coming from engineering calculations for HRJ conversion. The interactive Environmental Policy Integrated Climate (iEPIC) model, a biogeochemical based model, is being used to simulate the regional effects of soil types, weather, management practices, fuel use at farm, and cropping system of rapeseed cultivation in rotation with wheat on crop yield, soil organic carbon changes, and N_2O emissions. The Alternative Fuel Transportation Optimization Tool (AFTOT) is being used to create supply chain transportation routes for moving rapeseed feedstock at regional farming locations to biorefineries and finally to HRJ distributions based on the lowest cost of transportation. After recovery from rapeseed, rapeseed oil is converted into HRJ fuel through the UOP/Eni Ecofining™ Process, which is the combination of hydrodeoxygenation, decarboxylation, hydroisomerization, hydrocracking, and separation processes. The inventory of inputs (i.e., cultivation, oil extraction and HRJ fuel conversion, and transportation) from multiple landsc ape scales obtained from the iEPIC model, UOP/Eni Ecofining™ Process, and AFTOT are incorporated to produce robust analysis of regional variations in carbon footprint for rapeseed-derived HRJ. The LCA study and results are compared to the U.S. average fossil jet fuel pathway to determine savings of GHG emissions.

Land-use Change Implications for Large-scale Cultivation of Algae Feedstocks in the Southern United States

Rui Shi, Robert Handler, and David Shonnard
Sustainable Future Institute

Impacts of algae cultivation infrastructure development were assessed through a variety of means. IPCC Tier 1 methodology was used to assess potential emissions resulting from conversion of Gulf Coast and U.S. Southwest grassland, cropland and forestland in several management conditions. This assessment was combined with guidance from Pacific Northwest National Laboratory about promising sites for algae raceway development to provide an estimate of industry-wide GHG emissions impacts due to direct land-use change (LUC). Impacts of including pond liners in algal raceway facilities were assessed by using the Ecoinvent database to tabulate impacts of polyethylene liner production. Land preparation (bulldozing, leveling, and removing soil) activities were estimated with the help of an industrial partner, using proprietary construction modeling software to estimate machinery and fuel use impacts. Direct LUC impacts appear to be a larger infrastructure development concern than pond liner deployment or land preparation, and could result in GHG emissions equivalent to one or several important processing stages such as algae dewatering and drying, especially if previously forested lands are cleared.

Oral Presentation Abstracts

Advances in Biology, Biochemistry and Bioengineering

MUB Ballroom A1 9:00 AM – 11:20 PM

miR-483, a Novel MicroRNA Highly Expressed in Pancreatic β-cells

*Ramkumar Mohan1, Yiping Mao1, Shungang Zhang1 and Xiaoqing Tang1**
1-Dept. of Biological Science

Insulin (secreted from pancreatic β-cells) and glucagon (secreted from pancreatic α-cells) work in an opposing manner to regulate and maintain a normal glucose homeostasis in the blood. In diabetic patients, β-cells loss, insufficient insulin secretion combined with α-cell expansion and abnormal glucagon elevations lead to hyperglycemia and diabetes pathogenesis. MicroRNAs (miRNAs) are 21-23 nucleotides in length, non-coding RNA t hat negatively regulate gene expression in different aspects of cell differentiation, proliferation and survival. In order to identify key miRNAs that differentiate β-cells from α-cells, we performed miRNA screenings in pancreatic β-cells and α-cells respectively. One novel miRNA, miR-483 has been identified for its differential expression in pancreatic β-cells. Detailed studies by fluorescent in situ hybridization (FISH) and immunostaining revealed that miR-483 was localized in nucleus and mostly co-localized with insulin producing β-cells. Overexpression of miR-483 in β-cells increased insulin secretion by targeting SOCS3, a member of suppressor of cytokine signaling (SOCS) family. Whereas miR-483 overexpression in α-cells decreased glucagon secretion and glucagon transcription. Further studies revealed that miR-483 positively regulated beta-cell proliferation and repressed cytokine-induced apoptosis. In addition, miR- 483 was expressed at a higher level in the islets of prediabetic db/db mice compared to the wild-type mice, indicating increased miR-483 may promote beta-cell mass in the early stage of diabetes. High-fat diet fed wild-type mice shown higher expression of miR-483 compared to normal diet fed wild-type mice, indicating that miR-483's expression may be required to compensate the effects of high-fat diet treatment. Taken together, miR-483 exerts inverse effects upon the secretory function of α-cells and β-cells, and dysregulation of miR-483 may contribute to diabetes pathogenesis.

Genetic differentiation between Quercus rubra provenances at gene-based and non-genic microsatellite markers.

Sirikorn Khumwan & Oliver Gailing
School of Forest Resources and Environmental Science, Michigan Technological University

Forests have valuable effects on the climate, carbon cycle, biological responses, and attenuate the effects of global warming. Thus, a profound knowledge of forest tree responses to changing environments and the genetic control of key traits related to survival and growth under stresses is necessary. Northern red oak (Quercus rubra L.) is a keystone species due to its wide geographic distribution growing under different kinds of climate and various edaphic conditions. To bring more understanding of how oak trees adapt to changing environmental conditions, we investigated genetic variation at 14 gene-based and genomic microsatellite markers and trait variation in 288 selected genotypes. The trials consist of six provenances and have been established close to Michigan Technological University. A total of 1800 seedlings were planted in a completely randomized block design in spring 2011 at the Ford Forestry

Center and in Calumet County. The following traits were scored: the timing of vegetative bud burst, fall color, and growth rate. The specific goal of this project is to compare genetic differentiation among provenances at microsatellites with trait differentiation to assess patterns of adaptive evolution.

Characterization of nuclear microsatellite markers in sugar maple (Acer saccharum Marsh.)

Sudhir Khodwekar1, Oliver Gailing1
1-School of Forest and Environmental Sciences

A set of seven new nuclear microsatellite markers (nSSRs) is reported for sugar maple (Acer saccharum Marsh.) using paired-end Illumina sequencing. Out of 96 primers screened in a panel of six unrelated individuals, seven markers amplified polymorphic products. The utility of these markers, in addition to six already published microsatellites, for genetic variation and gene flow studies is assessed. Two out of the seven newly developed markers and the six published microsatellites amplified a single gene locus and showed regular Mendelian segregation in an open-pollinated single tree progeny. Observed heterozygosity (Ho) and expected heterozygosity (He) in 48 individuals from one population ranged from 0.809 to 0.979 and from 0.761 to 0.931, respectively. The other five markers amplified multiple fragments and were interpreted as dominant (absence/presence) markers. Paternity analyses at co-dominant markers showed effective dispersal of pollen in the sugar maple population both at 95% and 80% confidence intervals. The mean pollen dispersal distance within the population ranged from is 33.8 m to 45.5 m and gene flow from outside the stand from 82% to 88%. The absence of fine-scale Spatial Genetic Structure (SGS) suggested effective dispersal of both seeds and pollen.

MicroRNAs and the Development of Colorectal Cancer

Li Chen, Department of Biological Science

Colorectal cancer includes colon cancer, which begin in the region of the first four to five feet of the large intestine, and rectal cancer, which starts from the region of the last several inches of the large intestine leading to the anus. Both types begin in the inner lining of the colon and/or rectum, slowly growing across some or all of its layers. It typically starts from a growth of tissue termed polyp. Only the type of polyp called an adenoma can develop into cancer. MicroRNAs (miRNAs) are a newly discovered population of non-coding RNAs that have been found during cellular development. Abnormal expression of miRNAs can lead t o various cancers, including colorectal cancer. This proposal is aimed to identify unique miRNAs that are closely associated with the development of colorectal cancer. The overall objective is to understand the mechanism by which colorectal cancer is initiated, developed, and finally turned into metastatic state. Specifically, the following activities will be conducted: 1. Profiling miRNAs for their differential expressions at different stages of colorectal cancer; 2. Validating stage-specific miRNAs and their expressions in different patient tissues and colorectal cancer cell lines; 3. Identifying and characterizing the target genes of key colorectal cancer miRNAs for their functions in cancer signal transduction. To accomplish these aims, various technologies and approaches will be employed. Completion of the proposed studies promises to understand the development of colorectal cancer in depth and to develop new targets or biomarkers for the treatment/diagnostics of colorectal cancer.

Diversifying Drug Development through Scaffold Engineering: A Proposed New Strategy

Melanie L. Talaga1, Ni Fan1, Ashli L. Fueri1, Robert K. Brown1, Yoann M Chabre3, Purnima Bandyopadhyay2, René Roy3, Tarun K. Dam1.

1- *Laboratory of Mechanistic Glycobiology, Department of Chemistry ,*

2- *Department of Biological Sciences, Michigan Technological University*

3- *Department of Chemistry, Université du Québec à Montréal*

Numerous important macromolecules including many drugs contain structural scaffolds that act as anchoring platforms for functional groups or epitopes. Proteins, lipids, and synthetic structures often serve as scaffolds. While the epitopes of a macromolecule are thought to determine the functions of a ma cromolecule, very little is known about the contribution of the scaffolds. Using natural and synthetic glycoconjugates (a class of macromolecules that contain carbohydrate epitopes on scaffolds), we found that scaffolds profoundly influence the functions of biomolecules. For example, two macromolecules with similar affinity, epitopes and valence can function differently if their internal scaffolds are different. Our study opens up the possibility of diversifying drug functions by manipulating their scaffolds.

Simultaneous Detection and Quantification of Water- and Fat-Soluble Vitamins with Liquid Chromatography and Tandem Ion Trap-Mass Spectrometry

MARYAM KHAKSARI1, LYNN R. MAZZOLENI2 , CHUNHAI RUAN3, PENG SONG4, NEIL D. HERSHEY4, ROBERT T. KENNEDY4, MARK A. BURNS5, ADRIENNE R. MINERICK1

1 - Department of Chemical Engineering, Michigan Technological University

2 - Department of Chemistry, Michigan Technological University

3 - Metabolomics Core, BRCF

4 - Department of Chemistry, University of Michigan

5 - Department of Chemical Engineering, University of Michigan

A method for simultaneous determination of water-soluble and fat-soluble vitamins is de scribed. This method includes detection of seven water-soluble vitamins, specifically, B1, B2, B3 (nicotinamide), B5, B6 (pyridoxine), B7, B9 and three fat-soluble vitamins, A (retinol), D3 and E (α-tocopherol). The method uses liquid chromatography (LC) with a C18 reversed-phase column and an ion trap mass spectrometry (MS) detector coupled with an electrospray ionization (ESI) probe. Total analysis time was 53 min using gradient elution with ternary mobile phases of water and acetonitrile containing 0.1% formic acid and methanol containing 5 mM ammonium formate. The formic acid and ammonium formate enhanced molecular ionization required for MS detection. Vitamins were quantified with an internal standard method using MS/MS. With 25 µL injection volumes, the limits of detection (LODs) were in the range of 0.043-9.5 ng for all 10 vitamins with linear responses for water-soluble and polynomial responses for fat-soluble vitamins. This combined method was validated wit h human blood plasma. Accuracy, intra-day repeatability (n = 6), and inter-day precision (n = 7) for plasma were determined. The proposed method minimizes biological sample volumes, which has distinct advantages in many diagnostic applications with limited available fluids or sampling small subjects (e.g. rodents). Also, this method reduces material and solvent demands, while decreasing the preparation and instrument time in comparison to separate methods published for water-soluble and fat-soluble vitamins and provides substantial time savings for nutritional assessments from blood and other biofluids.

A New Carbohydrate-binding Hemolysin from the HelyX Family

*Ni Fan, Robert Brown, Melanie Talaga, Tarun K. Dam**
Department of Chemistry

Hemolysin was first discovered as a bacterial toxin that forms pores on the cell membrane to cause cell death. There are several hemolysins with comparable sequence found in other sources as well. Recently, more attention has been drawn to a special subgroup of it, the carbohydrate binding hemolysins. So far only two members in this subgroup have been identified, one from a fungi (mushroom) and the other from an invertebrate (sea cucumber). Both of them show specificity for Galactose and N-acetylglactosamine (GalNAc). Here, we report a new carbohydrate binding hemolysin, named FRE, from a monocot plant. W e have been investigating a family of new hemolysins termed HelyX (HemolysinX). FRE belongs to that family. The purified hemolysin is shown to be a trimer with a subunit molecular weight of 10 KDa, based on the data obtained from gel filtration and electrophoresis. Compare to other reported hemolysins, the hemolysis activity of FRE is dramatically strong. The activity of FRE is inhibited by thyroglobulin and asiaofetuin, two common human glycoproteins. FRE can tolerate a wide range of pH (pH 4.0 to pH 10.0) and is very heat stable. It retains lysis activity even at 100 C. FRE agglutinates yeast cells in a time dependent manner. In future, we plan to test the cytotoxicity of FRE and its antimicrobial and antitumor properties. We will also investigate how FRE disrupts cell membrane.

Effects of combined scattering and absorption coefficients on laser speckle contrast imaging values

Kosar Khaksari, Sean Kirkpatrick
Department of Biomedical Engineering

Laser Speckle contrast imaging (LSCI) is a non-invasive or minimally invasive method for visualizing blood flow and perfusion in biological tissues. In LSCI the motion of scattering particles results in a reduction in global and regional speckle contrast. A variety of parameters can affect the calculated contrast values in LSCI techniques, including the optical properties of the fluid and surrounding tissue.In typical LSCI where the motion of blood is of interests, optical properties are influenced by hematocrit levels. In this work, we considered the co mbined effects of both the scattering and absorption coefficients on LSCI measurements on a flow phantom. Fluid phantoms consisting of various concentrations of neutrally buoyant 10 micron microspheres and india ink mixed with DI water were formulated to mimic the optical properties of whole blood with various levels of hematocrit.. In general, in these flow studies, it was found that an increase in mua and/or mus led to a decrease in contrast values when all other experimental parameters were held constant. By increasing the number of absorbers, the effects of static scatterers is increased and the effects of moving scatterers decreased. The observed reduction in contrast due to optical property changes could easily be confused with a contrast reduction due to increased flow velocity. These results suggest that optical properties need to be considered when using LSCI to make flow estimates.

Computing, Sensing and Signal Processing

MUB Ballroom A1 1:00 PM – 2:40 PM

Emotional Expression and Recognition in Robots for Children with Autism Spectrum Disorders

Myounghoon Jeon1, Ruimin Zhang1, William Lehman1, Seyedeh M. Fakhrhosseini1, Jaclyn Barnes1, and Chung Hyuk Park2
1 - Michigan Technological University
2 - New York Institute of Technology

People with Autism Spectrum Disorders (ASD) struggle to recognize and understand emotional cues, which is one of the biggest barriers to their social inclusion. To help children with ASD develop emotional interaction skills, researchers have used interactive robots with positive results. We hope to gain an understanding of how children with ASD and neurotypical children comprehend and interpret emotions using a non-humanoid iOS-based robot, ROMO, and discover how the robot can encourage better emotional interaction. For successful emotional interaction, the robot needs emotion recognition and expression. Our second-generation facial detection system for this project has been developed using the Viola-Jones algorithm. It can detect affective states, such as anger, happiness, and surprise, etc. For vocal expression, one young male adult and a female adult recorded emotion-independent sentences in seven different affective voice types (curious, excited, happy, neutral, sad, scared, and sleepy). For facial expression, we used the standard ROMO app faces for the same seven states, which are formed using animated eyes and mouth on a solid blue background. This presentation focuses on the evaluation of users' recognition of ROMO's facial and voice expressions, rather than ROMO's recognition performance. In total, 11 college students (ages 18-22 with 2 female and 9 male) participated in this experiment. We used a within subject design in which each participant was subject to face-only and voice-only conditions. There were 42 trials for face and 42 trials for voice (7 emotions, 3 different phrases, and 2 genders). After presentation of the stimulus, the participant was asked to choose 1 out of 7 emotions that the stimulus conveyed. In all except curious, faces had higher recognition accuracy than voice, particularly with the happy, scared, and sleepy conditions. There was also a trend toward more intense ratings of the faces compared to voices.

Diffuse Gamma Radiation in our Galaxy

Hugo Alberto Ayala Solares, Department of Physics

To this day the 100-year old question of the origin of cosmic rays has not been settled. One way to investigate their origin is to study gamma rays. The gamma-ray "band" provides scientists with a new window to study the most energetic processes in the universe such as the production and propagation of high-energy cosmic rays. Tracing the galactic diffuse gamma-ray emission allows us to measure the spatial distribution and energy of cosmic rays far from our Solar System. This is because gamma rays are produced by the interaction of cosmic rays with the interstellar medium (e.g. Molecular Clouds) or radiation fields (e.g. Cosmic M icrowave Background Radiation) and because they reach Earth undeflected by magnetic fields. The High Altitude Water Cherenkov (HAWC) observatory, currently being built in Mexico at an altitude of 13450 ft, is designed to measure these high-energy gamma rays. I will discuss the latest results for the galactic diffuse gamma-ray emission obtained with data from the HAWC observatory.

An initio study of the structural and electronic properties of MgV_2O_4 in its cubic phase.

Kevin Waters, Ravindra Pandey
Department of Physics

The cubic phase of the MgV_2O_4 spinel was investigated using density functional theory. Due to the nature of transition-metal oxides and the strongly correlated d electrons the effect of the on-site Coulomb interaction is considered within the LDA+U formalism. The pressure induced metal-insulator transition was investigated along with the bulk modulus.

Highly Linear Electro-Optic Modulators for Microwave-Photonic Applications in Millimeter Frequency Ranges

Arash Hosseinzadeh, Christopher Middlebrook
Department of Electrical and Computer Engineering

As data rate transmission speeds and subsequently higher bandwidths continue to increase Microwave Photonic Links (MPLs) will be required for implementation of high speed wireless-access networks and antenna remoting applications within mass mobile hot spots. Conversion of electrical signals to optical signals (E/O) within a MPL is performed by modulating the high frequency signal onto an optical carrier (Laser) allowing for transmission to be done over common high bandwidth optical fiber. Modulators currently used are M ach-Zehnder Interference (MZI) modulators that possess an inherent nonlinearity transfer function. In this work a novel highly linear modulator using a Dual Ring Resonator (DRRM) is proposed that significantly increases linear E/O conversion capability. A rigorous theoretical analysis demonstrates that the DRRM structure can achieve a spur-free dynamic range (SFDR) close to 130 dB at the resonance frequency while keeping SFDR > 125 dB in frequencies away from the resonance frequency. The results categorize DRRM as a highly linear modulator with superior capability of linearization bandwidth in comparison to current state of the art modulators.

Thermal Remote Sensing for Dust Susceptibility Characterization at Mine Tailings Impoundments

Bonnie Zwissler1, Noah Buikema1, Thomas Oommen2, Eric Seagren1, Stan Vitton1
1 - Department of Civil and Environmantal Engineering
2 - Department of Geological and Mining Engineering and Sciences

Mine tailings impoundments are among the largest earthen structures in the world. One important and heavily regulated environmental hazard associated with tailings impoundments is air pollution from blowing tailings dust. Dust emissions occur when the shear stress exerted by the wind exceeds the frictional and cohesive forces that are holding the surface tailings in place. Therefore, understanding the strength properties of the upper few centimeters of the tailings is most critical for characterizing the susceptibility of tailings to dust emissions. The traditional approach for monitoring the susceptibility of mine tailings to dust emission involves collecting dust samples from monitoring stations, which are limited to a tiny sampling area. Additional limitations for dust emissions monitoring include cost, security issues, and trafficability issues. These limitations often lead to areas that are susceptible to dust emissions going unnoticed until a dust event occurs. Thermal remote sensing may prove useful to more thoroughly monitor the surface strength, and therefore the susceptibility to dusting, of mine tailings. In this study, laboratory experiments were performed to measure the thermal properties of mine tailings by thermal remote sensing. These thermal properties were compared to the thermal properties obtained by traditional laboratory methods, as well as the moisture content and surface strength of the tailings. The relationship between the thermal properties, moisture content, and near surface strength was then explored. These preliminary results show that the surface strength of tailings can be predicted using thermal remote sensing. ASTER satellite data was then used to apply these laboratory relationships to field scales, showing that changes in surface strength can be detected at tailings impoundment scales with thermal remote sensing.

Aggregate Numerical Representation Construction Using a Ball Growth Model Based on Realistic Aggregate Shapes

Xu YangZhanping You
Department of Civil Engineering

This study originates from the ideas of: 1) establishing an aggregate numerical representation library based on realistic aggregate shapes; and 2) reconstructing microstructure models of stone based materials using the aggregate numerical representations library. The numerical representations based on realistic shapes are created through three steps: 1) scan individual aggregate particles using X-Ray to obtain a series of cross sectional images; 2) process the sectional images and stack them to obtain the 3D aggregate boundary; and 3) apply a ball growth model to fill the inte rior space of the boundary. The aim of the ball growth is to use a low amount of balls to achieve a high filling ratio for space within the boundary. The ball growth mainly includes a first growth in 26 divergent directions which start from the centroid of the aggregate, and a second growth in 8 divergent directions which start from each ball in the first growth. Four aggregate particles were selected for the numerical representation construction using the ball growth model. The modeling results showed that the four aggregates had filling ratios of 97.3%, 94.9%, 90.2% and 98.1%, respectively. Afterward, the four numerical representations were stored as aggregate templates to establish a preliminary representation library, which can be invoked to generate numerical aggregate particles in the model reconstruction of stone based materials. A discrete element model and a finite element model of an asphalt mixture beam were reconstructed as an example of application of the numerical representation library.

Environmental Studies and Advances in Environmental Protection

MUB Ballroom A2 9:00 AM – 10:20 AM

Quantification of CO_2 emission from Crater Hills, Yellowtone

Peipei Lin, Chad Deering
Department of Geological and Mining Engineering and Science

The emission of carbon dioxide contributed by volcanic, hydrothermal and metamorphic system to the atmosphere received considerable attention, and Yellowstone as one of the largest geothermal system is a significant component in it. What's more, understanding on the spatial distribution of volcanic sourced CO_2 in Yellowstone offers the information of the underlying volcanic system. In order to quantify the release of CO_2 from Yellowstone, Crater Hills geothermal area which is on the rim of a resurgent dome is chosen to be measured in July-August 2014. The accumulation chamber method is used for measuring diffuse CO_2 degassing with ~15m spacing at field. The measured flux of CO_2 ranges from 2 g $m^{-2}d^{-1}$ to 58900 g $m^{-2}d^{-1}$, with the soil temperature varying from 11.2 Celsius to 92.3 Celsius. The sequential Gaussian simulation (sGs) is used for spatial interpolation to predict the flux of CO_2 for unmeasured areas. The total diffuse CO_2 output from sGs is 126t d^{-1} for Crater Hills (0.34 km^2).

Impacts of Land Cover Change on Biomass Burning Emissions of Mercury

Aditya Kumar1,2, Shiliang Wu1,2,3, Yaoxian Huang1
1: Department of Geological & Mining Engineering & Sciences
2: Department of Civil & Environmental Engineering
3: Atmospheric Sciences Program

Mercury is a toxic pollutant in the global environment. It can be deposited from the atmosphere to water bodies where conversion to the highly toxic methyl mercury occurs. Biomass burning is an important source of mercury to the atmosphere with emissions affected by vegetation type and density. We investigate the impacts of 2000-2050 land cover change on biomass burning emissions of mercury associated with the changes in wildfire activities and mercury emission factors. Our results show that the changes in mercury emission factors driven by vegetation change would significantly affect the mercury emissions from biomass burning over some regions, although little change in the global mercury emissions is calculated. Accounting for the changes in wildfire activities driven by land cover change by 2050 leads to an increase in the global total mercury emissions from biomass burning.

Photosynthetic temperature responses within temperate and tropical forest canopies

Alida Mau1, Molly Cavaleri1
1- Department of Forest Resources and Environmental Science

Tropical trees have been shown to be more susceptible to warming compared to temperate species, and have shown growth and photosynthetic declines at elevated temperatures as little as 30C above ambient. However, regional and global vegetation models lack the data needed to accurately represent physiological response to increased temperatures in tropical forests. We compared the instantaneous photosynthetic responses to elevated temperatures of four mature tropical rainforest tree species in Puerto Rico and the temperate broadleaf species sugar maple (Acer saccharum) in Michigan. The following hypotheses were tested: 1) Canopy leaves in

tropical trees are operating near the temperature optimum for photosynthesis Topt , while temperate canopy leaves have a lower temperature threshold compared to maximum current leaf temperature (Tleaf); 2) Tropical forests will have higher Topt and maximum rates of photosynthesis Pmax compared to temperate forests. Foliage was accessed with canopy towers, and photosynthesis was measured with a portable infrared gas analyzer. Contrary to expectations leaves in the upper canopy have Topt's that have already exceeded Tleaf. This indicates that tropical and temperate forests are already seeing photosynthesis decline at mid-day temperatures, and this decline will only worsen as air temperatures rise with climate change. Average Topt and Pmax were greater in tropical forests than temperate forests, supporting hypothesis 2. With continued warming, these forests may change from net carbon sinks to sources, with potentially dire implications to global climate feedbacks.

Development of a Computational Tool to Predict the Degradation Fate of Organic contaminants in Aqueous Phase Advanced Oxidation Processes

Divya Kamath1, Dr. Daisuke Minakata1
1- Department of Civil and Environmental Engineering

The objective of this research is to develop a novel computational tool to predict and visualize the fate of degradation of organic compounds, viz., “emerging contaminants” in aqueous phase advanced oxidation processes (AOPs) over space and time. With the availability of potential and suitable drinking water sources decreasing, and to meet the increasing water demands of the population, innovative treatment schemes such as Water Reclamation and Reuse has been on the rise. The removal of trace organic contaminants of concern is possible through cutting-edge chemical oxidation technologies. Advanced Oxidation Processes (AOPs) are among the prominent technologies employed to remove these emerging contaminants. However, a rising concern on the detection of several new organic compounds in trace amounts in the course of water/wastewater treatment processes has triggered intensive research in the direction of exploring the fate & transformation and potential human health effects of these “emerging contaminants”. The hydroxyl radical (HO•) reacts rapidly and non-selectively with most electron-rich sites on organic compounds and leads to the complete mineralization of organic compounds in the subsequent radical-involved chain reactions. These chain reactions lead to a variety of radical-intermediates and stable byproducts. However, the complexity and diversity of structures of huge numbers of known and emerging chemical contaminants makes it challenging to understand the general reaction mechanisms. To predict the fate of the byproducts for newly discovered compounds, a robust computational kinetic model needs to be developed. The kinetic model requires information on elementary reaction pathways and associated rate constants. Then, numerically mathematical equations should be solved simultaneously to obtain time-consequent byproduct distribution. Development of such a mechanistic model will give a broad insight not just into radical species interactions with different kinds of organic compounds in the water source but also into by-product transformation and pathways. This information will then serve as fundamentals to develop tools that can assess toxicity and potential health effects of new and/or possible, future emerging contaminants. Such a tool could also be prospectively employed at Water Treatment Plants to evaluate the efficiency and quality of the effluent from AOP system s. This kind of knowledge and regulated information will greatly impact the approaches used in water treatment processes and assist in better decision-making processes in employing treatment technology for emerging contaminants.

Human Impact

MUB Ballroom B1 10:20 AM – 12:00 PM

Music as an Intervention for Angry Drivers

Maryam Fakhrhosseini, Myounghoon Jeon
Department of Cognitive and Learning Science

Road accidents have become a serious threat and cause devastating human and economic cost. In order to drive safely, drivers must process considerable information, maintain high levels of attention, plan their actions, and control their operations. Often, there are some stimuli around drivers that can potentially occupy their cognitive resources necessary for safe driving and consequently have irrecoverable effects on road safety; affective states such as emotions have a major impact on performance by engaging various cognitive processes including attention, perception, and memory. Among all types of emotions, anger is relatively a common emotion during the drive. To regulate anger, studies on music show that affective states can be regulated or manipulated by music. Therefore, we investigated how music can mitigate the degenerated driving performance associated with angry driving. To this end, in the first study, fifty-three drivers participated in a simulated driving study either with or without induced anger. Three groups of participants with induced anger drove in a simulator while listening to happy or sad instrumental pieces, or without music. In the control group, anger was not induced and they did not listen to music during driving. The results show that participants who listened to either happy or sad music had significantly fewer driving errors than those who did not listen to music. However, no significant differences were found between happy and sad music conditions. In the second study, after emotion induction, we ask participants to drive in one of these conditions: participant-selected music, happy and sad music with lyrics, and the forth group will be no angry drivers and no-music condition as the control group. Results are discussed with an affect regulation model and auditory displays in cars.

Comparative Cancer Risk Assessment due to Inhalation of Asbestos in Tehran, Iran: A Case Study

Hossein Tavakoli1, Aryandokht Azari2
1 - Department of Environmental Engineering, MTU
2 - Faculty of Environment, University of Tehran, Tehran, Iran

This study presents the comparative lifetime cancer risk of Asbestos particularly combined risk of lung cancer and mesothelioma in the air of Tehran, Iran. It provides an overview of Asbestos concentration in 31 samples with the average concentration of 0.01f/ml in different districts in Tehran. Total lifetime cancer riskby EPA (IRIS) was $46.3\times10{-}5$. Based on the risk calculations presented in EPA (1986a),the average cancer risk value of lung cancer and mesothelioma was expected incidence are 46 and 152 mesothelioma deaths, and 42 and 13 lung cancer deaths per 100,000 persons for smokers and nonsmokers, respectively. In addition, In accordance with the Air Quality Guidelines of the World Health Organization (WHO, 1987), it was estimated that extra risk of lung cancer between $2.42\times10\text{-}5$ and $1.13\times10\text{-}3$, for smokers and $2.86\times10\text{-}6$ and $1.13\times10\text{-}3$ for nonsmokers may be presented by lifetime exposure to Asbestos.

Sorry I'm Late: I'm not in the Mood: Negative Emotions Lengthen Driving Time

Myounghoon Jeon1,2, Jayde Croschere1
1- Cognitive and Learning Sciences
2- Computer Science

A considerable amount of research has shown that anger degenerates driving performance but little research has empirically shown other affective effects on driving. Affect researchers have widely shown that sadness increases systematic information processing, while happiness decreases it. Given that driving is a complex, dynamic task that engages not only basic cognitive processes, but also other critical elements such as decision making, action selection, and motor control, it might result in different outcomes. Based on this notion, we pos ed a simple research question, "are sad drivers better drivers than other types of emotional drivers?" To investigate angry and sad effects on driving, we conducted a driving simulation study with induced affective states. Thirty-two young drivers participated in this study. Using a medium-fidelity NADS Mini-Sim driving simulator, a scenario was created with ten hazardous events. Affective states of angry, sad, and neutral were induced by writing about a past emotional experience. Participants rated their current affective states before and after affect induction, and after driving. Driving performance was recorded using measures such as driving time, collisions, lane deviations, max speed, and average speed. In addition, participants completed an electronic version of the NASA-TLX to provide measurements of perceived workload. Results found no difference in driving performance variables or perceived workload between the neutral and affective states, but results did show that both sad and angry affective states led to a significantly higher driving time, which can be partly explained by their higher number of lane departures. These results indicate that emotional effects might be independent of perceived workload and thus, we may need a different approach to measuring and solving affective issues. Future research plans include integrating a number of physiological measures and affect detection systems.

Lyricons (Lyrics + Earcons) Improve Identification Performance of Auditory Cues

Yuanjing Sun1, Myounghoon Jeon2
Department of Cognitive Learning Science

When users interact with electronic devices they expect instant feedback that convey a straightforward message and be distinguishable from other auditory feedback, but should not demand too much workload. To this end, aAuditory researchers have developed various non-speech (e.g., Auditory auditory icons [1] and, Earcons earcons [2], spearcons [3],spindex [4])) and speech cues (e.g., Spearcons [3] or Spindex[4])in designing auditory user interfaces. Auditory icons [1] use part of analogic sounds of the object or item, (e.g., shutter sound for the camera fu nction), while whereasEarcons earcons can represent more abstract operations or process in user interfaces, such as "save" or "file" by using a set of well-structured musical motives. However, Their their indirect link to the referent has some limitations [e.g., 5] and requires users' learning. Spearcons and spindex cues have shown successful cases in auditory menus, but each of them requires a specific context (e.g., spearcon: multi-dimensional menu, spindex: one-dimensional menu) [10] for optimal applications. Stevens and her colleagues' studies [5] revealed that users might not recognize Eearcons could go around unrecognized 40% of the time when there are more than seven earcons. Speech and non-speech sounds are different in the same way as text and graphics[6]. Speech cues could be clearer, but might be more intrusive notandlessbe aesthetic[5]. For example, The most common application of speech, Telephonetelephone-based interface (TBI) [6], reveals several limits when speech is used alone.that Besides the speech is not only slow and serial, which makes it hard to recall and retrieve in item lists but also, hard tothe main contradiction is that users can not clearly identify represent the structure or the hierarchy from of the content (e.g., of menu or function) when they are both presented in speech. From this background, a preliminary study of "Lyricons" (lyrics + earcons) [7] has have provided a novel approach to combining the two layers of musical speech sounds (lyrics) and non-speech sounds (earcons) concurrently. This combination is expected to improve both semantics and aesthetics of auditory user interfaces. The purpose of the present paper is aims to: 1) briefly present the results of focus groups conducted to obtain users' opinions about their awareness of auditory user interfaces in their everyday lives and comments on the initial design of lyricons; and 2) validate the effectiveness of lyricons compared to traditional earcons, whether people can more intuitively grasp the intended functions that lyricons imply than those of earcons. When we make a hybrid auditory cue, a parallel integration is less clear than a serial integration.

Economic and sustainable development of the Landlocked developing countries

Enkhtsog Damba, School of Business and Economics

Mongolian president was given a statement to the General Assembly of UN that last few years have been somewhat favorable for the overall economic development and growth of landlocked developing countries as a group. According to the Secretary-General's report GDP of Landlocked Developing Countries' (LLDC) grew annually by almost 8 percent for the recently. Foreign direct investment has also seen a certain increase over the same period. In addition, as of 2013 more than 90 percent of exports of LLDCs to developed markets enjoy duty-free access, a significant increase from 70 percent back in 2008. Despite these positive developments LLDCs continue to face considerable challenges inherently linked to their geographical handicap. Over the past decade, the share of LLDCs in world exports remains unacceptably dismal - well below 0.6 percent, with commodities accounting for the bulk of exports. Also, the UNDP Human Development Report shows 10 out of 20 lowest-ranking countries in the human development index were LLDCs. Therefore, the research topic associated to these countries based on their economic and social development, infrastructure, how do those countries have given related actions, declarations, advantage and disadvantage being landlocked. Some of advantage being landlocked is: Benefits from transit logistics than marine transportation – land transportations spend 12-17 days marine transportation spend 40 days connecting East Asia to Europe, Easier to travel to another country for a holiday, more of a connection to your allies, easier to track what's coming through your borders, don't need to pay for a navy, Less likely to be hit by a Hurricane, or a tsunami. Related Organizations: UN office of the high representative for the least developed countries, landlocked developing countries and small island developing states, International Ministerial Conference of Landlocked and Transit Developing Countries and Donor Countries on Transit Transport Cooperation (Almaty Ministerial Conference).

MUB Ballroom B1 9:00 AM – 1:00 PM

Improving World Food productivity Through Improved Tractor Tire Design to Reduce Soil Compaction: The Use of Photogrammetry to Measure Soil Compaction

Amaneh Eslami Kenarsari 1, Stanley Vitton 2

1- Department of Civil Engineering

2- Department of Civil Engineering

Improving World Food productivity Through Improved Tractor Tire Design to Reduced Soil Compaction: The Use of Photogrammetry to Measure Soil Compaction A recent report from the University of Minnesota's states that the current growth in global crop yields will be insufficient to feed the world by 2050[1]. To meet the food production needs by 2050 will require approximately a doubling of agricultural production, which equates to an increase of 2.4% per year. Unfortunately, the study also notes that average yield improvements are only projected to increase between 0.9 to 1.6 percent per year, much less than the needed 2.4% per year. To address both food production as well as the environmental impacts of food production, a recent movement known as conservation agriculture (CA) has been gaining acceptance throughout the world. CA has been defined as minimal soil disturbance, also known to as "no-till" farming, retaining permanent soil cover (mulch) with increasing crop rotations[2]. CA is therefore considered to be a much more sustainable and environmentally friendly management system for crops production. Currently, about 9% of the world's crops are grown using CA. The initial studies suggested that CA would result in equal productivity as conventional tillage while dramatically improving the environmental impacts of crop production and dramatically reducing the amount of energy required to produce food. The use of "no-till" agriculture, however, has recently been shown in some cases to reduce crop productivity and that the benefits of CA are more limited than often assumed. One of the main issues with no-till farming is the increase in soil compaction. In addition, tractor weights have increased have more than doubled over the past 50 years leading to more soil compaction. While the higher organic matter content and biological activity in no-till farming makes the soil more resilient to soil compaction, other factors such as decrease porosity, decline of some soil biota and stronger soils restricting root penetration appear to have an overall negative effect on agricultural production. To minimize soil compaction from farm tractors, the Titan Tractor Tire Company is developing a novel tire design to minimize soil compaction and is partnering with Michigan Tech to study the essential aspects of soil compaction produced by this new concept. Soil compaction is defined as reduction in soil volume by reducing the air void in soil mass. While soil compaction is most civil applications improves soil engineering behavior, in agricultural applications, as noted above, soil compaction can have unfavorable results. The degree of soil compaction is usually monitored by measuring the soil bulk density, soil strength or stress-strain behavior of the soil under tractor loads. In our research, for the first time, we use photogrammetry for measuring the soil compaction under a tire load. The research uses a large mechanical system to generate a tractor tire rut in a soil test box. The soil's surface is first photographed using a standard digital camera but with a series of markers and a scale object on the soil. A tractor tire rut is then created in the test box using full scale tractor tires. Different lo ads can be applied over different time periods of loading. After the rut has been created the soil surface is again photographed. Software is then used to generate 3D images of the two surfaces. Once the two surface are generate, the

MathLab software is used to determine the difference between the two surfaces, which then provides a measure of the tractor tire's rut volume. The greater the tractor tire rut volume the greater the soil compaction. The research has shown that the complex volume of the tire rut can be accurately determined using the photographic methods. This is an important contribution to better understanding the development of soil compaction from the tractor tire, which consists of a complex series of lugs and curved sections of the tractor tire. Previous research into tractor tire compaction has not been able to quantify the soil-tire interaction in any meaningful way. This use of constructing 3D images of the tractor tire rut will provide a significant tool in understanding and improving tractor tire soil compaction, which in turn should help improve no-till agriculture.

Identification of a Horizontal Axis Wind Turbines via Non-Stationary Parametric and Stochastic Identification Models

Antonio Velazquez1, R. Andrew Swartz2
Department of Civil and Environmental Engineering

Wind energy is becoming increasingly predominant worldwide as an alternative renewable energy source. As for the case of the so-called Horizontal-Axis Wind Turbines (HAWTs) as an emerging technology in this field, economical, maintenance and operative factors have turned critical issues when dealing with rotatory slender structures of large dimensions. Health monitoring systems are today very promising instruments to ensure reliability and acceptable performance of the structure overall. These sensing and control based techniques are mainly supported by data-driven identification methods intended to operate either in the frequency or time domains. Conventional approaches, which use traditional identification algorithms such as stochastic subspace identification methods, assume the vibration response as stationary under idealized operating conditions. Such approaches are not capable of providing the actual dynamics under real non-stationary loading and boundary conditions. This non-stationary behavior is due to the time varying dynamic loading and time varying operating conditions. Dynamic freezing methods based on Floquet and Coleman transforms, as well as improved parametric time-dependent autoregressive (TAR) models, alleviate the stationary assumption by presuming cyclo-stationarity of the vibration signals, from which it is possible to transform the cyclic non-stationary signal into a stationary counterpart where conventional stochastic identification may be applied. Full dynamic methods are based on non-stationary and cyclo-stationary identification, under normal operating conditions, that migrate into non-parametric non-stationary (time-frequency) identification techniques. In this line of thinking, full analysis of HAWTs dynamics is carried out using both smoothness priors TAR (SP-TAR) and Functional Series TAR (FS-TAR) models.

Using Topological Data Analysis in Scientific Visualization: Two Examples

Jun Tao, Ching-Kuang Shene
Department of Computer Science

Scientific research projects usually generate a huge amount of data. The rich information in a dataset is not fully conveyed by aggregating or summarizing the numbers. Scientific visualization provides insight of data by creating visual representation such as images and graphs so that researchers can analyze data through perceptual information. Furthermore, the state-of-art visualization often allows researchers to interact with data according to their specific needs. Topological analysis

treats the data points in a data set as a sample from the underlying space and from the neighborhood relation to infer the structures of the underlying space. Recently, it has been used in visualization to discover the relation among data points. In this presentation, we present two of our visualization works based on topological methods. First, VesselGraph provided an effective way to explore multivariate vascular data on a web-page. Vessel structures are originally in 3D and branches may occlude each other. VesselGraph flattened complicated vessel structures and generated a 2D graph representation, which eliminated occlusion and provided user-friendly interaction. Multiple properties are associated with vascular data in the form of scalar/vector fields. Motivated by a topological concept named the nerve of coverings, we analyze the relation among properties and branches by generating coverings based on properties, and comparing data in different coverings. Second, we applied persistent homology to study the features and structures of streamlines, which are normally used to visualize a steady vector field. Generally, persistent homology discovers features and determines their life spans based on neighborhood relation. In our case, similarity among streamlines provides the neighborhood relation, and persistent homology discovers the most prominent features that exist with varying neighborhood size. In addition, it determines features that can hardly be found by centroid-based clustering techniques such as clusters that contain "holes".

Parallel Processing of Image Reconstruction from Bispectrum Through Turbulence

Solmaz Hajmohammadi, Saeid Nooshabadi
Department of Electrical and Computer Engineering,

A massively parallel method for the phase reconstruction from the bispectrum phase of an object is presented. Our aim is to recover an enhanced version of a turbulence corrupted image by developing an efficient and near real time image restoration algorithm. We broke the dependencies in the recursive algorithm through wavefront processing along the image diagonal and strength reduction technique. The image recovered through our parallel technique entails the acceleration of a bispectrum techn ique with respect to sequential implementation of the same algorithm. The recovered image in this technique suffers no loss of quality, with more than 90% speedup compared to the sequential version of the algorithm.

Bilevel Optimization Approach for Building to Grid Integration

Meysam Razmara, Guna R. Bharati, Mahdi Shahbakhti, Sumit Paudyal, and Rush D. Robinett III
Department of Mechanical Engineering-Engineering Mechanics

This research proposes a novel bidirectional optimization of buildings integrated to the smart distribution grid, which possess potential benefits to the customers and utilities both Mathematical models required for the optimal operations of buildings and grids are developed and a new method is proposed to obtain the solution of the bidirectional optimization. In this work, minimization of the cost of energy is chosen as an objective for the building load management, while the distribution utilities aim to increase load penetration by maximizing the load factor. A new index is also proposed as a metric of combined optimal operations of the building and the grid, which considers energy cost and nodal load factor to account for the interests of customers and utilities both. Case studies are carried out based on actual data collected from an office building at Michigan Technological University, and using a standard distribution test feeder. Studies demonstrate that the proposed bidirectional optimization is beneficial to both the customer and the distribution grid as it shows significant saving in the energy costs and improvement on the system load factor.

Cross-Cultural Study of Human Visual Attention between Easterners and Westerners in Global-Local Task

Yin-Yin Tan1 & Shane T. Mueller2
Department Cognitive and Learning Sciences

Previous research suggests that Asians have global advantage compared to Westerners (McKone et al, 2010). However, using global processing vs. local processing to distinguish two distinct cultures is not sufficient enough as there are multiple components (e.g., interference suppression, response inhibition, and spatial uncertainty) within a global-local task which can be used to discriminate cultural differences. The present study uses the global-local task prebuilt in Psychology Experiment Building Language (PEBL .14 Versio n: Mueller, 2014) to assess cross-cultural differences between Westerners (Americans, n = 38) and Easterners (Taiwanese, n = 66). The results suggest that Easterners are better at suppressing interferences, dealing with spatial uncertainty, and searching for smaller, detailed configurations, while Westerners are better at attending to big, salient object configuration. There is no difference in response inhibition between two cultures. However, regarding global vs. local processing, this present study is conflicted with McKone et al's (2010) finding that Asians are better at global processing than Westerners. The plausible explanations include that simply using global vs. local processing to discriminate two distinct cultures is insufficient, and that the varied task complexity might contribute to the conflicting results. The authors suggest that a further study is needed to investigate this issue.

Design Issues and Considerations for Dance-Based Sonification

Steven Landry, Myounghoon Jeon, Joseph Ryan
Department Cognitive and Learning Sciences

The immersive Interactive Sonification Platform (iISoP) has been developed for multi-disciplinary research in a verity of fields such as data sonification, gesture interfaces, affective computing, and digital artistic performance. This paper discusses issues, considerations, and strategies currently implemented in the iISoP's dance-based sonification project, in hopes to spur discussion of applications of sonic interactions in the community. Professional dancers have been recruited as domain experts in affective gesture communication, and MTU music composition classes have been recruited to aid in the sonification system design. Analyses are conducted to validate the compatability between the intended emotion, visual gestures of the dance, and the content of the sonifications by domain experts and non-experts. The end goal of the dance-based sonification project is to have dancers generate aesthetically pleasing music from their dance in real time, instead of dancing to pre-recorded music. The generated music will reflect both the kinetic activities and affective contents of the dancer's movement.

Modularity Maximization using Completely Positive Programming

Sakineh Yazdanparast1, Timothy C. Havens1
1- Department of Electrical and Computer engineering

Community detection is one of the most prominent problems of social network analysis. In this paper, we present a novel method for Fuzzy Modularity Maximization (FMM) for community detection by maximizing a generalized form of Newmans modularity function. By reforming the Newmans modularity function as a quadratic problem, in

this paper the Completely Positive Programming (CPP) for deriving the global maximum for modularity function is proposed. To solve the Completely Positive Programming a closed form solution using the Alternating Direction Augmented Lagrangian (ADAL) method followed by a rank minimization approach has been applied. To evaluate the performance of proposed method, several real-word data networks have been experimented for both fuzzy and crisp community detection.

Joint Neighbor Discovery and Time of Arrival Estimation in Wireless Sensor Networks via OFDMA

Mohsen Jamalabdollahi1, Seyed (Reza) Zekavat1
1- Department of Electrical and Computer engineering

This paper introduces joint neighbor discovery (ND) and coarse time-of-arrival (ToA) estimation in wireless sensor networks (WSN) via orthogonal frequency division multiple access (OFDMA). In the proposed technique, each sensor node exploits at least one orthogonal sub-carrier as its allocated signature to respond the ND and ToA estimation requests trans- mitted by target nodes. The target node utilizes the orthogonality across sub-carriers to detect the transmitted signatures and their corresponding delays. This technique is energy efficient as it avoids multiple transmissions and receptions inherent in neighbor discovery protocols and traditional ToA estimation techniques in WSN. Moreover, in this technique, network initiation process does not require channel information or time synchronization across sensor nodes. The performance of the proposed method is studied by evaluating the probabilities of false alarm and miss detection of the neighbor discovery. In addition, ToA estimation error is calculated theoretically and via simulations. Moreover, the impact of available bandwidth on the performance and energy efficiency of ND and ToA estimation are investigated. Simulation results confirm the feasibility of the proposed method even at low signal to noise ratio (SNR) regimes and in multi-path Rayleigh fading channels.

Prediction of Oxygen Distribution in the Land-channel Direction of Proton Exchange Membrane Fuel Cell (PEMFC)

Udit N. Shrivastava1, Kazuya Tajiri2
Department of Mechanical Engineering and Engineering Mechanics.

In a typical proton exchange membrane fuel cell (PEMFC), land-channel geometry can cause uneven water and oxygen distribution, this effect may elevate at higher current densities. In past, many computational studies were conducted to predict uneven species concentration distribution and current density distribution. Recently few experimental techniques have been reported to determine the current distribution in the land-channel direction. However, only one experimental study reported in literature to simultaneously measure local ohmic resistance and current density distribution in the land-channel direction of an operating PEMFC. Simultaneous measurement of high frequency resistance (HFR) and current density can allow us to predict oxygen and water concentration distribution in the land-channel direction.The primary objective of this work is to demonstrate a technique to resolve oxygen concentration distribution in the land-channel direction. An active area of 3 mm x 3 mm is analyzed in this study that consists of two 1 mm wide land and one 1 mm wide channel. Anode was segmented into nine segments to measure the current density and HFR distribution at a high spatial resolution of 350 microns.

Computation of spontaneous emission dynamics in colored vacua

M. H. Teimourpour1, R. El-Ganainy2
Department of Physics

We present an efficient time domain numerical scheme for computing spontaneous emission dynamics in colored vacua. Starting from first principles, we map the unitary evolution of a dressed two-level quantum emitter onto the problem of electromagnetic radiation from a complex harmonic oscillator under self-interaction conditions. This latter oscillator-field system can be efficiently simulated by using finite difference time domain method without the need for calculating the photonic eigenmodes of the surrounding environment. In contrast to earlier investigations, our computational framework provides a unified numerical treatment for both weak and strong coupling regimes alike. We illustrate the versatility of our scheme by considering several different examples.

Development of the Intelligent Graphs for Everyday Decisions Tutor

Margo Woller-Carter1, Edward Cokely1,2, and Rocio Garcia-Retamero2,3
1- Department of Cognitive and Learning Sciences
2- Max Planck Institute for Human Development
3- University of Granada

Graphs are simple yet powerful technologies that can communicate large amounts of complicated information about potential causes and consequences of routine, everyday decisions (e.g., benefits of saving or recycling; the dangers of diseases or lifestyles). Research shows that simple graphical visual aids can dramatically improve risk literacy, particularly among more vulnerable populations (e.g., older adults, minority and immigrant samples). Unfortunately, while well-developed theory and standards for user-friendly graph design exist, the guidelines are not widely used by graph designers who sometimes face serious conflicts of interest (e.g., marketing and management constraints). Even when information is presented in well-designed graphs, many people struggle to make sense of the risks and data. How can we help people more efficiently learn to think about risks and understand graphs? In this proposal, I present a series of studies and plans contributing to the development the Berlin Adaptive Graph Literacy Tutoring Program at RiskLiteracy.org. I begin with a review of relevant risk literacy research emphasizing the state-of-the-science of graph literacy. I then present partial results from Phase 1 of the Intelligent Graphs for Everyday Risky Decisions Tutor project (iGERD tutor), which measures and models three component graph literacy skills and is nearly completed. I then present a proposal for a mixed-factorial experiment testing fundamental theoretical assumptions about graph literacy and the benefits of adaptive training, while assessing user experience and learning outcomes of the iGERD.

New Materials and Transport Phenomena

MUB Ballroom B2 9:00 AM – 12:00 PM

Two-phase flow analysis in a microfluidic groundwater model

Lindsey M. Watch1
1 - Department of Civil and Environmental Engineering

Chlorinated ethenes, like tetrachloroethene (PCE), are known/suspected carcinogens and common groundwater contaminants. They also form non-aqueous phase liquids (NAPLs) that slowly dissolve into groundwater and serve as long-term pollution sources. To better study this phenomenon in a controlled environment, pore-scale micromodels have been designed that observation of subsurface processes that are otherwise very difficult to analyze.There are many factors influencing flow in porous systems, including fluid viscosity and density, wetting properties, fluid flow rates, and the heterogeneity and geometry of the porous media. The mechanism of displacement of one immiscible fluid by another, as is the case of NAPL PCE in groundwater, can be described using a two-phase flow analysis. In two phase flow, additional factors influencing flow include the interfacial tension between phases and the contact angle at phase interfaces. The forces that are affected by these properties include capillary, viscous, gravitational, and inertial forces. The magnitudes of these forces determine the type and stability of displacement within a porous medium, and allow prediction of multiphase flow behavior. In this analysis, two-phase flow in a microfluidic groundwater model is numerically evaluated and utilized to control NAPL PCE flow in the micromodel.

Kinetic modeling and neutron imaging experiments of evaporation in cryogenic propellants.

Kishan Bellur, Ezequiel Medici, Jeffrey Allen, & Chang Kyoung Choi
Department of Mechanical Engineering-Engineering Mechanics

One of the key challenges to long term space travel is the capability to store propellants in microgravity. Cryogenic propellants are extremely sensitive to heat and undergo evaporation/condensation in space. The ability to predict the behavior of this liquid vapor mixture hugely depends on the accommodation coefficients. Further, it has been shown that 60-90% of the evaporation occurs in the transition film region. The evaporation model is a nonlinear, third order, ordinary differential equation formu lated such that all the fluid parameters and thermodynamic properties are expressed as a functions of the local film thickness. The numerical model is built on a modular approach using various submodels to account for the curvature, capillary pressure, disjoining pressure and other fluid parameters. The Hertz-Knudsen-Schrage equation is used to determine the evaporation rate. Capillary pressure is modeled using the augmented Young-Laplace equation. Condensation and evaporation processes of hydrogen in a cryogenic condition is visualized by using neutron imaging at the BT-2 beam facility in the National Institute of Standards and Technology (NIST). These processes are controlled by adjusting temperature (20 K ~ 23 K) and pressure (1.3 ~ 1.95 bar absolute). The condensation/evaporation rates obtained from neutron imaging along with corresponding temperature and pressure data is used in conjunction with the evaporation model to uniquely extract the accommodation coefficients.

Visualization of drop coalescence during condensation and evaporation using Surface Plasmon Resonance (SPR) reflectance microscopy

Vinaykumar Konduru, Dong Hwan Shin, Chang Kyoung Choi and Jeffrey Allen*
Department of Mechanical Engineering-Engineering Mechanics

The dynamics of the contact line region during condensation and evaporation is not clearly understood. A better understanding of the dynamics of contact line can resolve the unknowns in processes beyond condensation and evaporation. The complex process of evaporation and condensation makes it difficult to visualize contact line motion and drop coalescence mechanisms using traditional imaging techniques, especially in small channels. Surface Plasmon Resonance (SPR) reflectance microscopy is a label free method that can characterize the properties of thin films in a region of about 200 nm from the metal surface. SPR microscopy detects the changes in the refractive index (RI) of the test medium by measuring the change in the intensity of incident beam of monochromatic polarized light. An experimental setup of SPR microscopy has been built and using with high speed camera, we have been able to visualize the evaporation, condensation and coalescence of water droplets between two plates. These experiments would help in a better understanding of contact line dynamics.

On the formation and breakup of viscoelastic droplets at a microfluidic T-junction

Olabanji Shonibare1, Kathleen Feigl1, Franz Tanner1
Department of Mathematical Sciences

In an elastic-newtonian system, the effect of viscosity ratio and elasticity of fluid on drop size and droplet formation dynamics was investigated. In addition, the role the type of flow - poiseuille and couette flow - played on drop production was analyzed numerically. Two dimensional numerical simulations, using the Volume of Fluid (VOF) method within OpenFOAM, have been performed to predict the size and detachment dynamics of a viscoelastic droplet in a newtonian solution. The Giesekus model was used in this work to capture viscoelastic effects. The results obtained showed very good agreement with experimental work. In both pressure driven and shear driven flows, there was a decrease in drop size as the cross-flow shear increased. However, under the same average shear rate, the drop size generated in the couette flow was found to be smaller than that in poiseuille flow. It was also found that the influence of elasticity on drop size became accentuated as the cross-flow shear increased. An increase in elasticity was accompanied by a decrease in drop size.

pH Responsive, Reversibly Adherent Hydrogels based on Boronic acid- Catechol Interaction

Ameya Narkar1, Brett Barker1, Matthew Clisch1, Jingfeng Jiang1 and Bruce P. Lee1
Department of Biomedical Engineering

Smart hydrogel adhesives employ adhesive moieties in the polymer network that enable it to bond and debond from the surface of interest upon command. We have succeeded in synthesizing a moisture-resistant biomimetic hydrogel adhesive that exploits the marine mussels' ability to affix themselves to surfaces in rough, intertidal zones. The N-hydroxyethyl acrylamide (HEAA) – backbone hydrogel was formulated by photo-polymerization in a nitrogen- purged chamber. It chiefly consisted of dopamine methacrylamide (DMA), which is a derivative of the marine mussel adhesive protein, L-3, 4-dihydroxyphenylalanine (DOPA), and 3-acrylamido phenylboronic acid (AAPBA) in the crosslinked polymer network. In an acidic medium (i.e. pH 3-4), the catechol side chains of DMA were free for interfacial binding with the substrate. When the pH was raised to a basic value (i.e. pH 9-10), the bound catechol groups formed a catechol-boronate complex with the dual hydroxyl functionality of the AAPBA, thus causing the uncoupling of the hydrogel from the substrate. To determine work of adhesion due to the formation of catechol-boronate complex, a contact mechanics adhesion test was performed. Hemispherical hydrogels were indented at the rate of 0.01mm/s against both a dry glass substrate, and a glass substrate that was affixed within a petri dish and submerged in acidic, neutral and basic pH. 'Approach' and 'pull off' force values were obtained from force versus displacement curves plotted at a fixed preload of 20mN. In the near future, normalizing the area under the curves with the contact area of adhesion would help us determine the work of adhesion. Wet adhesion properties make it an ideal candidate for the potential replacement of sutures that are conventionally used in surgical operations.

Hydrogen Peroxide Generation and Biocompatibility of Hydrogel-Bound Mussel Adhesive Moiety

Hao Meng1, Yuting Li1, Madeline Faust1, Shari Konst2, Bruce P. Lee1
1 - Department of Biomedical Engineering
2 - Department of Chemistry

The simplicity and versatility of catechol chemistry has been exploited to design functional biomaterials for a wide range of applications ranging from tissue adhesives, drug carriers, to antifouling coatings. In culture, catechol exhibited both extracellular oxidative toxicity and intracellular non-oxidative toxicity. To decouple the contribution of these two toxicity factors, dopamine was chemically bound to a non-degradable polyacrylamide hydrogel through photo-initiated polymerization of dopamine methacrylamide (DMA) with acrylamide monomers. Network-bound dopamine released cytotoxic levels of H2O2 when its catechol side chain oxidized to quinone. Introduction of catalase at a concentration as low as 7.5 U/mL counteracted the cytotoxic effect of H2O2 and enhanced the viability and proliferation rate of fibroblasts. These results indicated that H2O2 generation is one of the main contributors to the cytotoxicity of dopamine in culture. Additionally, catalase is a potentially useful supplement to suppress the elevated oxidative stress found in typical culture conditions and can more accurately evaluate the biocompatibility of mussel-mimetic biomaterials. The release of H2O2also induced a higher foreign body reaction to catechol-modified hydrogel when it was implanted subcutaneously in rat. Given that H2O2 has a multitude of biological effects, both beneficiary and deleterious, regulation of H2O2 production from catechol-containing biomaterials is necessary to optimize the performance of these materials for a desired application.

Recoverable High Strength Hydrogel based on Polymer-Laponite Interfacial Binding as Potential Tissue Adhesive

Yuan Liu, Bruce P. Lee
Department of Biomedical Engineering

Hydrogels are 3D polymer networks with high water content. They are wildly used for biomedical applications such as tissue adhesive, tissue engineering scaffold, and drug delivery vector. However, the application of hydrogels is usually limited by the mechanically weakness of traditional single network. For tissue adhesive application, the hydrogel is even expected to have similar mechanical properties with tissue substrate, which is hardly achieved from single network. Double network (DN) hydrogels are composed of two interpenetrating networks, a stiff, highly cross-linked first network and a soft, loosely cross-linked second network. It exhibits two-three orders of magnitude higher tensile/compressive strength and fracture toughness than either single network, and has shown some promise in functioning as artificial cartilage in animal models. However, it has been demonstrated that the toughness of this DN hydrogel was obtained partially by breaking the covalent bonds of networks, which makes DN hydrogel cannot recover back to the original mechanical properties after the first deformation cycle. Previously we have developed a nanocomposite hydrogel incorporating a biomimetic adhesive moiety, catechol and a synthetic nano-silicate, Laponite. This novel nanocomposite hydrogel shows an improved mechanical properties and stress recovery in repeated large strain deformation cycles. Catechol is capable of forming reversible interfacial bonds with Laponite, which could be repeatedly broken and formed during each loadi ng cycle so as to dissipate the fracture energy. Here we expected to construct a novel, high-strength DN hydrogel which is capable of bear repeated load while maintaining the integrity of polymer networks by introducing the catechol-laponite interfacial bond into the networks. Then the feasibility of this gel to be applied as tissue adhesive will be evaluated afterwards.

Fluorine Functionalized Boron Nitride Nanotube for Spintronics

Kamal B. Dhungana, Ranjit Pati
Department of Physics

Hydrogels are 3D polymer networks with high water content. They are wildly used for biomedical applications such as tissue adhesive, tissue engineering scaffold, and drug delivery vector. However, the application of hydrogels is usually limited by the mechanically weakness of traditional single network. For tissue adhesive application, the hydrogel is even expected to have similar mechanical properties with tissue substrate, which is hardly achieved from single network. Double network (DN) hydrogels are composed of two interpenetrating networks, a stiff, highly cross-linked first network and a soft, loosely cross-linked second network. It exhibits two-three orders of magnitude higher tensile/compressive strength and fracture toughness than either single network, and has shown some promise in functioning as artificial cartilage in animal models. However, it has been demonstrated that the toughness of this DN hydrogel was obtained partially by breaking the covalent bonds of networks, which makes DN hydrogel cannot recover back to the original mechanical properties after the first deformation cycle. Previously we have developed a nanocomposite hydrogel incorporating a biomimetic adhesive moiety, catechol and a synthetic nano-silicate, Laponite. This novel nanocomposite hydrogel shows an improved mechanical properties and stress recovery in repeated large strain deformation cycles. Catechol is capable of forming reversible interfacial bonds with Laponite, which could be repeatedly broken and formed during each loadi ng cycle so as to dissipate the fracture energy. Here we expected to construct a novel, high-strength DN hydrogel which is capable of bear repeated load while maintaining the integrity of polymer networks by introducing the catechol-laponite interfacial bond into the networks. Then the feasibility of this gel to be applied as tissue adhesive will be evaluated afterwards.

A critical assessment of flow boiling heat transfer models in microfin tubes

Reem Merchant, Sunil Mehendale
Department of Mechanical Engineering

Since the early 1980s, microfin tubes have been used extensively in the residential and commercial air-conditioning industry. Several researchers have reported experimental data demonstrating that microfin tubes can have nearly twice the boiling heat transfer coefficient of conventional smooth tubes. Interestingly, past research also shows that the refrigerant pressure drop increases by less than 50% compared to smooth tubes (see Chamra et al. (2003)). Since the late 1980s, many correlations have been introduced to predict the in-tube boiling heat transfer coefficients for microfin tubes. However, due to the inherent complexities of in-tube flow boiling, most of these proposed mathematical models are empirical or semi-empirical in nature. Some popular microfin tube flow boiling correlations include those of Chamra and Mago (2007), Cavallini et al. (1999), Murata and Hashizume (1993), and Kido et al. (1995). There are varying degrees of discrepancies between the predictions of these correlations and the test data. In general, these correlations predict data for the refrigerant on which they were based very well. However, they are not as successful in predicting data from other test facilities, or that generated using different fluids under other flow conditions. As a consequence, no single correlation has been successfully validated against the wide range of data available. Moreover, since these correlations were proposed, many more experimental studies on flow boiling of newer refrigerants under a variety of flow conditions in smaller diameter microfin tubes have been published. The objective of the current study is to carefully and critically review previous research on in-tube boiling heat transfer in microfin tubes. Based on this assessment, the best available flow boiling heat transfer correlations will be identified by comparing their predictions to recent experimental data. The strengths as well as the limitations of these correlations will be documented, and recommendations about the correlation that best fits a given application will be provided. Through the findings of this study, it is hoped that researchers as well as practicing engineers will be able to select the most accurate and reliable tool for predicting flow boiling heat transfer coefficients in microfin tube applications spanning a wide range of fluid properties, tube geometries, and flow conditions.

Power and Energy

MUB Ballroom B2 1:00 PM – 2:20 PM

Integrated HCCI Engine Control Based on a Performance Index

Mehran Bidarvatan and Mahdi Shahbakhti
Mechanical Engineering-Engineering Mechanics Department

The integrated control of a homogenous charge compression ignition (HCCI) combustion phasing, load, and exhaust aftertreatment system is essential for realizing high-efficient HCCI engines, while maintaining low hydrocarbon (HC) and carbon monoxide (CO) emissions. This paper introduces a new approach for integrated HCCI engine control by defining a novel performance index to characterize different HCCI operating regions. The experimental data from a single cylinder engine at 214 operating condition s is used to determine the performance index for a blended fuel HCCI engine. The new performance index is then used to design an optimum reference trajectory for a multi-input multi-output HCCI controller. The optimum trajectory is designed for control of the combustion phasing and indicated mean effective pressure (IMEP), while meeting catalyst light-off requirements for the exhaust aftertreatment system. The designed controller is tested on a previously validated physical HCCI engine model. The simulation results illustrate the successful application of the new approach for controller design of HCCI engines.

Experimental Investigation Into The Particulate Matter Oxidation and NOx Reduction Performance of a Diesel Engine Aftertreatment System

1. Krishnan Raghavan, 2. Erik Gustafson, 3. Vaibhav Kadam
Mechanical Engineering-Engineering Mechanics Department

The past decade has seen a steep increase in US diesel engine exhaust emissions regulations. The 2015 EPA regulations and California emissions standards for on-road Heavy Duty CI engines require Particulate Matter (PM) to be no more than 0.01 g/bhp and NOx to be no more than 0.2 g/bhp and optionally as low as 0.02 g/bhp [1]. Exhaust aftertreatment systems are important to meet these stringent emissions challenges [2]. A typical aftertreatment system consists of a Diesel Oxidation Catalyst (DOC) to oxidize unburnt hydrocarbons and Carbon monoxide (CO), a Diesel Particulate Filter (DPF, or CPF if catalyzed) to trap particulate matter and a Selective Catalytic Reduction system (SCR) to reduce Oxides of Nitrogen (NOx). Additionally it is known that the PM trapped in the CPF must be oxidized periodically or continuously, in order to alleviate the loss in engine performance due to increased exhaust backpressure caused by accumulation of PM in the filter[2]. In this study, experiments are performed on a Cummins 2013 ISB 280 hp engine and aftertreatment system and exhaust data is collected and analyzed to determine the performance of the CPF and SCR. The CPF tests are performed by first loading the CPF with PM using exhaust at suitable condition. The loaded PM is then oxidized using hot exhaust at specific conditions and the rate of oxidation is determined based on the experimental results. Simultaneously, the filtration capacity of the filter is determined. The SCR performance is investigated by dosing different levels of urea solution into the exhaust stream under different exhaust conditions, in order to attain different levels of ammonia (NH_3) into the SCR. In this manner, the NOx reduction capability of the SCR at different temperatures, exhaust flowrates and NH_3 levels are explored.

Effects of Torrefaction Severity on the Product Distribution of Two-Stage Pyrolysis

Jordan Klinger1,Bethany Klemetsrud2, Miron Perelman1, Ezra Bar-Ziv1, David Shonnard2,3
1 - Department of Mechanical Engineering
2 - Department of Chemical Engineering3 - Sustainable Futures Institute

Pyrolysis oil has potential to provide a renewable source of liquid fuel, transportation fuel, or can act as a feedstock for production of renewable chemicals. There are disadvantageous, though, with traditional pyrolysis oil such as acidity, water content, product inhomogeneity, product quality, and storage stability. Experimental work has indicated that these problems can be addressed with the use torrefaction as a pretreatment stage to pyrolysis. This talk will present changes in product distribution between pyrolysis oil generated from raw biomass or from biomass that is torrefied at different severities (time, temperature). Observed changes include decreased organic acids (>40% reduction), chemically formed water (>60% reduction), the number and quantity of oxygenated compounds (much cleaner GC chromatogram), and relative increased in desired high elemental C/O compounds. These changes can directly address the issue with traditional pyrolysis oil stated above. The work is being conducted with a CDS Analytical 5200HP Pyroprobe (250-320C torrefaction, 0-90min; 500C pyrolysis, 20sec). An kinetic model was developed around the measured product detachment kinetics, and can be used to interpret the combination of torrefaction and pyrolysis at various conditions. Aspen wood samples sizes studied are between 500-600μm, and 0. 05-0.2mg. The effects of torrefaction were explored through modeling, and process optimizations were determined around maximizing fuel quality (highest carbon and hydrogen content for the lowest oxygen) resulting from pyrolysis.Keywords: torrefaction, pyrolysis, bio oil, product distribution

Experimental and Numerical Study on Surrogate Fuel Formulation for ULSD and Green Diesel

Meng Tang, Le Zhao, Seong-Young Lee, Jeffrey Naber
Department of Mechanical Engineering

Green diesel is a non-oxygenated plant-based fuel that replicates the physicochemical properties of conventional diesel fuel which features lower emissions and energy supply diversification. The optimal use of fuels requires a quantitative understanding of its fundamental properties and their impact in injection and combustion. Surrogates for both conventional diesel and green diesel have been formulated by matching key physicochemical properties. Key target properties include ch emical classes, fuel volatility, density, cetane number and H/C ratio. The formulated surrogate fuels were tested in an optically-accessible combustion vessel under both vaporizing and combusting conditions with 700, 1200 and 1800 bar injection pressure through a single hole solenoid injector at fixed ambient condition of 950K and 25.4kg/m3 . Comparison of the results between original and surrogate fuels on spray and combustion characteristics include vapor penetration, liquid length, spray angle, ignition delay and lift-off length. The test results will be used to calibrate and validate a CFD spray model, laying the ground work for further CFD study with chemical kinetics modeling.

Early Model-Based Design and Verification of Automotive Control System Software Implementations

Mohammad Reza Amini1, Mahdi Shahbakhti1, Jimmy Li2, Satoshi Asami3, J. Karl Hedrick2

1. Mechanical Engineering–Engineering Mechanics Department, Michigan Technological University, Houghton, MI 49931-1295
2. Department of Mechanical Engineering, University of California, Berkeley, CA 94720-1740
3. Graduate School of Environment and Information Science, Yokohama National University, 79-7 Tokiwadai, Hodogaya-ku,,Yokohama 240-8501, Japan

Verification and validation (V&V) are es sential stages in the design cycle of automotive controllers to remove the gap between the designed and implemented controller. In this paper, an early model-based methodology is proposed to reduce the V&V time and improve the robustness of the designed controllers. The application of the proposed methodology is demonstrated on a cold start emission control problem in a midsize passenger car. A nonlinear reduced order model-based controller based on singular perturbation approximation (SPA) is designed to reduce cold start hydrocarbon (HC) emissions from a spark ignition (SI) combustion engine. A model-based simulation platform is created to verify the controller robustness against sampling, quantization, and fixed-point arithmetic imprecision. In addition, the results from early model-based verification are used to identify and remove sources of errors causing propagation of numerical imprecision in the controller s tructure. Thus the structure of the controller is modified to avoid or to reduce the level of numerical noise in the controller design. The performance of the final modified controller is validated in real-time by testing the control algorithm on a real engine control unit. The validation results indicate the modified controller is 17–63% more robust to different implementation imprecision while it requires lower implementation cost. The proposed methodology from this paper is expected to reduce typical V&V efforts in the development of automotive controllers.

Sustainability

MUB Ballroom A2 1:00 PM – 3:00 PM

Heritage-led Community Development in Mining areas: possibility or utopia?

Leonor Medeiros
Department of Social Sciences

In today's postindustrial society we can see an increasing tension between the need to preserve relevant testimonies of our past while promoting social and economic development. This makes that one of our biggest challenges when addressing the development of an area or territory, is to find a way to balance the frequently opposing needs of conservation and growth.This is particularly urgent in places and communities with a strong industrial heritage which have faced a process of deindustrialization and disinvestment (with resulting social and economic problems). Even though they possess a strong cultur al capital, their maintenance and their sustainable development requires an integrated approach that remains to be developed.Several approaches have been discussed in the past decades but they are characterized by narrowness or fail to be exportable to different contexts. In the industrial heritage and Archaeology program here at Michigan Technological University we are developing a new approach and management process that harnesses expertise from several fields to address these issues.Uniting the current best practice in the heritage field, with methodology derived from archaeology, anthropology and geography, aggregating the new technological developments and harnessing the power of the communities (namely trough crowdsourcing), it is possible to make heritage, mining and communities work and live together.This study addresses as case studies communities with a mining heritage of copper extraction, here in the USA and in my home country of Portugal.

Developing a Sustainable Process for Removal of Synthetic Hormones in Wastewater Treatment

Jennifer L. Fuller
Civil and Environmental Engineering

Pharmaceutical use in the U.S. has increased dramatically in recent years. At the same time, these pharmaceuticals (referred to as "micropollutants") are increasingly detected in wastewater treatment plant discharges and the natural waters that receive these discharges. The overall impacts of these "micropollutants" on human health and the environment are not well understood; however, it is clear that some compounds act as endocrine disrupters even at very low concentrations. In particular, 17α-ethinylestradiol (EE2), a synthetic hormone, is contributing to the feminization of male fish, which negatively impacts the ability of wild fish populations to sustain themselves. Thus, there is an urgent need for treatment processes that can effectively remove EE2 and other micropollutants from wastewater. Complete biodegradation by wastewater bacteria is the preferred removal process for these compounds; however, micropollutant concentrations in wastewater are generally too low to support the growth of bacteria, which limits the potential for biodegradation and removal. The hypothesis of the current study is that sorption of micropollutants to activated carbon will concentrate these compounds so that they can sustain bacterial growth. Adsorption isotherm studies have been performed to quantify EE2 adsorption to powdered activated carbon. The desorption of EE2 from the activated carbon is also being evaluated to assess the bioavailability of sorbed EE2 to bacteria. As water reuse becomes critical due to increasing scarcity and contamination of water resources, projects such as these are critical to ensure adequate removal of active pharmaceuticals from wastewater to sustainably protect the environment.

The Subaltern Woman: the Most Othered Other? An Analysis of the Condition of the Postcolonial Woman

Fatimata Wunpini Mohammed
Department of Humanities

An exposition on the situation of the postcolonial woman closely examining how she has been represented in film and literature and how these representations bring to fore her condition as the other in postcolonial society. This paper draws on Gayatri Spivak's work on the subaltern and Ania Loomba's discussion of postcolonial feminism to understand the condition of the postcolonial woman and her position as the other. It explores power relations between the postcolonial woman and the postcolonial man and between the postcolonial woman and the western woman. Many believe that the oppression and suppression of the postcolonial woman should be blamed on the cultural values of her society; however, colonialism played a critical role in giving more power to patriarchal institutions and perpetuating the othering of the postcolonial woman. Keywords: subaltern, other, postcolonial woman, representation, discourse, feminism

Techno-Economic Analyses and Life Cycle Assessment of Two Stage Fast Pyrolysis for Bio-oil Production from Wood.

Olumide Winjobi1, David Shonnard1,Wen Zhou1, Ezra Bar Ziv2
1- Department of Chemical Engineering
2- Department of Mechanical Engineering – Engineering Mechanics

Thermochemical conversion of wood to biofuel via fast pyrolysis is regarded as a promising alternative for producing biofuels. This process involves a quick thermal degradation of wood in the absence of air at a temperature of approximately 530OC with a short residence time of less than 1 second in the pyrolysis unit. Despite its potential, one of the major drawbacks of this approach for prod uction of biofuels is the process energy intensity. Drying and size reduction of wood are major contributors to energy consumption and the development of a two stage process that involves a torrefaction pretreatment step prior to pyrolysis was investigated as an approach to minimize the energy consumption associated with the size reduction step. Torrefaction, often referred to as mild pyrolysis, tends to enhance bio-oil properties by reducing water content, minimizing acidity, and increasing heating value. The impact different torrefaction temperatures has on the cost of production as well as the environmental will be investigated by carrying out TEA and LCA respectively, and the two stage processes will be compared to the one stage pyrolysis. However, the work reported here investigated a 2-stage process for producing pyrolysis oil. Benefits of heat integration will also be investigated for this work.Aspen Plus process simulation package is used to model the two stage torre faction-fast pyrolysis process. The effect of torrefaction severity on composition and yield of pyrolysis bio-oil was included using data from works of Westerhof et al (2012)3,Zheng et al (2012) 4, and Jones et al (2009) 1 while the work of Phanphanich et al (2011) 2 was used for the effect of torrefaction on size reduction energy requirements. Using these data, mass and energy balances are obtained, and then subsequently used in sizing the equipment, with equipment prices estimated from a number of sources such as the Aspen Economic Process Analyzer, previous works and equipment vendors. A Discounted Cash Flow Rate of Return spreadsheet prepared will be used to obtain the gate cost of production, data obtained from the simulation will also serve as inputs for the Life Cycle Assessment that will be carried out using the LCA software SimaPro.

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The Residues of Industry: Identifying and Evaluating Mine Waste in Michigan's Copper Country

Sean M. Gohman
Department of Social Sciences

Over a century of mining native copper in Michigan produced several million tons of workable metal, and an even greater amount of waste byproducts. Poor rock, mill tailings, and slag were deposited around mining lands, riverbanks, and lakeshores. Each of these waste types represent a separate step in the process of hard rock mining, and provide tangible links to an historic industry that shaped a landscape covering over 2,500 square miles. As Michigan faces efforts to both re-open former mining lands and remediate areas impacted by historic mining activity, identifying and evaluating t he number and extent of historic mine waste deposits is becoming increasingly important. Recently, the Keweenaw National Historic Park's Advisory Commission funded the survey of mine waste associated with Michigan's native copper mining industry. Gohman, representing Michigan Technological University's Industrial Heritage and Archaeology program, visited over 100 mining related locations and recorded over 350 separate sites of mine waste. These ranged from multi-acre tailings deposits to slag heaps and rock piles occupying less than 50 square feet of land. Each deposit was recorded and then evaluated using the guidelines laid out by the National Historic Register. Their National Register eligibility, integrity, morphology, visibility, and access were all considered and then scored with the intention of compiling a comprehensive list useful for heritage managers interested in acquisition and/or interpretation of waste deposits. The paper presented will briefly discuss the practice of mine waste creation and deposition in Michigan's Copper Country, as well as the survey's methodology, scoring rubric, and findings. These findings are not only useful to the National Park and its Advisory Commission, but to those who understand that the byproducts of industrial processes are as important (and as at risk) as the structures and technology that created them.

Making Connections: Mobility, Accessibility, and Policy Failure

Ronesha Strozier, Social Sciences Department

On November 4, 2014 approximately 73% of Clayton County, Georgia residents voted to enter into a contract with the Metropolitan Atlanta Rapid Transit Authority (MARTA).

This decision will bring public transportation to a county that has failed to provide adequate public transportation options to its residents. The referendum was a political issue that divided politicians and citizens due to the 1 cent sales tax that will be collected to support the bus system. Clayton County's history with public transportation has been varied. The county's most recent attempt to provide public transportation (Clayton Trans it) was only in operation from 2001-2010 with service ending due to budgetary restraints. Most of the literature concerning public transportation focuses on mobility and accessibility, but this literature does not adequately discuss how policy impacts these types of transportation issues. My research focuses on the time period from 2010-2014 when Clayton County did not have public transportation. This paper will provide a review of the mobility and accessibility literature and show how the arguments about transportation issues within Clayton County can be attributed to policy failure. This research is a part of a larger master's research project at Michigan Technological University.

Graduate Research Colloquium Banquet

MUB Ballroom Thursday, February 26, 2015 at 6:00 PM

The graduate research colloquium is the largest event hosted by the graduate student government. At this event, everyone involved with the GRC; both planning and participating, help the graduate student government congratulate the graduate students and faculty who receive awards. The awards given at the Graduate Research Colloquium include:

- Dean's Award for Outstanding Scholarship
- Outstanding Graduate Student Teaching Award
- Graduate Student Service Award
- Presentation Awards (1st, 2nd, 3rd place)
- Poster Awards (1st, 2nd, 3rd place)
- Exceptional Student Scholar Award
- Exceptional Student Leader Award
- Exceptional Faculty Mentor Award

Graduate School Awards

The graduate school sponsors three awards to honor students that have committed an extraordinary amount of time to their studies, instructing others or serving their graduate community. This awards include:

Dean's Award for Outstanding Scholarship
This award is given to one graduate student per department in recognition of their academic success in their chosen field.
Outstanding Graduate Student Teaching Award
This award is given to one graduate student per department in recognition of their exceptional ability as a teacher and excellent evaluations from students.
Graduate Student Service Award
This award is given to graduate students nominated by the Graduate Student Government Executive Board for their outstanding contributions to graduate education at Michigan Tech.

Graduate Research Colloquium Awards

Graduate students participating in the GRC are judged by Michigan Tech faculty based upon the quality of their work and ability to present in a professional manner. The best three presentations and the best three posters are granted a certificate of recognition and a cash prize of $300 for 1st place, $200 for 2nd place or $100 for 3rd place in each category.

Graduate Student Government Merit Awards

The GSG sponsors three awards to honor outstanding work by two graduate students and one faculty mentor. The recipients of these awards were nominated by their colleagues, peers and supervisors and reviewed by the Graduate Student Government Executive board.

Exceptional Student Scholar

One graduate student is awarded with a plaque and $300 for their excellence in academic pursuits, performance inside and outside the classroom, research achievements, publications and presentations, and exceptional work ethic.

Exceptional Student Leader

One graduate student is awarded with a plaque and $300 for their ability to work with others, participation in extra-curricular activities, contribution to their department and graduate student community, collegial attitude and demeanor, and integrity.

Exceptional Faculty Mentor

One faculty member is awarded with a plaque for their collegial and professional excellence, advocacy for graduate students, availability to graduate students, awareness to graduate student opportunities, inter-disciplinary collaboration, and creativity to avail new opportunities to graduate students.

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