UNIVERSITY of DAYTON
School of Engineering

ARC 2016

Sustainability, Energy, and Environmental Engineering

APRIL 19-21, 2016

Academic Research Colloquium for Engineering Ph.D. Candidates

Dear participants, fellow faculty, staff and students,

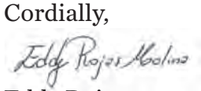
On behalf of the University of Dayton and the School of Engineering, I would like to welcome you to Dayton and the first Academic Research Colloquium (ARC) at the University. The University was founded in 1850 on land that was purchased by French Marianists. Since the 19th century, Dayton has been historically the hotbed of entrepreneurs, with the invention of the airplane by the Wright brothers, the electric self-starter for cars by Charles Kettering (who founded the Dayton Electric Company, DELCO), and the cash register by James Ritty and John Patterson (who founded the National Cash Register Company, NCR). While working at NCR, Joe Desch, one of our early graduates in electrical engineering, was instrumental in decoding German Enigma machine messages, which helped end World War II.

As a Marianist institution of higher learning with the motto "learn, lead and serve," we feel it is important for the University of Dayton to play a strong role in the vital education of future generations and in conducting innovative research to advance cutting-edge technologies for the betterment of society. In resonance with the world's emphasis on renewable energy and systems, the focus of this year's ARC is sustainability, energy, and environmental engineering. Indeed, according to the latest UN report, the world's investments on renewables last year was over $250 billion, with the developing world's investments topping that of the developed nations for the first time. The renewable and clean energy graduate program within our Department of Mechanical & Aerospace Engineering focuses on the need for stable, clean and economical energy sources, and is shared with Wright State University's Department of Mechanical and Materials Engineering. The newly established Hanley Sustainability Institute seeks to extend the University of Dayton's efforts campuswide and into the community by preparing students to meet the growing demand for sustainability skills in the workplace. One of our faculty, who is chairing The Optical Society's Environmental Sensing technical group, is co-organizing the first international incubator meeting on precision measurements in air quality and turbulence in Washington, D.C. next month.

The 24 students selected for this colloquium represent a wide variety of disciplines and come from distinguished universities around the country, each with their unique approach to addressing the issues of sustainability, energy and the environment. From the design of indoor water distribution systems for sustainable water supply to intelligent water usage solar power development in Nevada, and from the design of low-power circuits and systems to the investigation of lignin-degrading microbes of the deep ocean for biofuel applications, the participants of this ARC bring a plethora of excellent and innovative ideas to the forum to address the urgency of preserving the environment for the benefit of our future generations.

We are excited to host the 2016 ARC in the School of Engineering and share our teaching and research facilities, student and faculty research, and future prospects for collaboration with our colleagues in academia and industry. My sincere thanks to Partha Banerjee, Professor and Director of Electro-Optics, and Laura Bistrek, Director of Diversity in Engineering Center, for organizing this event.

Cordially,



Eddy Rojas
Dean, School of Engineering
University of Dayton

Colloquium Schedule

TUESDAY, APRIL 19, 2016

›› Prior to 5:45 p.m. — Arrival and check-in, Marriott at the University of Dayton

›› 5:45 p.m. — Meet in Marriott lobby for transportation to dinner

›› 6-7:45 p.m. — Dinner at Coco's Bistro

- Eddy Rojas, Ph.D., M.A., P.E., Dean, School of Engineering
- Partha Banerjee, Ph.D., Director, Electro-Optics
- Laura Bistrek, P.E., Director, Diversity in Engineering Center

›› 7:45 p.m. — Transportation to Raymond L. Fitz Hall

›› 8-9 p.m. — Workshop #1 – *Effective Proposal Writing*, Raymond L. Fitz Hall, Room 580

- Mary Connolly, Ph.D., Manager, Research & Grants Operations, Kettering Health Network

›› 9:15 p.m. — Transportation to hotel

WEDNESDAY, APRIL 20, 2016

›› 8 a.m. — Meet in Marriott lobby for transportation to Raymond L. Fitz Hall

›› 8:15-8:45 a.m. — Continental breakfast, Raymond L. Fitz Hall, Room 580

›› 8:45-9:30 a.m. — Tour of Raymond L. Fitz Hall

›› 9:30-10:30 a.m. — Workshop #2 — *Effective Faculty Job Applications and Interviewing*, Raymond L. Fitz Hall, Room 580

- Margaret Pinnell, Ph.D., Associate Dean for Faculty and Staff Development, School of Engineering
- Eddy Rojas, Ph.D., M.A., P.E., Dean, School of Engineering

›› 10:30 a.m. — Transportation to RecPlex

›› 10:45 a.m.-noon — Attend Stander Symposium poster sessions

›› Noon — Transportation to Virginia W. Kettering Residence Hall

›› 12:15-1:30 p.m. — Lunch at The Grainary, Virginia W. Kettering Residence Hall

›› 1:30-2 p.m. — Transportation to Emerson Climate Technologies Helix Innovation Center

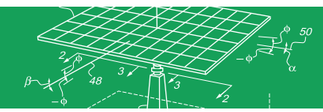
›› 2-3:30 p.m. — Tour of the Helix Innovation Center

- Rajan Rajendran, Ph.D., Vice President, System Innovation Center and Sustainability at Emerson Climate Technologies

›› 3:30 p.m. — Transportation to GE EPISCenter

›› 3:45-5:15 p.m. — Tour of the GE EPISCenter

- Joe Krisciunas, Vice President Engineering, GE Aviation



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›› 5:15 p.m. — Transportation to River Campus

›› 5:30-7 p.m. — Dinner and *Why Dayton (the City)* presentation at River Campus, Executive Dining Area

- Scott Murphy, Downtown Dayton Partnership and founder of UpDayton

›› 7:15 p.m. — Transportation to hotel

THURSDAY, APRIL 21, 2016

›› 7:45-8:15 a.m. — Continental breakfast, Helix Innovation Center

›› 8:15 a.m. — Welcome, Helix Innovation Center

- Paul Benson, Ph.D., Interim Provost, University of Dayton

›› 8:30-10 a.m. — Presentation session #1

SUSTAINABILITY

Session moderator: Denise Taylor, Civil and Environmental Engineering

Toritseju Omaghomi, Environmental Engineering, University of Cincinnati
Sizing Indoor Water Distribution Systems for Sustainable Water Supply

Aihua Huang, Mechanical Engineering, University of Kentucky
Developing Alternate Methods for Sustainable Manufacturing Performance Evaluation at the Systems Level

Anna Prisacari, Human Computer Interaction, Iowa State University
Benefits of Applying User Experience Guidelines When Designing Technology to Promote Sustainability

Ahmed Tukur, Mechanical Engineering, University of Dayton
Reducing Ventilation Energy Use in Buildings Via Statistically Informed Supply Pressure Control

Rodwan Elhashmi, Mechanical Engineering, University of Dayton
Borehole Thermal Energy Storage for Multifamily Residences

Junling Xie, Mechanical Engineering, University of Wisconsin—Milwaukee
Energy Efficiency Improvement with Novel Structures Applied in Building Energy Storage Systems

›› 10-10:30 a.m. — Coffee break

›› 10:30 a.m.-noon — Presentation session #2

ENERGY CONSERVATION AND TRANSFER

Session moderator: Kevin Hallinan, Mechanical and Aerospace Engineering

Syeda Saria Bukhary, Civil Engineering, University of Nevada, Las Vegas
Water Usage for Solar Power Development in Semi-arid Nevada

Mahboobe Mahdavi, Mechanical Engineering, Temple University
Numerical Analysis and Experimental Validation of Heat Pipe Network Performance Developed for High-Temperature Latent Heat Thermal Energy Storage Systems

Laura Solomon, Mechanical Engineering, Lehigh University
Heat Transfer Within Encapsulated Phase Change Materials — The Void Effect

Raqibul Hasan, Electrical Engineering, University of Dayton
Memristor Based Low Power Circuits and Systems

Sidaard Gunasekaran, Aerospace Engineering, University of Dayton
Relationship Between the Free Shear Layer, the Wingtip Vortex and Aerodynamic Efficiency

James Allen, Mechanical Engineering, University of Alabama
Preheating Effect on the Flame Structure of a Swirl Stabilized Combustor with Porous Insert to Control Thermoacoustics

›› Noon-1 p.m. — Lunch

›› 1-2:30 p.m. — Presentation session #3

ENVIRONMENTAL SENSING TECHNIQUES AND CHEMICAL DIAGNOSTICS

Session moderator: Andrew Chiasson, Mechanical and Aerospace Engineering

Diego Felipe Garcia Mina, Electro-Optics, University of Dayton
Nanometer Metal Films on Tapered Optical Fibers to Enhance Environmental Sensing Capabilities

Matthew Rosenberger, Mechanical Science and Engineering, University of Illinois at Urbana-Champaign
Probing Local Thermal, Mechanical and Optical Properties Utilizing Dynamic Cantilever Response in Contact Mode Atomic Force Microscopy

Farshad Zahedi, Mechanical Engineering, University of Texas at Arlington
Wireless Sensor Tomography for Structural Health Monitoring

Hannah Woo, Environmental Engineering, University of Tennessee
Investigating Lignin-Degrading Microbes of the Deep Ocean for Biofuel Applications

Kyle Shimabuku, Environmental Engineering, University of Colorado Boulder
Biochar Sorbents for the Control of Organic Contaminants in Drinking Water, Stormwater, and Wastewater Effluent: Understanding the Role of Biochar Structure and Water Quality on Sorption Behavior

Tadesse Sinshaw, Environmental Engineering, University of Mississippi
Developing a Water Quality Assessment Framework for Nutrients Load: Monitoring, Prioritizing Recoverability, and Recovery Process

›› 2:30 p.m. — Transportation to Eugene W. Kettering Engineering and Research Laboratories

›› 2:45-3:45 p.m. — Tour of Kettering Engineering and Research Laboratories

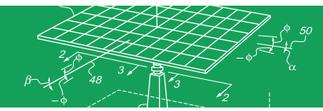
›› 3:45 p.m. — Transportation to Science Center

›› 4-4:45 p.m. — Tour of Science Center

›› 5-6 p.m. — ARC closing dinner, Kennedy Union Torch Lounge

- Daniel Curran, Ph.D., President, University of Dayton
- Eddy Rojas, Ph.D., M.A., P.E., Dean, School of Engineering

›› 6 p.m. — Transportation to hotel



Abstracts

PRESENTATION SESSION #1 — SUSTAINABILITY

Toritseju Omaghomi, Environmental Engineering, University of Cincinnati
Sizing Indoor Water Distribution Systems for Sustainable Water Supply

Designing indoor water distribution systems today requires a sustainable methodology that reflects the recent changes in water conservation measures. The current method is not flexible to recent water use changes. This research will provide a probability model with updated metrics to estimate water demand for right pipe sizing in buildings.

Aihua Huang, Mechanical Engineering, University of Kentucky
Developing Alternate Methods for Sustainable Manufacturing Performance Evaluation at the Systems Level

Development of index-based and value-based methods for sustainable manufacturing performance assessment at the systems level ranging from production line to plant and to enterprise levels. The alternate methods are developed based on hierarchical framework to investigate sustainable manufacturing performance metrics from the product and process levels.

Anna Prisacari, Human Computer Interaction, Iowa State University
Benefits of Applying User Experience Guidelines When Designing Technology to Promote Sustainability

How can the general public be encouraged to adopt sustainable technologies? In this presentation I will discuss several solutions that are designed to educate people about sustainability and environment. These solutions were tested with diverse user experience and cognitive methods, providing practical guidelines for how the design of products can be improved and encourage user adoption.

Ahmed Tukur, Mechanical Engineering, University of Dayton
Reducing Ventilation Energy Use in Buildings Via Statistically Informed Supply Pressure Control

Ventilation accounts for roughly 13.6% of a building's energy consumption. In most buildings static pressure is constant and many zonal dampers are partially closed, thus wasting energy. Statistical analysis of the zonal damper positions is used to control the supply pressure for ventilation to realize savings between 11% and 50%.

Rodwan Elhashmi, Mechanical Engineering, University of Dayton
Borehole Thermal Energy Storage for Multifamily Residences

Multifamily residences are the least energy effective of all buildings in the U.S. In this study, a large-scale Borehole Thermal solar Energy Storage (BTES) system design is developed to meet all heating and hot water demands in an apartment complex in Ohio. The resulting cost-optimal system can pay back in 13 years.

Junling Xie, Mechanical Engineering, University of Wisconsin—Milwaukee
Energy Efficiency Improvement with Novel Structures Applied in Building Energy Storage Systems

Nowadays many different energy storage technologies have been widely applied in building energy management, such as ice thermal storage for the cooling energy control and battery energy storage for the electricity control. In my research, novel structures have been innovated and experimentally analyzed to improve the technical performance of two building energy storage systems.

PRESENTATION SESSION #2 — ENERGY CONSERVATION AND TRANSFER

Syeda Saria Bukhary, Civil Engineering, University of Nevada, Las Vegas
Water Usage for Solar Power Development in Semi-arid Nevada

This study analyzed the water requirements and availability, reduction in carbon emissions as well as land usage of solar installations by using a system dynamics model, for the state of Nevada to meet the goals of renewable portfolio standard during the period 2010-2030.

Mahboobe Mahdavi, Mechanical Engineering, Temple University
Numerical Analysis and Experimental Validation of Heat Pipe Network Performance Developed for High-Temperature Latent Heat Thermal Energy Storage Systems

In the current study, the thermal-fluid phenomenon inside a novel heat pipe network is investigated numerically and experimentally. The heat pipe is specially configured to be implemented in thermal energy storage units for concentrating solar power generation systems.

Laura Solomon, Mechanical Engineering, Lehigh University
Heat Transfer Within Encapsulated Phase Change Materials — The Void Effect

An internal void space is required within an encapsulated phase change material capsule to accommodate the volumetric expansion of a phase change material upon melting and prevent rupturing. The effect of the location of the void space on the heat transfer within encapsulated phase change material capsules was numerically studied.

Raqibul Hasan, Electrical Engineering, University of Dayton
Memristor Based Low Power Circuits and Systems

There is strong demand for extreme low power computing architectures for the emerging big data applications. The memristor is a novel device having a large varying resistance range. Physical memristors in a crossbar structure can evaluate many multiply-add operations in parallel in analog domain which are the dominant operations in neural network applications. Objective of this research is to examine memristor based extreme low power neuromorphic architectures for big data processing.

Sidaard Gunasekaran, Aerospace Engineering, University of Dayton
Relationship Between the Free Shear Layer, the Wingtip Vortex and Aerodynamic Efficiency

Most airplanes today do not operate at maximum aerodynamic efficiency. The relationship between the free shear layer and the wingtip vortex in the wake of a 2-D and 3-D wing was determined in order to effectively manipulate the maximum aerodynamic efficiency of the airplane to occur at operating conditions.

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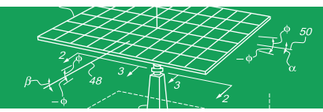

James Allen, Mechanical Engineering, University of Alabama
Preheating Effect on the Flame Structure of a Swirl Stabilized Combustor with Porous Insert to Control Thermoacoustics

Lean premixed (LPM) combustion is a common strategy in the turbine industry for power generation to reduce emissions, but tends to produce thermoacoustic instabilities under specific conditions. Using time-resolved OH planar laser-induced fluorescence technique, the stabilized flame structure without and with the porous insert is observed under preheated conditions.

PRESENTATION SESSION #3 — ENVIRONMENTAL SENSING TECHNIQUES AND CHEMICAL DIAGNOSTICS

Diego Felipe Garcia Mina, Electro-Optics, University of Dayton
Nanometer Metal Films on Tapered Optical Fibers to Enhance Environmental Sensing Capabilities

Using a tunable laser we analyze the optical signal transmission through a bi-tapered fiber sensor. The device sensitivity can be increased by depositing a gold metal film a few nanometers in thickness on the surface. By attaching selected molecules to the surface we can determine the presence of specific biomolecules.

Matthew Rosenberger, Mechanical Science and Engineering, University of Illinois at Urbana-Champaign
Probing Local Thermal, Mechanical and Optical Properties Utilizing Dynamic Cantilever Response in Contact Mode Atomic Force Microscopy

This work describes the use of atomic force microscopy to measure nanometer-scale material properties by observing surface deformation in response to a stimulus (e.g., heating or mechanical force). Three measurement applications are presented: thermomechanical deformation of AlGaN/GaN transistors, infrared absorption of individual carbon nanotubes, and mechanical properties of polymers.

Farshad Zahedi, Mechanical Engineering, University of Texas at Arlington
Wireless Sensor Tomography for Structural Health Monitoring

In this research, different wireless sensor configurations have been developed based on the frequency conversion principle. A passive wireless pitch-catch system, a microwave and solar powered wireless Acoustic Emission sensor, and a wireless tomography system which do not rely on any external power source are some of the achievements..

Hannah Woo, Environmental Engineering, University of Tennessee
Investigating Lignin-Degrading Microbes of the Deep Ocean for Biofuel Applications

My project utilizes DNA sequencing technology to identify and investigate microbes with plant-degrading enzymes in the deep ocean. The deep ocean is known to possess a broad and uncharacterized diversity of enzymes that likely include those that degrade plants. These enzymes would benefit biofuels and address a major knowledge gap.

Kyle Shimabuku, Environmental Engineering, University of Colorado Boulder
Biochar Sorbents for the Control of Organic Contaminants in Drinking Water, Stormwater, and Wastewater Effluent: Understanding the Role of Biochar Structure and Water Quality on Sorption Behavior

Biochar is a low-cost, sustainable sorbent for removing organic contaminants in water treatment applications. However, the relationship between its production conditions and sorption behavior is poorly understood. I am evaluating how production conditions govern biochar properties to better understand sorption phenomena and how to optimize the production of biochar sorbents.

Tadesse Sinshaw, Environmental Engineering, University of Mississippi
Developing a Water Quality Assessment Framework for Nutrients Load: Monitoring, Prioritizing Recoverability, and Recovery Process

This Ph.D. research developed a water quality assessment framework that supports efforts to identify and restore nutrient-impaired waters by developing: nutrients predicting models based on cost-effective parameters, a method to examine the recovery potential based on the quality of life, and a spatial decision support system to evaluate restoration.

NOTES:

School of Engineering