# Conference Program

ASTFE

NSU
NOVA SOUTHEASTERN UNIVERSITY

## 3RD THERMAL AND FLUIDS ENGINEERING CONFERENCE

4-7 March 2018, Fort Lauderdale, FL, USA

www.astfe.org/tfec2018/

# Preface

On behalf of the conference committee, welcome to the **3rd Thermal and Fluids Engineering Conference (TFEC)**. We are enthusiastic to have you join us at Nova Southeastern University in Ft. Lauderdale, FL. The conference is hosted by the American Society of Thermal and Fluids Engineering (ASTFE). There are about 400 full research papers, extended abstracts and presentations covering a wide range of topics in the thermal and fluids engineering technical communities. National and international experts from academia, industry, and government are attending, along with many students from around the world.

Pre-conference activities will include a 3-day short course, Introduction to Finite Element, Boundary Element, and Meshless Methods, March 2-4. The conference will open on Sunday, March 4, with a Welcome Reception at 6:00 pm. Monday through Wednesday morning will begin with our distinguished plenary speakers. Tuesday afternoon will feature the Donald Q. Kern Award plenary lecture. Monday through Wednesday will feature lectures from widely recognized keynote speakers.

An annual TFEC highlight is the Technology, Entrepreneurship, Communications (TEC) Talks, which have been organized as a single session on Monday afternoon. Panel sessions covering thermal fluid engineering topics are planned for Monday through Wednesday during the morning and afternoon. Please join us Tuesday afternoon for the TFEC Award Luncheon.

We encourage you to enhance your involvement in ASTFE by becoming a member and volunteering to help plan and organize our future conferences and events. The ASTFE Board of Directors and organizing committees, thank you for your participation in this exciting conference. Special appreciation goes to Anna Berlinova, and other Begell House staff, for their support and dedication, and to the staff and students from Nova Southeastern University for their assistance to make this program a success.

We also wish to thank our conference sponsors: Begell House Publishers, Meter Group Inc., Advanced Clustering Technologies, Dante Dynamics Inc. for their contributions to make this conference possible. We would like to extend our gratitude to the dedication of the session organizers and chairs, reviewers and authors, without whom this conference would not be possible. Finally, we would like to thank the speakers for their time and commitment by traveling to the meeting and sharing their work.

Thank you for your participation and we hope you enjoy the TFEC events!

Yours sincerely,

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**Dr. James Klausner**
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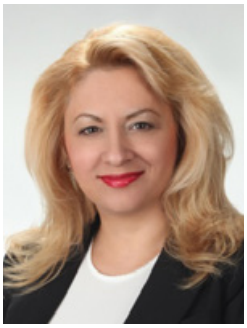

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# About ASTFE

The American Society of Thermal and Fluids Engineers (ASTFE) is a U.S. nonprofit organization based in New York City. The organization is operating to arrange professional communications, support conferences and professional communities. It is supported by individual contributors, private foundations and other governmental bodies. ASTFE supports the Open Access movement.

# Mission

ASTFE aims at providing opportunities to promote the dissemination of information and knowledge regarding thermal and fluids engineering, both nationally and internationally. It aligns itself with globally collaborative activities in the traditional areas of heat transfer and fluids engineering, as well as, in emerging areas such as those related to energy, environmental sustainability, manufacturing, thermal management, and micro- and nano-scale transport phenomena.

ASTFE encourages the personal and professional development of young scientists and engineers, and promotes cooperation with other engineering and technical societies to enhance interactions with industry, government agencies and the public at large. Of particular interest to the Society is the organization of conferences and workshops that bring together diverse groups in these fields.

# History

ASTFE was established in July 2014 to promote the science and applications of thermal and fluids engineering and related disciplines. ASTFE cooperates with several awards, such as the William Begell Medal, the Nukiyama Memorial Award, and the Global Energy International Prize.

The William Begell Medal is made possible by the support of the Executive Committee of the International Centre for Heat and Mass Transfer (ICHMT) and the Assembly for International Heat Transfer Conferences (AIHTC) and the generosity of Begell House Inc.

The Nukiyama Memorial Award has been established and sponsored by the Heat Transfer Society of Japan to commemorate outstanding contributions by Shiro Nukiyama as an excellent heat transfer scientist. Nukiyama addressed the challenges of the boiling phenomena and published a pioneering paper which clarified these phenomena in the form of the Nukiyama curve (boiling curve).

The Global Energy Prize annually honors outstanding achievements in energy research and technology from around the world that are helping address the world's various and pressing energy challenges. The Global Energy Prize, founded in 2002, is awarded to the most accomplished minds in the research world.

# Plenary Speakers

## ARUN MAJUMDAR

**Affiliation: Director, Precourt Institute for Energy, Jay Precourt Professor, Professor of Mechanical Engineering and of Photon Science and, by courtesy, of Materials Science and Engineering, Stanford University**

**Title: Thermochemical Transformations for a Sustainable Energy Future**

**Abstract:** There are several reactions and chemical transformations that are critically important for a sustainable energy future. These include, but are not limited to, the following:

1. The ability to split water [$H_2O \rightarrow H_2 + \frac{1}{2}O_2$] to produce hydrogen ($H_2$) is a vitally important reaction in energy science with broad applications to store intermittent solar and wind electricity, as a transportation fuel, as a reducing agent to convert $CO_2$ into organics including fuels, and to decarbonize the existing petrochemical and fertilizer industries.
2. The ability to reduce $CO_2$ to CO [$CO_2 \rightarrow CO + \frac{1}{2}O_2$], which can then be combined with $H_2$ to synthesize various chemicals and fuels, thus offering a pathway to utilize $CO_2$ and create value.
3. The ability to convert $CO_2$ directly into methanol [$2CO_2 + 4H_2 \rightarrow 2CH_3OH + O_2$], which is highly energy dense fuel at room temperature that can be transported easily.
4. The ability to directly transform $CH_4$ to $CH_3OH$ and $C_2H_6$.

These reactions can be achieved using four possible pathways: electrochemical, photochemical, biochemical and thermochemical. A key requirement, however, of finding chemical transformation pathways for these reactions is that they can be eventually scaled to the 100s of Milliontonne to Gigatonne level annually (1011-1012 kg/yr) worldwide. Without this level of scaling, it would be difficult to have impact on global energy systems and greenhouse gas emissions.

This talk will give an overview of the challenges and opportunities and then focus on the science of the thermochemical pathway to address them, which is the only known pathway that has reached these scales worldwide.

**Bio:** Dr. Arun Majumdar is the Jay Precourt Professor at Stanford University, a faculty member of the Departments of Mechanical Engineering and Materials Science and Engineering (by courtesy) and co-director of the Precourt Institute for Energy, which integrates and coordinates research and education activities across all seven Schools and the Hoover Institution at Stanford.

Dr. Majumdar's research in the past has involved the science and engineering of nanoscale materials and devices, especially in the areas of energy conversion, transport and storage as well as biomolecular analysis. His current research focuses on using electrochemical reactions for thermal energy conversion, thermochemical water splitting reactions to produce carbon-free hydrogen, understanding the limits of heat transport in nanostructured materials and a new effort to re-engineer the electricity grid.

In October 2009, Dr. Majumdar was nominated by President Obama and confirmed by the Senate to become the Founding Director of the Advanced Research Projects Agency - Energy (ARPA-E), where he served till June 2012 and helped ARPA-E become a model of excellence for the government with bipartisan support from Congress and other stakeholders. Between March 2011 and June 2012, he also served as the Acting Under Secretary of Energy, enabling the portfolio that reported to him: Office of Energy Efficiency and Renewable Energy, Office of Electricity Delivery and Reliability, Office of Nuclear Energy and the Office of Fossil Energy, as well as multiple cross-cutting efforts such as Sunshot, Grid Tech Team and others that he had initiated. Furthermore, he was a Senior Advisor to the Secretary of Energy on a variety of matters related to management, personnel, budget, and policy.

After leaving Washington, DC and before joining Stanford, Dr. Majumdar was the Vice President for Energy at Google, where he created several energy technology initiatives, especially at the intersection of data, computing and electricity grid, and advised the company on its broader energy strategy.

Prior to joining the Department of Energy, Dr. Majumdar was the Almy & Agnes Maynard Chair Professor of Mechanical Engineering and Materials Science & Engineering at University of California–Berkeley and the Associate Laboratory Director for energy and environment at Lawrence Berkeley National Laboratory.

Dr. Majumdar is a member of the National Academy of Engineering and the American Academy of Arts and Sciences. He served as the Vice Chairman of the Advisory Board to US Secretary of Energy, Ernest Moniz, and was also a Science Envoy for the US Department of State with focus on energy and technology innovation in the Baltics and Poland. He served as a member of the Council of the National Academy of Engineering, and is currently on the Advisory Council of the Electric Power Research Institute and on the Science Advisory Board of the Oak Ridge National Laboratory. He is a member of the International Advisory Panel for Energy of the Singapore Ministry of Trade and Industry and sits on the Advisory Board of Envision Energy and Breakthrough Energy Ventures.

Dr. Majumdar received his bachelor's degree in Mechanical Engineering at the Indian Institute of Technology, Bombay in 1985 and his Ph.D. from the University of California, Berkeley in 1989.

## GRETAR TRYGGVASON

### Affiliation: Department Head and Charles A. Miller, Jr. Distinguished Professor, Department of Mechanical Engineering, Johns Hopkins University

### Title: Direct Numerical Simulations of Complex Multiphase Flows

**Abstract:** Predicting the behavior of multiphase flows is critical for many industrial processes. The unsteady turbulent motion of two or more phases poses formidable challenges and traditional modeling of the large scale or averaged flow has therefore relied mostly on experimental results, supplemented by scaling analysis and the application of elementary conservation laws. Increasing computational power has lead to models of growing complexity, but industrial model generally include unresolved closure terms that must be prescribed. The ability to conduct direct numerical simulations (DNS), where the full governing equations for the fluid motion and the evolution of the phase boundary are solved for a large range of length and time scales is providing us with unprecedented insight and massive amount of data that open up new opportunities for modeling. Results for relatively simple multifluid and multiphase systems with bubbles and drops in turbulent flows are now available, but new challenges are emerging. First of all, DNS of very large systems are yielding enormous amount of data that, in addition to providing physical insights, opens up new opportunities for the development of lower order models that describe the average or large-scale behavior. Recent results for bubbly flows and the application of statistical learning tools to extract closure models from the data suggest one possible strategy. Secondly, success with relatively simple systems calls for simulations of more complex problems. Multiphase flows often produce features such as thin films, filaments, and drops that are much smaller than the dominant flow scales and are well-described by analytical or semi-analytical models. Recent efforts to combine semi-analytical models for thin films using classical thin film theory, and to compute mass transfer in high Schmidt number bubbly flows using boundary layer approximations, in combination with fully resolved numerical simulations of the rest of the flow, are described.

**Bio:** Gretar Tryggvason is the Charles A. Miller, Jr. Distinguished Professor at the Johns Hopkins University and the head of the Department of Mechanical Engineering. He received his PhD from Brown University in 1985 and was on the faculty of the University of Michigan in Ann Arbor until 2000, when he moved to Worcester Polytechnic Institute as the head of the Department of Mechanical Engineering. Between 2010 and 2017 he was the Viola D. Hank professor at the University of Notre Dame and the chair of the Department of Aerospace and Mechanical Engineering. Professor Tryggvason is well known for his contributions to computational fluid dynamics; particularly the development of methods for computations of multiphase flows and for pioneering direct numerical simulations of such flows. He served as the editor-in-chief of the Journal of Computational Physics 2002-2015, is a fellow of APS, ASME and AAAS, and the recipient of several awards, including the 2012 ASME Fluids Engineering Award.

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## JANE DAVIDSON

### Affiliation: Ronald L. and Janet A. Christenson Chair in Renewable Energy, Professor of Mechanical Engineering, University of Minnesota

### Title: Solar After Dark

**Abstract:** The detrimental effects of our reliance on petroleum are evident to scientists and most politicians. Engineers are challenged as never before to solve problems of unparalleled scientific complexity toward development of econmically-viable renewable energy technologies. The solar energy resource is not limited. Yet solar energy provides less than 2% of global energy consumption. My students and I are working on several fronts to make solar energy more accessible. This talk will discuss progress in the developement of thermal energy storage for solar heating and electricity and production of renewable fuels via thermochemical processes that use concentrated solar radiation as the source of process heat.

**Bio:** Jane Davidson is Professor of Mechanical Engineering at the University of Minnesota and holds the College of Science and Engineering Ronald L. and Janet A. Christenson Chair in Renewable Energy. She received the B.S. and M.S. degrees in Engineering Mechanics from the University of Tennessee and Ph.D. in Mechanical Engineering from Duke University. Prior to joining the faculty at the University of Minnesota in 1993, she was a faculty member at the University of Delaware and Colorado State University. Her current areas of research include solar thermo-chemical cycles to produce fuels, thermal storage, advanced polymer and additive manufactured heat exchangers, and building integrated solar. She is past Editor of the ASME Journal of Solar Energy Engineering. Her efforts in research and engineering education have been recognized with the 2012 ASME Frank Kreith Energy Award, the University of Minnesota 2009 Ada Comstock Award, the 2007 American Solar Energy Society Charles Greeley Abbot Award, the 2005 University of Minnesota Distinguished Women Scholar Award in Science and Engineering, the 2004 ASME John I. Yellott Award, and the 2000 John Tate Award for Excellence in Undergraduate Advising. She has co-authored 2 books, 6 book chapters and 160 archival journal publications. Her work has been featured on PBS Tech Talk, PBS NewsHour and the Weather Station. She is a Fellow of ASME and ASES.

# Keynote Speakers

## SAEED MOGHADDAM

### Affiliation: Knox T. Millsaps Associate Professor, Department of Mechanical and Aerospace Engineering, University of Florida

### Title: A New Paradigm for Understanding and Enhancing the Critical Heat Flux (CHF) Limit

**Abstract:** Nearly a century of research on enhancing critical heat flux (CHF) has focused on altering the boiling surface properties such as its nucleation site density, wettability, wickability and heat transfer area. But, a mechanism to manipulate dynamics of the vapor and liquid interactions above the boiling surface as a means of enhancing CHF has not been proposed. In this talk, implementation of a new approach will be presented to limit the vapor phase lateral expansion over the heat transfer surface and actively control the surface wetted area fraction, known to decline monotonically with increasing heat flux. This new degree of freedom has enabled reaching unprecedented CHF levels and revealed new details about the physics of CHF. The impact of wickability, effective heat transfer area, and liquid pressure on CHF is precisely quantified. Test results show that, when rewetting is facilitated, the CHF increases linearly with the effective surface heat transfer area. A maximum CHF of 1.8 kW/cm2 was achieved on a copper structure with the highest surface area among all tested surfaces. A model developed based on the experimental data suggests that the thermal conductivity of the surface structures ultimately limits the CHF; and a maximum CHF of 7–8 kW/cm2 may be achieved using diamond surface structures.

**Bio:** Dr. Saeed Moghaddam is Knox T. Millsaps Associate Professor at the University of Florida. He received his Ph.D. in Mechanical Engineering from the University of Maryland at College Park in 2006. Before joining the University of Florida in 2010, he was a postdoc in the Chemical and Biomolecular Engineering Department at UIUC (2007-2010). Dr. Moghaddam's research has been published in nearly 100 peer reviewed articles and featured in Heat Pumping Technologies and New Scientist magazines, Nano Science and Technology Institute (NSTI) Innovation Spotlight, Nature Nanotechnology News & Views, and 2010 Guinness World Records for development of the world's smallest fully functional fuel cell with an on-board self-regulating hydrogen generator. Dr. Moghaddam's research is funded by ARPA-A, DARPA, DOE, NSF, NIH, SRC, ORNL, and private companies.

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## SHAWN PUTNAM

### Affiliation: Assistant Professor, Mechanical and Aerospace Engineering, Interfacial Transport Laboratory, University of Central Florida

### Title: Deciphering the Fundamental Limits of Micro- and Nano-Scale Heat and Mass Transport

**Abstract:** Transient heat fluxes in cutting-edge computing systems, electro-magnetic switches, and diode-pumped lasers can exceed 50 MW/m2, which is nearly the heat flux radiated by the Sun. To manage extreme thermal loads, the State-of-the-Art is to boil and evaporate liquid coolants on micro- and nano-structured heat sinks. However, a major technical challenge coincides with the reality that modern cooling techniques cannot manage extreme heat fluxes under transient conditions. For example, thermo-fluid transients due to on/off device operation or system exposure to an extreme environment result in highly unstable thermo-fluid behavior, ultimately placing a liquid-cooled device in danger of catastrophic failure via thermal runaway — i.e., a rapid, uncontrolled increase in device temperature.

This talk will cover the Research Groups' journey in understanding the fundamentals of micro- and nano-scale heat and mass transport at liquid interfaces. In particular, liquid interfaces exposed to different heating and flow-field conditions. A majority of the talk will describe the application of optical pump-probe diagnostics to characterize the local, transient heat transfer coefficient in confined geometries. For example, the local, transient heat transfer coefficient (HTC) that corresponds to (1) a developing thermal boundary layer over a micron-sized hot-spot and (2) bubble ebullition during subcooled flow boiling in a microchannel heat sink. In particular, a differential form of the anisotropic Time-Domain Thermoreflectance (TDTR) technique was developed to measure the HTC as a function of flow-field velocity, hot-spot heat flux, and degree of subcooling. The talk will also briefly discuss some of the other efforts by the research group coupled to optical diagnostics and biological systems

**Bio:** Shawn Putnam joined the Mechanical and Aerospace Engineering Department at the University of Central Florida (UCF) in 2012. A native

of the northern logging town of Cloquet, Minnesota, Dr. Putnam received B.Sc. degrees in 2001 in both Physics and Applied Mathematics from the University of Minnesota, Duluth. In 2007, he received his Ph.D. in Materials Science and Engineering (MSE) from the University of Illinois Urbana-Champaign (UIUC). His Ph.D. research focused on the thermo-diffusion and thermal conductivity of nanoparticle suspensions. Following his Ph.D. studies, Dr. Putnam served as the lead thermal and materials scientist at the Air Force Research Laboratory (AFRL) at Wright-Patterson AFB in Dayton OH. His postdoctoral work at AFRL broadened the use of optical pump-probe diagnostics for micro-/nano-scale studies of thermo-fluid transport at liquid interfaces. While at AFRL, Dr. Putnam was also a part-time lecturer at University of Dayton in Dayton OH. His expertise spans a multidisciplinary skill set in thermo-fluid sciences, optical metrology, and materials science and engineering. His current research at UCF focuses on interfacial phenomena using optical diagnostics to characterize biomolecular binding and heat and mass transport at liquid interfaces, where the latter is currently funded by the NSF CAREER award, the Binational Science Foundation, and the Office of Naval Research (ONR) Thermal Sciences program. In addition of his research endeavors, Dr. Putnam has a passion for pioneering improved student education and training methodologies via the incorporation of digital testing centers and assessment, project-based learning modules, and elements of mixed-mode instruction.

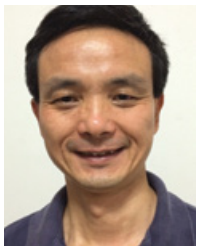
## ELISA TOULSON

### Affiliation: Assistant Professor, Department of Mechanical Engineering, Michigan State University

### Title: Turbulent Jet Ignition for Improved Fuel Economy and Emissions

**Abstract:** The United States' increasingly stringent fuel economy standards require the development of new more fuel efficient combustion technologies as large gains with conventional spark ignition combustion decline. Turbulent Jet Ignition is an advanced pre-chamber initiated combustion system that replaces the spark plug in a standard spark ignition engine and enables very fast burn rates due to the ignition system producing multiple, distributed ignition sites, which consume the main charge rapidly and with minimal combustion variability. The large number of distributed ignition sites ensures that the flame travel distances are relatively small, enabling short combustion durations even in traditionally slow burning lean and dilute mixtures. Research has shown that these faster burn rates allow for a base compression ratio increase when compared to spark ignition and when combined with diluted mixture combustion, provide a near 20% peak thermal efficiency improvement relative to spark ignition combustion, resulting in both lower fuel consumption and CO2 emissions.

**Bio:** Dr. Elisa Toulson is Assistant Professor in the Department of Mechanical Engineering at Michigan State University. Prior to this she completed a postdoctoral appointment at Michigan State University's Energy and Automotive Laboratory. Her PhD was awarded in 2008 from the University of Melbourne on the topic of applying alternative fuels to the jet ignition process through both experimental engine testing and CFD modeling. She has published over 40 archival papers and has recently been awarded the Society of Automotive Engineers Myers and Teetor awards. Dr. Toulson's research interests include combustion, ignition and chemical kinetics with an emphasis on alternative and next generation renewable fuels.



## RENWEI MEI

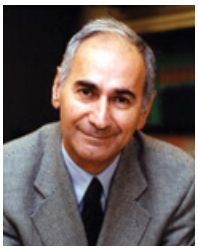
### Affiliation: Professor, Department of Mechanical and Aerospace Engineering, University of Florida

### Title: Handling Boundary Condition Discontinuities in Lattice Boltzmann Method for Thermal Fluid Flow Problems

**Abstract:** Lattice Boltzmann method (LBM) is an effective alternative computational method to solving thermal and fluid flow problems. It has been widely studied and applied for many different types of flow and thermal problems in the last three decades because of its flexibility in handling complex geometry, intrinsic spatial second order accuracy, and ease in parallel implementation. In this work, we focus on issues related to discontinuities in the boundary conditions in solving energy equation (based on convection-diffusion transport equation) and momentum equations (Navier-Stokes equation) using various lattice formulations, with the main emphasis on the energy equation. A short review on the practical approaches for implementing the Dirichlet and Neumann conditions on curved boundaries is given. The order of accuracy for the temperature field and heat flux field is discussed. The subsequent combination of Dirichlet and Neumann boundary condition treatment leads to an accurate LBM formulation for solving conjugate heat and mass transfer problems. Three types of discontinuity in the boundary condition are considered. The first involves jump conditions across an interface in the heat and mass transfer problems. Spatial second order accuracy can be

obtained. The second type involves discontinuous temperature or heat flux distribution along the boundary. Degradation in the order of accuracy occurs as a result of this tangential discontinuity along the boundary. The third type involves corner singularity where different types of boundary conditions are encountered at the intersection of walls. For solving 2-D convection-diffusion equations, D2Q5 lattice model is preferred over D2Q9 model as the former can easily bypass the singularity at the corner while the latter requires special attention in order to obtain spatial second order accuracy. Guidelines for implementing D2Q9 lattice model at the singular corners are proposed for solving both fluid momentum equation and convection-diffusion equation. Second order accuracy are obtained for steady conduction problem and 2-D lid-driven cavity flow at finite Reynolds number.

**Bio:** Dr. Mei is a Professor of Mechanical and Aerospace Engineering at the University of Florida. He received his Ph.D. from the University of Illinois at Urbana-Champaign in 1990. He has engaged in research in the areas of multi-phase flow and computational fluid dynamics. Some of his research topics include theoretical and computational analyses of the equation of motions of particle and bubbles at finite Reynolds number in fluid flows, dispersion and collision of particles in turbulent flows, nucleation, growth and departure of vapor bubbles near the heating surface, simulation of dense powder flows, desalination, lattice Boltzmann method for fluid flow and heat transfer, hydrogen production using water-splitting looping process, solar thermalchemical fuel production via non-volatile iron looping process. He was YK Pao Chair Professor in the College of Energy Engineering at Zhejiang University in China. He is currently on editorial board of Acta Mechanics Sinica and International Journal of Multiphase Flows.



## MASSOUD KAVIANY

### Affiliation: Professor, Department of Mechanical Engineering and Applied Physics Program, University of Michigan

### Title: Toward theoretical maximum saturated-boiling heat flux: a boiling metamedium

**Abstract:** The maximum theoretical boiling heat transfer rate is set by interface unidirectional thermal vapor flux, and quest continues for achieving a high fraction of it under saturated liquid flow. We introduce the flow-boiling canopy wick (FBCW) employing film (meniscus) evaporation and perforated screenlayer separating the liquid stream from the underlying vapor space. The vapor vents continuously through periodic perforations, in contrast to plain surface which becomes completely covered by vapor at high heat flux. The FBCW allows streamwise liquid tracks on the screenlayer between perforations providing capillary liquid flow toward heated surface and evaporation on high-effective-conductivity monolayer wick. Under extreme heat flux, various hydrodynamic limits prevent liquid supply and vapor removal, i.e., the capillary-viscous, wick superheat, perforation pressure drop and chocking and liquid-vapor stability limits. The liquid and vapor inertia control the streamwise continuous liquid track (with isolated and/or merged vapor track) and for saturated water at 1 atm CFD and wick pressure drop predict heat flux up to 20 MW/m2, an order-of-magnitude larger than the nucleate flow-boiling limit. The boiling metamedium replaces the chaotic nucleated bubbles with the structured, continuous vapor venting in the periodic FBCW transforms boiling heat transfer and its upper limit.

**Bio:** Massoud Kaviany (Ph.D. UC-Berkeley 1979) is Professor in Department of Mechanical Engineering and in Applied Physics Program, University of Michigan, since 1986. His interest is in heat transfer physics -- a multiscale research/education including energy carriers phonon, electron, fluid particle and photon, and multiphase systems such as porous media.

He has authored four books, including Principles of Heat Transfer in Porous Media, 2nd Edition, Springer, 1995 (over 3000 citations), Heat Transfer Physics, 2nd Edition 2014 and Essentials of Heat Transfer 2011, by Cambridge University Press. He was Chair of ASME Committee on Theory and Fundamental Research in Heat Transfer, is Associate Editor of Nanoscale and Microscale Thermophysical Engineering, ASME Lifetime Fellow and APS Fellow, and recipient of University of Michigan Engineering 2003 Education Excellence Award, ASME 2002 Heat Transfer Memorial Award (Science), 2010 Harry Potter Gold Medal (Thermodynamics Science), and 2013 Heat Transfer Division 75th Anniversary Medal.

## SIDY NDAO

### Affiliation: Assistant Professor, Mechanical & Materials Engineering, University of Nebraska-Lincoln

### Title: Thermal Computing: High Temperature NanoThermoMechanical Memory & Logic Devices

**Abstract:** The ability to control and manipulate heat transfer at the micro/nanoscale is of great interest to many engineering applications such as thermal management, energy conversion, and thermal computing. In this talk, I will present my lab's research effort in tailoring and/or controlling radiative heat transfer and the micro- and nanoscale. I will specifically discuss our work in High Temperature Thermal Memory and Logic Devices. Limited performance and reliability of electronic devices at extreme temperatures and harsh environments requires the development of alter-

native computing technologies. Unlike electronics, thermal memory and logic devices use heat instead of electricity to record and process data. Memory function is achieved through the coupling of Near-Field Thermal Radiation and thermal expansion resulting in negative differential thermal resistance and thermal latching. Our research group has proposed and experimentally demonstrated the world first high temperature thermal rectifier based on near-field thermal radiation; we called it NanoThermoMechanical diode; a building block for performing logic operations in harsh and extreme environments. We fabricated and tested a proof-of-concept NanoThermoMechanical device that has shown a maximum rectification of 10.9% at terminals' temperatures of 375 and 530 K. I will also discuss our most recent work on near-field heat transfer enhancement from microstructured meshed doped silicon photonic crystals, which have shown thermal rectifications as high as 2500%. We are basically creating the world's first thermal computer, and hopefully one day it will be used to unlock the mysteries of outer space, explore and harvest our own planet's deep-beneath-the-surface geology and harness waste heat for more efficient energy utilization.

**Bio:** Dr. Ndao is an Assistant Professor in the Department of Mechanical and Materials Engineering Engineering (MME) at the University of Nebraska-Lincoln (UNL). Before Joining UNL in 2012, Dr. Ndao spent about 2 years as a Postdoctoral Associate in the Chemical Engineering Department and the Institute of Soldier Nanotechnology at the Massachusetts Institute of Technology (MIT), in Cambridge, MA. He completed his Ph.D. studies in Mechanical Engineering at Rensselaer Polytechnic Institute (RPI) in 2010.

At UNL, Dr. Ndao is director of the Nano & Microsystems Research lab with research interest in Nanotechnology and Thermal-Fluid Sciences. He is interested in both fundamental and applied research in Thermal-Fluid Sciences, Energy and Nanotechnology with current research focus on energy conversion and thermal storage, nanoengineered surfaces, NanoThermoMechanical logic and memory devices, two-phase heat transfer, and microfluidics. His team has published many papers in peer-reviewed journals such as Nature, Applied Physics Letters, Langmuir, and IJHMT; and in international conferences. Dr. Ndao's research group has recently developed the world's first high temperature thermal rectifier, a building block for future High Temperature Thermal Memory and Logic Devices, i.e., thermal computer. Unlike electronics, thermal memory and logic devices use heat instead of electricity to record and process data. his research group has proposed and experimentally demonstrated the high temperature thermal rectifier based on near-field thermal radiation; they called it NanoThermoMechanical diode. Dr. Ndao was recently awarded the UNL College of Engineering Henry Y. Kleinkauf Family Distinguished New Faculty Teaching Award.

## RONGGUI YANG

### Affiliation: Professor, Department of Mechanical Engineering and Materials Science and Engineering Program, University of Colorado, Boulder

### Title: Sustaining Dropwise Condensation on Superhydrophobic Micro/Nano-Structured Surfaces

**Abstract:** Condensation is a ubiquitous phase-change energy transfer process and has been widely used in energy-intensive industrial applications. By promoting rapid droplet removal, the micro/nanostructured materials offer an avenue to potentially improve condensation heat transfer performance. However, these approaches suffer from nucleation within the micro/nano-structures which results in flooding condensation at high heat flux and make it difficult to exceed the state-of-the-art dropwise condensation heat transfer. Here, we provide two novel strategies to enhance dropwise condensation heat transfer. To circumvent nucleation-induced wetting transition, we first exploit superhydrophobic surfaces with closely spaced hydrophobic copper nanowires, including straight nanowire arrays and 3-D nanowire networks, to control droplet nucleation occurring only on the top of nanowires for highly mobile droplets. A stable and efficient jumping droplet condensation is experimentally demonstrated in a wide range of surface subcooling (< 28 K), which results in a 100% higher heat flux compared to that on the plain hydrophobic surface. Taking into account the challenges in scalable manufacturing, we report an alternative micromesh-covered superhydrophobic surface via a simple and scalable fabrication method that allows for highly efficient jumping droplet condensation at small surface subcooling (< 4.5 K) and continuous droplet suction-enhanced condensation at large surface subcooling (> 4.5 K). We show that the unique surface morphology can lead to unprecedented condensation heat transfer enhancement compared to the plain hydrophobic surface. The new insights about the cost-effective surface fabrication and the novel condensation mechanism we discovered can help to guide the design of novel structured surfaces for phase-change heat transfer applications.

**Bio:** Dr. Ronggui Yang is a Full Professor of Mechanical Engineering at at the University of Colorado Boulder (CU-Boulder), directing the Nano-enabled Energy Conversion, Storage, and Thermal Management Systems (NEXT) group. Dr. Yang received his Ph.D degree focusing on Nanoscale Heat Transfer with Professor Gang Chen in Mechanical Engineering from MIT in February 2006. Since January 2006, he started his faculty career as an Assistant Professor, was promoted to Associate Professor in 2011 (2 years ahead of normal clock) and to a Full Professor in 2016. His innovative research has won him numerous awards including the 2014 ITS Young Investigator in Thermoelectrics from International Thermoelectric Society (ITS), the 2010 ASME Bergles-Rohsenow Young Investigator Award in Heat Transfer, an NSF CAREER Award in 2009, the MIT Technology Review's TR35 Award and the DARPA Young Faculty Award in 2008. He has also won the Provost's Achievement Award (2012), the Dean's Performance Award (2010), the Woodward Outstanding Faculty of Mechanical Engineering (2011) and the Outstanding Research Award in Mechanical Engineering (2008) from the University of Colorado Boulder. Dr. Yang is also well recognized for his professional services for heat transfer community as conference organizers, committee chairs, and associate editors. He was elected as an ASME Fellow in 2015.

## RAVI PRASHER

### Affiliation: Scientific Division Director, Energy Storage and Distributed Resources Division, Lawrence Berkeley National Laboratory

### Title: New and Emerging Applications of Nanoscale Thermal Science and Engineering

**Abstract:** It has been almost three decades since Nanoscale Thermal Science and Engineering became a well-established research field. Various major breakthroughs in fundamental understanding of thermal transport at nanoscale have been achieved in these three decades, however, the impact of these fundamental insights have been primarily targeted for microelectronics and thermoelectrics applications. In this talk, the speaker will provide examples of other applications such as Lithium ion battery thermal management, building thermal insulation, and highly stable high temperature selective solar absorber where nanoscale thermal science has a significant role to play. For example, it is well known that effective heat dissipation in batteries is important for a number of reasons, such as performance, reliability, safety and fast charging. Currently, thermal management of battery cells is provided at the system level by either forced air or liquid cooling. This engineering solution has many shortcomings, such as a reduction in the energy density at the system level and complex system level designs that allow for fluid flow. A better understanding of thermal transport inside battery cell including all the interfaces such as cathode/separator interface can enable a much simpler thermal design. Thermal transport inside the battery cell is inherently at nanoscale as it is mostly dominated by thermal interfaces.

On the other hand, for high temperature applications, a highly stable selective solar absorber can be a game changer for concentrated solar power as high temperatures can enable higher thermal-to -electrical conversion efficiency. Selective solar absorbers can be easily designed using nanoscale multilayer thin films, however, stability and reliability at high temperature has been a major issue. Using materials stable at high temperatures, speaker's group has recently developed a nanostructured selective solar absorber that is highly stable up to a temperature of 900 °C.

**Bio:** Ravi Prasher is the director of Energy Storage and Distributed Resources Division (ESDR) at LBNL. ESDR conducts R&D in energy conversion, storage and distribution. Ravi is also an Adjunct Professor in the Department of Mechanical Engineering at University of California, Berkeley. Prior to joining LBL, Ravi was the VP of product development of Sheetak Inc., a startup developing thermoelectric energy converters. Ravi was also an adjunct professor in the school of engineering at ASU from 2005 – 2013. Ravi earlier worked as one of the first program directors at ARPA-E which was started by Dr. Steven Chu (Energy Secretary in the Obama administration and 1996 Physics Nobel Prize Winner). At ARPA-E, Ravi created two programs on cooling/heating of buildings and thermal storage for applications ranging from climate conditioning of electric vehicles and high temperature solar thermal power plants. Prior to joining ARAP-E, Ravi was the technology development manager of the Thermal & Fluids core competency group at Intel. Ravi is a recipient of an Intel Achievement Award, Intel's highest technical recognition. Ravi has published more than 85 archival journal papers and holds more than 30 patents. He is a fellow of ASME and senior member of IEEE. He is on the editorial committee of multiple journals including Annual Reviews of Environment and Resources and ASME Journal of Heat Transfer. Ravi obtained his B.Tech. from IIT Delhi and Ph.D. from Arizona State University.

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## KAREN THOLE

### Affiliation: Distinguished Professor and Department Head, Mechanical and Nuclear Engineering Department, Pennsylvania State University

### Title: Exploiting Additive Manufacturing for Convective Cooling

**Abstract:** Recent technological advances in the field of additive manufacturing (AM) have widened the design space for complex convective cooling designs. Using additive manufacturing allows for increasingly small and complex geometries to be fabricated with little increase in time or cost. The opportunity for the heat transfer community is to exploit the use of additive manufacturing in re-thinking cooling schemes for components. Two topic areas related to the use of additive manufacturing for convective cooling schemes will be discussed including roughness effects and optimization of wavy microchannels. Interesting roughness features result when using laser powdered bed fusion (LPBF), which is a common additive manufacturing technique. The inherent roughness, in fact, can be used to improve convective heat transfer beyond that of engineered cooling designs. For example, when considering engineering cooling designs such as microchannels and pin fins, the resulting roughness from the additive process significantly enhances convective cooling. Roughness features can be controlled based on build direction, channel shape, and on build parameters. Numerically optimized geometries, such as wavy microchannels, can now be manufactured using additive such that new designs can be tailored to minimize pressure loss or maximize heat transfer.

**Bio:** Dr. Karen A. Thole is a Distinguished Professor and Head of the Department of Mechanical and Nuclear Engineering at The Pennsylvania State University. She is the founder of the Steady Thermal Aero Research Turbine Laboratory (START) lab, which focuses on gas turbine heat transfer and is a center of excellence for a major turbine engine manufacturer.

She has published over 200 archival papers and advised 70 dissertations and theses. She is currently a nominee to the ASME Board of Governors. Dr. Thole co-founded the Engineering Ambassadors, which is a professional development program with an outreach mission. She was recently recognized as SWE's 2014 Distinguished Engineering Educator and in 2015 with ASME's George Westinghouse Gold Medal and the Edwin F. Church Medal. She holds two degrees in Mechanical Engineering from the University of Illinois, and a PhD from the University of Texas at Austin.

# Donald Q. Kern Award

## AFSHIN GHAJAR

**Affiliation: Regents Professor and John Brammer Endowed Professor, School of Mechanical and Aerospace Engineering, Oklahoma State University**

### Title: Gas-Liquid Two-Phase Flow in Inclined Systems

**Abstract:** The phenomenon of gas-liquid two-phase flow in inclined systems, although not as common as horizontal or vertical flow, is of great practical significance in several applications such as undulating oil-gas flow lines, chemical process engineering, inclined flow paths in steam condensers and generators. In these practical applications, accurate determination of two-phase flow variables such as void fraction, pressure drop and heat transfer is of great importance for system sizing and optimization. It is well established fact that these parameters are very sensitive to the spatial and morphological variations of the two-phase flow structure. The two-phase flow structure commonly termed as flow pattern, depends on the interaction and balance between the buoyancy-inertia-gravity forces which in turn are a function of pipe inclination. Thus, a correct understanding of the effect of change in pipe inclination on the two-phase flow structure is needed and its effect on the thermofluidics of two-phase flow needs to be understood. Thus, the scope of this lecture is to present an overview of the pipe inclination effects of the gas-liquid two-phase flow phenomenon.

The pipe inclination effects on non-boiling two-phase flow are studied through the data available in literature and extensive experiments carried out in Two Phase Heat Transfer Laboratory at Oklahoma State University. These experiments are carried out in two different test rigs of 0.5 inch and 1 inch I.D. respectively, using air-water as fluid combination. These experimental setups are unique as they can be inclined to in both upward and downward inclinations and are capable of flow visualization and simultaneous measurements of void fraction, pressure drop, and heat transfer. The experimental data show the flow pattern and pipe inclination dependency of all two-phase flow variables. At lower mass fluxes, this effect is found to be most significant where the two-phase flow phenomenon is dominated by the buoyant forces acting on the gas phase. Experiments also reveal the prevalence and insights about the flow reversal and transient nature of the two-phase flow in upward and downward inclined systems.

Two-phase flow literature reports a plethora of correlations/models for determination of void fraction, pressure drop and non-boiling heat transfer. Since the two-phase flow is a function of several variables such as flow patterns, fluid properties, and pipe diameter and inclination, it is quite a challenging task for the end user to select an appropriate flow condition specific correlation/model. Selection of a correct model also requires some fundamental understanding of the two-phase flow physics and the underlying principles/ assumptions/limitations associated with these correlations. To address these issues, this lecture also introduces some of the top performing two-phase flow models validated against a comprehensive data set.

**Bio:** Afshin J. Ghajar is Regents Professor and John Brammer Professor in the School of Mechanical and Aerospace Engineering at Oklahoma State University, Stillwater, Oklahoma, USA and a Honorary Professor of Xi'an Jiaotong University, Xi'an, China. He received his B.S., M.S., and Ph.D. all in Mechanical Engineering from Oklahoma State University. His expertise is in experimental heat transfer/fluid mechanics and development of practical engineering correlations. Dr. Ghajar has made significant contributions to the field of thermal sciences through his experimental, empirical, and numerical works in heat transfer and stratification in sensible heat storage systems, heat transfer to non-Newtonian fluids, heat transfer in the transition region, and non-boiling heat transfer in two-phase flow. His current research is in two-phase flow heat transfer/ pressure drop studies in pipes with different orientations, heat transfer/pressure drop in mini/micro tubes, and mixed convective heat transfer/pressure drop in the transition region (plain and enhanced tubes). Dr. Ghajar has been a Summer Research Fellow at Wright Patterson AFB (Dayton, Ohio) and Dow Chemical Company (Freeport, Texas). He and his co-workers have published over 200 reviewed research papers and 10 book/handbook chapters. He has delivered numerous keynote and invited lectures at major technical conferences and institutions. He has received several outstanding teaching, research, advising, and service awards from College of Engineering at Oklahoma State University. His latest significant awards are the 75th Anniversary Medal of the ASME Heat Transfer Division "in recognition of his service to the heat transfer community and contributions to the field", awarded in 2013, the ASME ICNMM 2016 Outstanding Leadership Award, this award recognizes a person whose service within the ICNMM (International Conference on Nanochannels, Microchannels, and Minichannels) is exemplary; the recipient of the award contributed significantly to the lasting success of the conference, and the 2017 Donald Q. Kern Award "in recognition of his extensive record of major contributions to the science and technology of heat transfer". Dr. Ghajar is a Fellow of the American Society of Mechanical Engineers (ASME), Heat Transfer Series Editor for CRC Press/Taylor & Francis (he has edited nine books to date), and Editor-in-Chief of Heat Transfer Engineering, an international journal published twenty times per year by Taylor and Francis. Heat Transfer Engineering is aimed at practicing engineers and specialists in heat transfer. Dr. Ghajar is also the co-author of the 5th Edition of Cengel and Ghajar, Heat and Mass Transfer – Fundamentals and Applications, McGraw-Hill, 2015.

# TEC Talk speakers

## YOAV PELES

### Affiliation: Department of Mechanical and Aerospace Engineering, University of Central Florida

### Title: Convective heat transfer in micro domains — experimental challenges and mitigation strategies

The last two decades have witnessed a growing interest in studying and developing micro scale heat transfer systems. These efforts significantly extended knowledge about single-phase and phase change processes at diminishing length scales. However, as new knowledge and capabilities emerged it became clear that experimental techniques at the micro scale are seriously lacking. As a result continuous improvement of experimental capabilities have been undertaken by several research groups. This talk will discuss key experimental challenges pertinent to convection heat transfer in micro domains. It will also discuss potential strategies to address some of these shortcomings.

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## D. YOGI GOSWAMI

### Affiliation: Distinguished University Professor, Director, Clean Energy Research Center, University of South Florida, Tampa, FL, Editor-in-Chief, Solar Energy Journal

### Title: Molekule — My Story of Innovation and Entrepreneurship

The talk will start with an exploration of an education philosophy that emphasizes practical thinking and encourages innovation and entrepreneurship in academic research. In an academic culture of innovation, students and faculty become partners in solving problems and developing practical solutions that improve the quality of life for people around them. Students who are educated in such a culture of innovation and entrepreneurship, create start-ups and employ other people rather than looking for jobs themselves. There are many successful examples of such thinking, most notably in the Silicon Valley, California. The talk will illustrate this philosophy through my story of innovation and entrepreneurship.

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## JAMES LYNCH

### Affiliation: Managing Partner, Spartan Ventures

### Title: How is your project going to make me successful?

My talk centers on investors' expectations, especially early state investments. What is it that you need to prove to me that will make me comfortable enough to invest in you?

## MICHAEL OHADI

### Affiliation: Program Director at U.S. department of energy (ARPA-E division), University of Maryland, College Park

### Title: Next generation Ultra-high Efficiency Modular Power/Electricity Generation Systems — Opportunities and Challenges

It is well established that through the combination of much higher operating pressures and temperatures and use of certain super critical fluids it is possible to achieve substantially higher fuel to power/electricity conversion efficacies. In this presentation we will review some potential improvements that can be realized if certain challenges are overcome. The need for innovative thermo-mechanical designs, materials and advanced manufacturing techniques to achieve some of these targets will be discussed.

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## WILLIAM M. DECAMPLI

### Affiliation: Chief, Pediatric Cardiovascular Surgery, Arnold Palmer Hospital for Children, Professor of Surgery, University of Central Florida College of Medicine, Orlando, FL , Managing Director, Data Center, Congenital Heart Surgeons Society, The Hospital for Sick Children, Toronto, ON, CA

### Title: Will engineers cure congenital heart disease?

Congenital heart defects, present in about 1% of live newborns, are structural in nature and arise from errors in cardiac formation. There is mounting evidence that these defects are not entirely the result of mistakes in genetic coding or signaling, but are also influenced both at the micro- (cellular) as well as macro- (whole organ) scales by the fluid dynamics of blood traveling through the heart. Thus, there is an opportunity for engineers to contribute to our knowledge and treatment of these defects.

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## BRUCE M. BUTLER

### Affiliation: Principal Engineer, Design Assurance, Technology & Analysis, Walt Disney Parks and Resorts, ASTM

### Title: Design Considerations for Amusement Rides

Modern amusement rides are continually pushing the envelope for safe yet exciting experiences. When developing the design scope for a new attraction, what are the aspects most important to consider? This talk will discuss anthropometrics, restraints, accelerations, and design validation techniques.

# March 4, Sunday

| Time | Session | Room |
|---|---|---|
| 10:00 AM | Registration opens | Huizenga Hall of Fame (1014) |
| 1:00 PM | ASTFE Board of Directors meeting [CLOSED] | Huizenga Sales Institute (3000) |
| 3:00 PM | ASTFE Board of Directors meeting [OPEN] | Huizenga Sales Institute (3000) |
| 6:00 PM | Welcome Reception | Huizenga Sales Institute (3000) |

# March 5, Monday

| Time | Session | Room | Duration | Title | Author |
|---|---|---|---|---|---|
| 8:45 AM - 9:15 AM | TFEC 2018 Opening Remarks | Rose and Alfred Miniaci Performing Arts Center | | | |
| 9:15 AM - 10:15 AM | TFEC Plenary Lecture - Arun Majumdar | | | | |
| 10:15 AM - 10:30 AM | Break to grab coffee and walk to sessions | Dr. William Spears Atrium (1062) | | | |
| 10:30 AM - 12:00 PM | Heat/Mass Transfer in Renewable and Clean Energy Systems - I<br>Chair: Howard Pearlman | 1047 | 10:30 - 10:48 | 21831 - Heat recovery from exhaust gas of biogas engine using corona wind | Dongho Shin |
| | | | 10:48 - 11:06 | 21522 - Numerical modeling and performance evaluation of a multi-pass solar air heater | Soheil Soleimanikutanei |
| | | | 11:06 - 11:24 | 21669 - Mass transfer from circles in a turbulent boundary layer | Matthew Taliaferro |
| | | | 11:24 - 11:42 | 22453 - Heat transfer analysis of a cavity type solar receiver: Experimental validation and design improvement | Cedric Ophoff |
| 10:30 AM - 12:00 PM | Experimental Methods/Tools and Instrumentation in Fluid Mechanics and Heat/Mass Transfer<br>Chair: Aneesha Gogineni | 1048 | 10:30 - 10:48 | 21990 - Thermal investigation of a GDI multi-hole spray impact on a heated thin foil | Alessandro Montanaro |
| | | | 10:48 - 11:06 | 22950 - Time-domain transient fluorescence spectroscopy for thermal characterization of polymers | Yanan Yue |
| | | | 11:06 - 11:24 | 22951 - Thermal characterization of microscale heat convection under rare gas condition by a modified “hot wire” method | Yanan Yue |
| | | | 11:24 - 11:42 | 25404 - Investigating scaling effects on the partial turbulence simulation method of peak wind load estimation | Mohammadtaghi Moravej |
| | | | 11:42 - 12:00 | 21628 - Theoretical analysis of miniature ejector refrigeration powered by thermoelectric cooler | Baffoe Obeng |
| 10:30 AM - 12:00 PM | Fluid Flow/Heat Transfer in Biosystems - I<br>Chair: Eduardo Divo | 1049 | 10:30 - 10:48 | 22013 - Numerical study of heat transfer in living tissues during hyperthermia treatment of cancer | Saeed Tiari |
| | | | 10:48 - 11:06 | 22070 - Prediction of turbulent shear stresses through dysfunctional bileaflet mechanical heart valves using computational fluid dynamics | Fardin Khalili |
| | | | 11:06 - 11:24 | 21629 - Computational analysis of inspiratory and expiratory flow in the lung airway | Peshala Thibbotuwawa Gamage |
| | | | 11:24 - 11:42 | 21734 - Parametric simulated study of high intensity focused ultrasound (HIFU) for treatment of cancer | Laura de los Rios |
| | | | 11:42 - 12:00 | 24756 - Computational investigation of patient-specific self-powered Fontan circulations | Marcus Ni |
| 10:30 AM - 12:00 PM | Multiphase Flow - I<br>Chair: Kashif Nawaz | 1052 | 10:30 - 11:06 | Keynote speech by Saeed Moghaddam titled "A New Paradigm for Understanding and Enhancing the Critical Heat Flux (CHF) Limit" | |
| | | | 11:06 - 11:24 | 20939 - Research on characteristics of pressure oscillation amplitude due to double-hole steam Jet submerged in subcooled water | Weixiong Chen |
| | | | 11:24 - 11:42 | 20942 - Experimental investigation on pressure oscillations caused by condensation induced water hammer in a horizontal pipe | Lutao Wang |
| | | | 11:42 - 12:00 | 21689 - Numerical simulation of atomization and mixing at a gas-liquid interface | Adam Carlton |

| Time | Session | Room | Duration | Title | Author |
|---|---|---|---|---|---|
| 10:30 AM - 12:00 PM | **Computational Methods/Tools in Thermal-Fluid Systems - I<br>Chair: Darrell Pepper** | 1053 | 10:30 - 10:48 | 24515 - A 2D transient heat transfer model and optical analysis of a solar receiver | Mostafa Abuseada |
| | | | 10:48 - 11:06 | 21553 - Investigation of open boundary problem in pure thermal plume by hybrid boundary condition with multi-GPU implementation | Wei-Hsiang Wang |
| | | | 11:06 - 11:24 | 21613 - The effect of nanoparticle orientation on thermal conductivity of a water-hexagonal boron nitride nanofluid | Hakan Erturk |
| | | | 11:24 - 11:42 | 21682 - Simulation of the Rayleigh–Benard convection in a finned cavity filled with liquid gallium | Emel Selamet |
| | | | 11:42 - 12:00 | 21497 - CFD analysis of thermal hydraulic behavior in moderator of PHWR | Jin-Hyuck Kim |
| 10:30 AM - 12:00 PM | **Fluid Flow and Heat Transfer in Industrial and Commercial Processes - I<br>Chair: Mohammad Reza Shaeri** | 1054 | 10:30 - 10:48 | 21362 - Experimental study on the thermal performance of water thermocline storage tank | Xiaoze Du |
| | | | 10:48 - 11:06 | 21474 - System-level optimization of fan-supplied tube-fin evaporators for frosting conditions | Christian Hermes |
| | | | 11:06 - 11:24 | 21693 - Characterization of the thermal response of energetic materials in ISO shipping container storage | Ken Blecker |
| | | | 11:24 - 11:42 | 21602 - Analysis of continuous caster flow pattern variations relating to argon injection | Bangju Chen |
| | | | 11:42 - 12:00 | 24484 - Experimental parameters identification of a flexible cylinder undergoing vortex-induced vibrations | Cintia Monreal |
| 10:30 AM - 12:00 PM | **PANEL: Industrial Multiphase CFD: Risks, Rewards, and Remorse<br>Chair: Wayne Strasser** | 3032 | Panelist 1<br>Panelist 2<br>Panelist 3<br>Panelist 4<br>Panelist 5 | | |
| 10:30 AM - 12:00 PM | **Thermo-Fluid Field General Aspects<br>Chair: Patrick Mensah** | 3034 | 10:30 - 10:48 | 20961 - Axial solid transport in rotary kilns - Influence of operational parameters | Haozhi Jie |
| | | | 10:48 - 11:06 | 21216 - Development of active flow control for trucks | Sinisa Krajnovic |
| | | | 11:06 - 11:24 | 22278 - Improving International level of Engineering Students' Education in Energy Related Majors in China: Some Practices and Challenges | Yanan Yue |
| | | | 11:24 - 11:42 | 25214 - Thermal Energy Storage Course for Engineering Students at the University of Cincinnnati | Michael Kazmierczak |
| | | | 11:42 - 12:00 | 24245 - Modeling of heat transfer and flow patterns in a porous wick: Parametric study | Mustafa Hadj-Nacer |
| 10:30 AM - 12:00 PM | **Micro/Nano Heat/Mass Transfer - I<br>Chair: Patrick Oosthuizen,<br>Co-Chair: Rafiq Manna** | 3044 | 10:30 - 11:06 | Keynote speech by Sidy Ndao titled "Thermal Computing: High Temperature NanoThermoMechanical Memory & Logic Devices" | |
| | | | 11:06 - 11:24 | 21694 - Design of composites composed of nano-material microstructure to achieve specific thermal behavior based on optimal topology concepts | Ashley Emery |
| | | | 11:24 - 11:42 | 25202 - Thermal radiative properties of alternating-layer topological insulators: Bi2Te3 and Bi2Se3 | Anton Yorzh |
| | | | 11:42 - 12:00 | 20757 - Experimental investigations on the cooling performance of microchannels using Alumina nano-fluids with different base fluids | Harkirat Sandhu |
| 10:30 AM - 12:00 PM | **Aerospace Applications - I<br>Chair: Kevin Dowding,<br>Co-Chair: Nick Francis** | 3045 | 10:30 - 10:48 | 20929 - Numerical analysis of heat exchange in a modified protective layer of a TPS panel | Lukasz Brodzik |
| | | | 10:48 - 11:06 | 21494 - A multi-purpose unmanned aerial system design | Mohammed Mayeed |
| | | | 11:06 - 11:24 | 21715 - Propagation of a detoniation wave in supersonic free-stream crossflows under varied parameters | Jalime Vargas |
| | | | 11:24 - 11:42 | 25143 - Optimization of in-flight ice protection systems | Wagdi Habashi |
| | | | 11:42 - 12:00 | 24485 - Experimental study of ice formation on an aeronautical Pitot probe | Geydy Gutierrez Urueta |
| 10:30 AM - 12:00 PM | **Electric, Magnetic, Flow and Thermal Phenomena in Micro and Nano-Scale Systems<br>Chair: Myeongsub (Mike) Kim** | 3047 | 10:30 - 10:48 | 21650 - Modeling and optimization of microchannel systems under pressure and temperature constraints | Yogesh Jaluria |
| | | | 10:48 - 11:06 | 22741 - Thermal actuators based on bi-material cantilever | Peng Zhang |
| | | | 11:06 - 11:24 | 22856 - Studies of thermal transport properties of carbonyl iron particle doped magnetor rheological elastomers | Hongmei Zhong |
| | | | 11:24 - 11:42 | 21433 - Water-in-air droplet generation in a T-junction geometry | Mohammad Moastiani |

| Time | Session | Room | Duration | Title | Author |
|---|---|---|---|---|---|
| 10:30 AM - 12:00 PM | **Heat/Mass Transfer Enhancement Techniques - I Chair: Shima Hajimirza** | 3050 | 10:30 - 11:06 | Keynote speech by Ronggui Yang titled "Sustaining Dropwise Condensation on Superhydrophobic Micro/Nano-Structured Surfaces" | |
| | | | 11:06 - 11:24 | 21183 - Effects of coverage area on the spray cooling heat transfer performance | Azzam S. Salman |
| | | | 11:24 - 11:42 | 21674 - Thermohydraulic characteristics of a knurled microchannel heat sink in single phase regime | Saad Oudah |
| | | | 11:42 - 12:00 | 25072 - Modeling and optimization of heat and mass transfer enhancement in heat exchangers | Ahmad Elhares |
| 10:30 AM - 12:00 PM | **Heat/Mass Transfer in Porous Media - I Chair: Maulik Shelat** | Knight Auditorium (1124) | 10:30 - 11:06 | Keynote speech by Massoud Kaviany titled "Toward theoretical maximum saturated-boiling heat flux: a boiling metamedium" | |
| | | | 11:06 - 11:24 | 20804 - Modelling of phase change in porous media | Brian Schwartz |
| | | | 11:24 - 11:42 | 20830 - Thermal conductivity measurements of ceramic fiber insulation materials | Alexander Headley |
| | | | 11:42 - 12:00 | 21463 - Influence of pore microstructure on melting in paraffin/metal-foam composite PCM | Abishek Sridhar |
| 10:30 AM - 12:00 PM | **General Thermodynamics, Fluid, and Heat Transfer - I Chair: Michael Pate Co-chair: Leitao Chen** | Huizenga Sales Institute (3000) | 10:30 - 10:48 | 21640 - Direct numerical simulation of boundary layer on flat plate with vortex generator for heat transfer enhancement | Shihoko Endo |
| | | | 10:48 - 11:06 | 22665 - Specific entropy generation: A true measure of inefficiencies in power plants | Yousef Haseli |
| | | | 11:06 - 11:24 | 20734 - Numerical Study on Transient Mixed Convection and entropy generation in a skewed ventilated enclosure | Neha Gupta |
| | | | 11:24 - 11:42 | 23172 - Novel concept of fluidized bed muffler with heat recovery | Daria Chudnovsky |
| | | | 11:42 - 12:00 | 20949 - Heat transfer analysis of jet impingement on moving and stationary metal sheet | Gaurav Abhay Kulkarni |
| **12:00 PM - 1:00 PM** | **LUNCH BREAK** | **Dr. William Spears Atrium (1062)** | | | |
| **1:00 PM - 2:45 PM** | **TEC talks session Moderator: John Lloyd** | **Rose and Alfred Miniaci Performing Arts Center** | | | |
| **2:45 PM - 3:00 PM** | **Refreshment break** | **Dr. William Spears Atrium (1062)** | | | |
| 3:00 PM - 4:30 PM | **Energy and Sustainability - I Chair: Jorge Alvarado, Co-Chair: M Helal Uddin** | 1047 | 3:00 - 3:18 | 21467 - The case against biorefineries | Michael Boot |
| | | | 3:18 - 3:36 | 21543 - Optimization of tilt angle in solar-tracking PV panels in the presence of dust particles for maximum solar efficienecy | Shima Hajimirza |
| | | | 3:36 - 3:54 | 24925 - Experimental characterizations of downburst wind field at the wall of wind experimental facility | Krishna Vutukuru |
| | | | 3:54 - 4:12 | 21723 - Demand responsive solar-powered integrated cooling, heating and hot-water system | Hamidreza Shabgard |
| 3:00 PM - 4:30 PM | **Advanced Energy Systems - I Chair: Michael Pate, Co-Chair: Andrea Strzelec** | 1048 | 3:00 - 3:18 | 21617 - Experimental investigation of a waste heat driven turbo-compression chiller | Todd Bandhauer |
| | | | 3:18 - 3:36 | 21587 - Thermodynamic assessment of organic Rankine cycle systems during off-design operation in combined heat and power (CHP) applications | Maria Anna Chatzopoulou |
| | | | 3:36 - 3:54 | 21748 - Ionic liquid-based hybrid absorption cycle for water heating, dehumidification, and cooling | Saeed Moghaddam |
| | | | 3:54 - 4:12 | 21926 - TEG heat exchanger for self-powered water heater | Aleksandr Kozlov |
| | | | 4:12 - 4:30 | 22085 - CFD model validation of the turbulent flows in inserted pipes for a ground-air heat exchanger application | Long Phan |
| 3:00 PM - 4:30 PM | **Flow and Heat Transfer in Materials Processing Science and Manufacturing Chair: Sean Hoenig, Co-Chair: Leitao Chen** | 1049 | 3:00 - 3:18 | 21804 - Developing high-temperature water-repellent glass fiber cloths through atomic layer deposition | Mohammad Reza Shaeri |
| | | | 3:18 - 3:36 | 21649 - Numerical simulation and optimization of Gallium Nitride growth in MOCVD manufacturing process | Yogesh Jaluria |
| | | | 3:36 - 3:54 | 20739 - Heat transfer and fluid flow in additive manufacturing | Jun Zhou |
| | | | 3:54 - 4:12 | 20751 - Predicting heat transfer rates for industrial scale quench tanks | Jeffrey Franklin |
| | | | 4:12 - 4:30 | 21750 - Laser-assisted additive manufacturing of Bi2Te3-based thermoelectric modules | Jon Longtin |

| Time | Session | Room | Duration | Title | Author |
|---|---|---|---|---|---|
| 3:00 PM - 4:30 PM | **Heat/Mass Transfer in Compact Heat Exchangers - I Chair: S.A. Sherif** | 1052 | 3:00 - 3:18 | 21500 - Effect of flow maldistribution on the performance of rotary regenerators | Sukrut Phansalkar |
| | | | 3:18 - 3:36 | 21636 - Effect of fin height on a cross-cut flow control in wavy fin heat exchangers | Gun Woo Kim |
| | | | 3:36 - 3:54 | 21663 - Flow boiling heat transfer and flow distribution in non-uniformly heated parallel mini-channels | Kizuku Kurose |
| | | | 3:54 - 4:12 | 21733 - Experimental and numerical investigations on slug flow characteristics inside microchannels | Chaobin Dang |
| 3:00 PM - 4:30 PM | **Heat/Mass Transfer at High Temperature and Turbulence Processes Chair: Muhammad Sharif** | 1053 | 3:00 - 3:18 | 21883 - Covective heat transfer performance of solar salt with a high melting-point in a circular tube | Dong Xinyu |
| | | | 3:18 - 3:36 | 22751 - LIVE experiments on melt pool heat transfer in the reactor pressure vessel lower head | Alexei Miassoedov |
| | | | 3:36 - 3:54 | 20958 - Numerical investigation of impinging heat transfer and fluid flow due to a turbulent annular jet | Muhammad Ali Rob Sharif |
| | | | 3:54 - 4:12 | 21830 - Evaluation of wear damage during a high speed scenario | Armando DeLeon |
| 3:00 PM - 4:30 PM | **Fluid Flow and Heat Transfer Multiphase Phenomena - I Chair: Sandra Boetcher** | 1054 | 3:00 - 3:18 | 21342 - Experimental study on the effect of step-changing heating on water flow boing in a horizontal long small channel | Li Jia |
| | | | 3:18 - 3:36 | 21434 - Water-in-water droplet generation using pressure-driven flow | Mohammad Moastiani |
| | | | 3:36 - 3:54 | 21505 - A combined experimental and computational study of the heat transfer characteristics of falling liquid-films | Alexandros Charogiannis |
| | | | 3:54 - 4:12 | 21904 - Experimental study on flow and heat transfer in porous media | Ping Wang |
| | | | 4:12 - 4:30 | 22443 - Frost spreading on microscale wettability/morphology patterned surfaces | Chun Yang |
| 3:00 PM - 4:30 PM | **PANEL: Research Directions for Droplet, Bubble and Particle Flows Chair: Frank Kulacki** | 3032 | Joseph Katz, Johns Hopkins University<br>James F. Klausner, Michigan State University<br>Efsthathios E. Michaelides, Texas Christian University | | |
| 3:00 PM - 4:30 PM | **Combustion, Fire and Fuels - I Chair: Francine Battaglia, Co-Chair: Lu Chen** | 3034 | 3:00 - 3:36 | Keynote speech by Elisa Elisa Toulson titled “Turbulent Jet Ignition for Improved Fuel Economy and Emissions” | |
| | | | 3:36 - 3:54 | 21690 - Feedstock effect on biomass torrefaction: A comparative assessment of willow and beech torrefaction | Yousef Haseli |
| | | | 3:54 - 4:12 | 22778 - Turbulent cold flow analysis of Spark Ignition (SI) engine | Uddin Emad |
| | | | 4:12 - 4:30 | 21702 - Characteristics of laser induced plasma flame Kernel formation and evolution | Wilmer Flores |
| 3:00 PM - 4:30 PM | **Turbulent and Laminar Flows Chair: Maulik Shelat** | 3044 | 3:00 - 3:18 | 21662 - Verification of turbulence models for flow in a constructed pipe at low Reynolds number | Fardin Khalili |
| | | | 3:18 - 3:36 | 21718 - Numerical investigation of three-dimensional fluid structures developed in the wake of an infinitely long inclined flat plate | Ron Barron |
| | | | 3:36 - 3:54 | 22349 - Direct numerical simulation on turbulent flow over truncated pyramids in an open channel | Mitsuhiro Shintani |
| | | | 3:54 - 4:12 | 22272 - Effect of slip on laminar flow friction number in microchannels | Mohamed El-Genk |
| | | | 4:12 - 4:30 | 21712 - Effect of aspect ratio on the flow structures behind a square cylinder | Junting Chen |
| 3:00 PM - 4:30 PM | **Technoeconomic and Ecological Analysis of Energy Systems - I Chair: Saptarshi Basu** | 3045 | 3:00 - 3:18 | 21767 - Technoeconomic analysis of the inlet air evaporative cooling on improvement the performance of dry-cooled natural-gas combined-cycle (NGCC) power plants | Tao He |
| | | | 3:18 - 3:36 | 22007 - Cascaded thermoelectric generation and absorption refrigeration waste heat recovery | Shahzaib Abbasi |
| | | | 3:36 - 3:54 | 22668 - Techno-economic feasibility of small modular nuclear reactors for power production | Jason Quinn |
| | | | 3:54 - 4:12 | 21609 - Determining the apparent cost of water for thermoelectric power plants | Joshua Richey |
| | | | 4:12 - 4:30 | 25406 - Thermo-economic analysis of the indigenously developed micro-scale organic Rankine cycle | Bhavesh Patel |

| Time | Session | Room | Duration | Title | Author |
|---|---|---|---|---|---|
| 3:00 PM - 4:30 PM | **Radiative Heat Transfer - I Chair: Hakan Erturk, Co-Chair: Cedric Ophoff** | 3047 | 3:00 - 3:18 | 21280 - Application of Lie-group shooting method to estimate nonhomogeneous thermal conductivity and absorption coefficient | Hong Qi |
| | | | 3:18 - 3:36 | 22038 - An application of the Monte Carlo ray tracing method with bidirectional reflection | J.R. Mahan |
| | | | 3:36 - 3:54 | 21611 - Characterization limits for nanoparticle aggregates using optical light scattering experiments at different wavelengths using approximate Bayesian computation | Hakan Erturk |
| | | | 3:54 - 4:12 | 21616 - Investigation of localized heating of core-shell nano particles made of different materials using AFM probe | Hakan Erturk |
| | | | 4:12 - 4:30 | 21882 - Experimental investigation of Mie-metamaterial-based thermal emitters for thermophotovoltaic systems | Yanpei Tian |
| 3:00 PM - 4:30 PM | **Fluid Measurements and Instrumentation Chair: Peiwen Li** | 3050 | 3:00 - 3:36 | Keynote speech by Ravi Prasher titled “New and Emerging Applications of Nanoscale Thermal Science and Engineering” | |
| | | | 3:36 - 3:54 | 21710 - Evaluation of several types of high temperature heat transfer fluids for concentrated solar power system | Peiwen Li |
| | | | 3:54 - 4:12 | 21615 - Experimental and numerical investigation of a silica gel/ water packed bed for adsorption cooling applications | Ramy Mohammed Abdelhady |
| | | | 4:12 - 4:30 | 24752 - Measurements of thermal effect on bubble parameter | Hassan Abdulmouti |
| 3:00 PM - 4:30 PM | **Internal Multiphase Flows hair: Eduardo Divo** | Knight Auditorium (1124) | 3:00 - 3:18 | 21427 - Experimental study of condensation heat transfer of R134a in the condenser with liquid-vapor separation | Qi Peng |
| | | | 3:18 - 3:36 | 21701 - Characterization of flow regimes in two phase flow using wavelet analysis | Aziz Rahman |
| | | | 3:36 - 3:54 | 20944 - Influence of operating parameters on the temperature distribution in flighted rotary drums | Jakob Seidenbecher |
| | | | 3:54 - 4:12 | 21722 - Sliding bubble dynamics and wake heat transfer effects | Wasy Akhtar |
| | | | 4:12 - 4:30 | 22889 - Computational studies of multi-phase heat transfer in micro-scale heat sinks | Patrick Mensah |
| **4:30 PM - 4:45 PM** | **Refreshment break** | **Dr. William Spears Atrium (1062)** | | | |
| **4:45 PM - 6:15 PM** | **Exhibition and Networking** | **Huizenga Hall of Fame (1014)** | | | |

# March 6, Tuesday

| Time | Session | Room | Duration | Title | Author |
|---|---|---|---|---|---|
| **9:15 AM - 10:15 AM** | **TFEC Plenary Lecture - Jane Davidson** | **Rose and Alfred Miniaci Performing Arts Center** | | | |
| **10:15 AM - 10:30 AM** | **Break to grab coffee and walk to sessions** | **Dr. William Spears Atrium (1062)** | | | |
| 10:30 AM - 12:00 PM | **Energy-Water-Food Nexus Chair: Jorge Alvarado** | 1048 | 10:30 - 10:48 | 20972 - Evaporation from porous media: Single hydrophobic and hydrophilic pores | Melanie Derby |
| | | | 10:48 - 11:06 | 21246 - Nucleating agent enhanced thermal desalination at the triple point | Fangyu Cao |
| | | | 11:06 - 11:24 | 21614 - Effect of changes in input parameters on the operation of a MED-TVC plant | Mohamed Abdelkareem |
| | | | 11:24 - 11:42 | 20720 - Influence of temperature on fresh packaged tomato fruits during transportation | Taofiq Olanrewaju |
| | | | 11:42 - 12:00 | 24441 - Innovative thermal distillation method using solar heat localization | Divya Jaladi |

| Time | Session | Room | Duration | Title | Author |
|---|---|---|---|---|---|
| 10:30 AM - 12:00 PM | **Engineering Fundamentals and Methodology**<br>**Chair: Saeid Vafaei** | 1052 | 10:30 - 10:48 | 20908 - Modeling of frost growth on flat surfaces with varying contact angle | Ellyn Harges |
| | | | 10:48 - 11:06 | 21709 - Numerical study of the distance between two particles effect on sweeping convection in a straight isotherm channel | Jose Lage |
| | | | 11:06 - 11:24 | 22075 - Design of data center free-space optical network: Optical and mechanical considerations | Kai Zheng |
| | | | 11:24 - 11:42 | 21805 - Development of P-PD- and PID-fuzzy SISO controllers of a subscaled multi-room building test bed | Joshua Baltazar |
| | | | 11:42 - 12:00 | 24723 - Effect of using different equations of states in the analysis of rotary displacer Stirling engines | Amir Hossein Bagheri |
| 10:30 AM - 12:00 PM | **General Thermodynamics, Fluid, and Heat Transfer - II**<br>**Chair: Ahmad Fakheri** | 1053 | 10:30 - 10:48 | 22257 - Lattice Boltzmann simulation of electrolyte transport inside the porous electrodes of Li-Ion batteries | Yuwen Zhang |
| | | | 10:48 - 11:06 | 21950 - Numerical investigation of dissolution reaction between UO2 and molten Zry-4 using MPS method | Yonglin Li |
| | | | 11:06 - 11:24 | 22620 - Study on thermal contact resistance between stainless steel and titanium alloy with different roughness | Yanjun Dai |
| | | | 11:24 - 11:42 | 21624 - A feasibility study of power generation using a metal-semiconductor-metal multi-layered cell | Kazuma Isobe |
| | | | 11:42 - 12:00 | 21971 - Rheological studies of new class ionic liquid nanolubricants for space applications | Sayavur Bakhtiyarov |
| 10:30 AM - 12:00 PM | **CFD: Fluid-Solid Interaction**<br>**Chair: Sandra Boetcher** | 1054 | 10:30 - 10:48 | 20841 - Numerical simulation for predicting a morphology of a thin solid layer forming from an inkjet droplet | Jun Fukai |
| | | | 10:48 - 11:06 | 22084 - Heat transfer over super hydrophobic and liquid infused surfaces | Umberto Ciri |
| | | | 11:06 - 11:24 | 22299 - A multi-physics study of the effect of fluid-thermo-structure interactions on thin film coatings under extreme environments | Antoine Jost |
| | | | 11:24 - 11:42 | 21705 - An investigation of multiphase flow induced vibration in offshore pipeline using CFD | Aziz Rahman |
| | | | 11:42 - 12:00 | 21696 - CFD evaluation of a counter-flowing wall jet | Sachin Sharma |
| 10:30 AM - 12:00 PM | **PANEL: Gas Turbine Cooling and Aerodynamics**<br>**Chair: Sumanta Acharya** | 3031 | Panelist 1<br>Panelist 2<br>Panelist 3<br>Panelist 4<br>Panelist 5 | | |
| 10:30 AM - 12:00 PM | **Fluid Mechanics and Rheology of Nonlinear Materials and Complex Fluids**<br>**Chair: David Pratt** | 3032 | 10:30 - 10:48 | 21958 - Assessment of blends of Hydrocarbon/CO2 as alternative natural refrigerants | Sai Yelishala |
| | | | 10:48 - 11:06 | 21654 - Icing study of super cooled water droplet impinging on airfoil using E-MPS method | Daiki Toba |
| | | | 11:06 - 11:24 | 21751 - Rheological analysis of cell embedded hydrogel bio-ink for extrusion bioprinting | Prabhuti Kharel |
| | | | 11:24 - 11:42 | 21677 - Thermodynamic optimization of horizontal multichannel ground heat exchanger | Titan Paul |
| | | | 11:42 - 12:00 | 21679 - Optimal operating conditions of a nanofluid driven heat exchanger | Titan Paul |
| 10:30 AM - 12:00 PM | **CFD: Computational Methods Algorithms - I**<br>**Chair: S.A. Sherif** | 3034 | 10:30 - 10:48 | 21672 - Semi-analytic numerical solution of heat conduction problems using Green's functions | Forooza Samadi |
| | | | 10:48 - 11:06 | 22338 - Fluid interface capturing on parallel adaptive octree grids | M. Wasy Akhtar |
| | | | 11:06 - 11:24 | 24451 - Molecular dynamics simulation of water nanodroplets impact on nanopillar surfaces | Shan Gao |
| | | | 11:24 - 11:42 | 21684 - An adaptive moment-of-fluid method for simulating nucleate boiling and bubble dynamics | Yang Liu |
| | | | 11:42 - 12:00 | 21651 - Mixed convection past a sphere for liquid metals using higher order compact scheme | Hema Sundar Raju |

| Time | Session | Room | Duration | Title | Author |
|---|---|---|---|---|---|
| 10:30 AM - 12:00 PM | **CFD: Natural and Mixed Convection**<br>**Chair: Lorenzo Cremaschi** | 3035 | 10:30 - 10:48 | 21539 - Numerical study of natural convective heat transfer from an upward facing circular heated horizontal isothermal element with a non-flat surface | Patrick Oosthuizen |
| | | | 10:48 - 11:06 | 21540 - A numerical study of natural convective heat transfer from two-sided circular and square heated horizontal isothermal plates having a finite thickness | Patrick Oosthuizen |
| | | | 11:06 - 11:24 | 21580 - Flow and heat transfer dynamics in natural convection in a cubical enclosure with hot and cold sectors on the same vertical wall | Ramon Frederick |
| | | | 11:24 - 11:42 | 20859 - Experimental study of forced convective heat transfer in composite packed beds of spheres | Jian Yang |
| | | | 11:42 - 12:00 | 22080 - Modeling fluid flow in collapsible tubing | Nicholas Wilde |
| 10:30 AM - 12:00 PM | **Combustion, Fire and Fuels - II**<br>**Chair: Lu Chen** | 3045 | 10:30 - 10:48 | 20954 - Scale-resolving simulations of the flow in internal combustion engines | Basara Branislav |
| | | | 10:48 - 11:06 | 22880 - Detonative combustion in a pulse combustor when enriching the heptane-air mixture with oxygen | Mohamad Assad |
| | | | 11:06 - 11:24 | 22060 - Efficient atomization of highly viscous fluids using a novel counterflow geometry | Alison Hoxie |
| | | | 11:24 - 11:42 | 20966 - Combustion behavior of lumpy coke in packed bed | Bassem Hallak |
| 10:30 AM - 12:00 PM | **Multiphase Flow - II**<br>**Chair: Chenn Zhou** | 3047 | 10:30 - 10:48 | 21541 - Cavitating bubbly flow computations by means of mixture balance equations | Dia Zeidan |
| | | | 10:48 - 11:06 | 22291 - Numerical prediction of liquid film flow characteristics of column flow outside horizontal tubes | Qinggang Qiu |
| | | | 11:06 - 11:24 | 24337 - Liquid plug in gas flow in annular channel | Yadi Cao |
| | | | 11:24 - 11:42 | 21676 - Bubble dynamics in pool boiling on rough surface under exponential heat supply | Avdhoot Walunj |
| | | | 11:42 - 12:00 | 21591 - Mathematical modelling for forecasting the flooding flow impact on different shape of dam | Alibek Issakhov |
| 10:30 AM - 12:00 PM | **Fluid Flow/Heat Transfer in Biosystems - II**<br>**Chair: Kourosh Shoele** | 3049 | 10:30 - 10:48 | 20861 - Transcatheter aortic valve tilt angle affecting hemodynamics in the ascending aorta | Angela Ourivio Nieckele |
| | | | 10:48 - 11:06 | 24758 - Pulsatile multi-scale fluid structure interaction modeling for optimal left ventricular assist device implantation | Eduardo Divo |
| | | | 11:06 - 11:24 | 21647 - Numerical modeling of pulse wave propagation in a stenosed arteries using two-way coupled fluid structure interaction (FSI) | Peshala Thibbotuwawa Gamage |
| | | | 11:24 - 11:42 | 21673 - Pulsatile flow in a curved stenosed artery | Abdullah Y. Usmani |
| | | | 11:42 - 12:00 | 24759 - A mock-flow loop (MFL) investigation of a self-powered Fontan for single-ventricle congenital heart disease | Eduardo Divo |
| **12:00 PM - 1:30 PM** | **TFEC Award Luncheon** | **Dr. William Spears Atrium (1062)** | | | |
| **1:30 PM - 1:45 PM** | **Break to walk to sessions** | **Dr. William Spears Atrium (1062)** | | | |
| **1:45 PM - 2:45 PM** | **TFEC Plenary Lecture - Afshin Ghajar: Donald Q. Kern Award** | **Rose and Alfred Miniaci Performing Arts Center** | | | |
| **2:45 PM - 3:00 PM** | **Refreshment break** | **Dr. William Spears Atrium (1062)** | | | |
| 3:00 PM - 4:30 PM | **Heat/Mass Transfer in Renewable and Clean Energy Systems - II**<br>**Chair: Ahmad Fakheri** | 1048 | 3:00 - 3:18 | 20947 - The theory of the unsteady cylindrical finite ground heat source for heat pumps | Olga Kordas |
| | | | 3:18 - 3:36 | 21731 - Development of autonomous absorber by using temperature-responsive polymer coated surface | Chaobin Dang |
| | | | 3:36 - 3:54 | 21732 - Performance evaluation of isothermal hollow fiber membrane based generator applied to absorption refrigeration system | Chaobin Dang |
| | | | 3:54 - 4:12 | 22300 - Comparison of an adiabatic and diabatic absorption system working with ammonia-lithium nitrate and water-lithium bromide as working fluids | Geydy Gutierrez Urueta |
| | | | 4:12 - 4:30 | 22235 - Investigations on mineral oil based nanolubricants with sulphur impregnated reduced graphene oxide nanosheets | Shijo Thomas |

| Time | Session | Room | Duration | Title | Author |
|---|---|---|---|---|---|
| 3:00 PM - 4:30 PM | **Technoeconomic and Ecological Analysis of Energy Systems - II**<br>**Chair: David Pratt** | 1049 | 3:00 - 3:18 | 21605 - Working fluid selection and technoeconomic optimization of turbo-compression cooling systems | Derek Young |
| | | | 3:18 - 3:36 | 21619 - Techno-economic study of waste heat recovery strategies for natural gas combined cycle power plants | Todd Bandhauer |
| | | | 3:36 - 3:54 | 22089 - A comparative techno-economic analysis of cyanobacterial and cellulosic ethanol | Nawa Baral |
| | | | 3:54 - 4:12 | 24453 - Cost and performance evaluation of a large scale wind turbine in Yemen | Mudhafar Mudhafar |
| | | | 4:12 - 4:30 | 20741 - Ecological optimization of a generalized irreversible chemical pump | Lingen Chen |
| 3:00 PM - 4:30 PM | **CFD: Electromagnetically Enhanced Heat Transfer**<br>**Chair: M Helal Uddin,**<br>**Co-Chair: Cedric Ophoff** | 1052 | 3:00 - 3:18 | 20884 - Numerical investigation on cooling of a heating plate with hot spots using electrostatic air accelerators | Jianfei Zhang |
| | | | 3:18 - 3:36 | 21737 - Thermal-fluid-electric coupled modeling of novel pin-fin integrated thermoelectric devices: The effect of packing density on performance | Matthew Barry |
| | | | 3:36 - 3:54 | 21810 - A numerical study on acoustic streaming and tissue heating during magnetic resonance guided high intensity focused ultrasound through blood vessel with an obstacle | Md. Abdul Hakim Khan |
| | | | 3:54 - 4:12 | 22111 - Soret and dufour effects in biomagnetic fluid of blood flow through a tapered porous stenosed artery | Madhu Sharma |
| 3:00 PM - 4:30 PM | **Multiphase Flow - III**<br>**Chair: Maulik Shelat** | 1053 | 3:00 - 3:18 | 20965 - Theoretical damped oscillating model of segment spherical droplet on the solid flat | Shi Chen |
| | | | 3:18 - 3:36 | 22044 - A study on the thermal conductivity and flow of copper-argon nanofluids in microchannel | Lei Chen |
| | | | 3:36 - 3:54 | 21681 - Analysis of liquid-gas two-phase flow pressure drop signature in minichannels | Mehdi Mortazavi |
| | | | 3:54 - 4:12 | 21668 - High fidelity velocity measurements in a matched refractive index facility of randomly packed spheres | Thien Nguyen |
| | | | 4:12 - 4:30 | 21645 - Experimental study on condensate droplets movements in Marangoni condensation of ethanol-water mixture vapors on a horizontal surface | Jinshi Wang |
| 3:00 PM - 4:30 PM | **Computational Methods/Tools in Thermal-Fluid Systems - II**<br>**Chair: Leitao Chen** | 1054 | 3:00 - 3:18 | 20922 - Recovering thermal contact conductances in three-dimensional composites via reciprocity functional analysis and TSVD regularization technique | Marcelo Colaco |
| | | | 3:18 - 3:36 | 21726 - Smartmedia® design optimization using CFD for automatic transmission suction filters: A case study | Jorge Kurita |
| | | | 3:36 - 3:54 | 21716 - CFD study of turbulent offset jets | Vimaldoss Jesudhas |
| | | | 3:54 - 4:12 | 21736 - Optimization of cross-sectional area of segmented thermoelectric elements legs for maximum performance | Joanna Rivero |
| | | | 4:12 - 4:30 | 21735 - GPU accelerated ray tracing-resolving radiation view factors within multi-junction thermoelectric devices | Laura Fulton |
| 3:00 PM - 4:30 PM | **Fluid Flow and Heat Transfer Multiphase Phenomena - II**<br>**Chair: Mohammad Reza Shaeri** | 3030 | 3:00 - 3:18 | 21515 - On the mechanism of bubble induced forced convective heat transfer enhancement | Clement Roy |
| | | | 3:18 - 3:36 | 21711 - The effect of inclination on pressure drop on a two-phase (gas-liquid) pipe system | Noble Anumbe |
| | | | 3:36 - 3:54 | 21548 - Microfluidics for enhanced oil recovery from underground reservoirs using nonionic surfactant | Seokju Seo |
| | | | 3:54 - 4:12 | 21699 - Physics of microlayer formation and evaporation in microchannels | Saeed Moghaddam |
| | | | 4:12 - 4:30 | 22022 - Experimental investigation on the effect of two-phase ejector on the performance of a transcritical CO2 heat pump system | Yinhai Zhu |
| 3:00 PM - 4:30 PM | **PANEL: NSF-Sponsored Panel on Thermal Comfort and Sensing Technology**<br>**Chair: Yong Tao** | 3031 | | | |
| 3:00 PM - 4:30 PM | **Micro/Nano Heat/Mass Transfer - II**<br>**Chair: Patrick Mensah** | 3032 | 3:00 - 3:36 | Keynote speech by Shawn Putnam titled “Deciphering the Fundamental Limits of Micro- and Nano-Scale Heat and Mass Transport” | |
| | | | 3:36 - 3:54 | 20659 - Nanofuid heat transfer in micro-channels: Comparison between theoretical and experimental data | Saeid Vafaei |
| | | | 3:54 - 4:12 | 21566 - Thermal properties of novel graphene nanofluids ideal as coolants for computer cooling systems | Maria del Rocio Rodriguez-Laguna |
| | | | 4:12 - 4:30 | 21567 - A molecular dynamic study of boiling on a nano dot decorated solid surface | Titan Paul |

| Time | Session | Room | Duration | Title | Author |
|---|---|---|---|---|---|
| 3:00 PM - 4:30 PM | **Heat/Mass Transfer in Porous Media - II**<br>**Chair: Ehsan Languri** | 3035 | 3:00 - 3:18 | 21595 - Modeling and simulation of closed low-pressure honeycomb adsorber for thermal storage | Micha Schaefer |
| | | | 3:18 - 3:36 | 21600 - Measurement of GDL effective permeability and inertial coefficient under different land widths | Xuyang Zhang |
| | | | 3:36 - 3:54 | 22042 - Effect of volume evaporator and bed heat exchanger on performance of adsorption chiller | Gamze Gediz Ilis |
| | | | 3:54 - 4:12 | 22071 - Experimental and numerical study of heat transfer enhancement in a pipe partially or totally filled with a porous material | Saeed Tiari |
| | | | 4:12 - 4:30 | 23768 - Numerical solution of transient viscoelastic boundary layer flow past a vertical porous plate | Vasu B Buddakkagari |
| 3:00 PM - 4:30 PM | **Heat/Mass Transfer Enhancement Techniques - II**<br>**Chair: Howard Pearlman** | 3044 | 3:00 - 3:18 | 21626 - Magnetic field and heat transfer enhancement of Halbach magnet arrays for use in magnetic refrigeration systems | Erim Yanik |
| | | | 3:18 - 3:36 | 21631 - Theoretical analysis of combined compact evaporative cooler | Laith Ismael |
| | | | 3:36 - 3:54 | 21658 - Experimental investigation of the performance of refrigerant R134a working in a spray cooling | Nabeel Abdulrazzaq |
| | | | 3:54 - 4:12 | 21707 - Delaying airfoil stall with internal slots | Tsung-chow Su |
| | | | 4:12 - 4:30 | 21581 - Transport enhancement in a channel with multiple triangular prisms | Himadri Chattopadhyay |
| 3:00 PM - 4:30 PM | **Energy and Sustainability - II**<br>**Chair: Todd Bandhauer,**<br>**Co-Chair: Jason Quinn** | 3045 | 3:00 - 3:18 | 22311 - A core-shell structured PCM with Na2SO4 encapsulated by SiO2 for high temperature thermal storage | Gang Tan |
| | | | 3:18 - 3:36 | 24454 - The performance variation of self-humidifying PEM fuel cell with Aquivion® membrane | Dowon Cha |
| | | | 3:36 - 3:54 | 20574 - Fluid-structure interaction analysis of modeling a microcantilever beam for piezoelectric energy harvesting | Khalil Khanafer |
| | | | 3:54 - 4:12 | 21549 - Enhanced catalytic potential of nickel nanoparticles for carbon sequestration | Seokju Seo |
| | | | 4:12 - 4:30 | 24418 - Optimal tilt angle of air solar heaters of natural convection regime locatedin Equatorial region | Juan José González Bayón |
| 3:00 PM - 4:30 PM | **Advanced Energy Systems - II**<br>**Chair: Michael Pate** | 3047 | 3:00 - 3:18 | 22008 - Parametric analysis of the thermal shielding performance of a cold plate with a serpentine flow design | Zijun Wang |
| | | | 3:18 - 3:36 | 22325 - Modeling of blade cooling on the first two turbine stages and the cooling effect on the gas turbine performance | Xianchang Li |
| | | | 3:36 - 3:54 | 22504 - Research on the design improvement of thermal safety in multi-parallel Lithium ion battery module | Chengchao Yuan |
| | | | 3:54 - 4:12 | 24456 - Performance analysis of a solar duplex Stirling refrigerator system | Dongdong Dai |
| | | | 4:12 - 4:30 | 22023 - A numerical study for approximating cells temperature inside a PV module | Shahzada Pamir Aly |
| 3:00 PM - 4:30 PM | **Heat/Mass Transfer in Compact Heat Exchangers - II**<br>**Chair: Sandra Boetcher** | 3049 | 3:00 - 3:18 | 21832 - Performance enhancement of heat exchanger by using bimetals | Dongho Shin |
| | | | 3:18 - 3:36 | 21866 - An analytical model for heat and mass transfer processes in new hybrid indirect/direct evaporative cooling design with parallel flow configuration | Amged Al Ezzi |
| | | | 3:36 - 3:54 | 22154 - Development of extended empirical Nusselt number correlation for single phase flow through corrugated plate heat exchanger | Zeeshan Haider |
| | | | 3:54 - 4:12 | 21934 - An additive manufactured hydraulic oil cooler: Tradeoffs in design and thermal performance | Jane Davidson |
| | | | 4:12 - 4:30 | 20705 - Optimization of fin spacing for a condenser | David C. Zietlow |
| **4:30 PM - 4:45 PM** | **Refreshment break** | **Dr. William Spears Atrium (1062)** | | | |
| **4:45 PM - 6:15 PM** | **Exhibition and Networking** | **Huizenga Hall of Fame (1014)** | | | |

# March 7, Wednesday

| Time | Session | Room | Duration | Title | Author |
|---|---|---|---|---|---|
| **9:15 AM - 10:15 AM** | **TFEC Plenary Lecture - Gretar Tryggvason** | **Rose and Alfred Miniaci Performing Arts Center** | | | |
| **10:15 AM - 10:30 AM** | **Break to grab coffee and walk to sessions** | **Dr. William Spears Atrium (1062)** | | | |
| 10:30 AM - 12:00 PM | **Fluid Flow and Heat Transfer in Industrial and Commercial Processes - II Chair: Mohammad Reza Shaeri** | 1048 | 10:30 - 11:06 | Keynote speech by Karen Thole titled “Exploiting Additive Manufacturing for Convective Cooling” | |
| | | | 11:06 - 11:24 | 21601 - Critical flow velocity for collapse of a clamped pipe conveying gas-liquid flow | L. Enrique Ortiz Vidal |
| | | | 11:24 - 11:42 | 22086 - Experimental research inside a gas heater with different intermediate heat carrier medium | Yun Guo |
| | | | 11:42 - 12:00 | 22287 - Droplet deformation after impact on cylindrical outer surface | Luyuan Gong |
| 10:30 AM - 12:00 PM | **Engineering Equipment and Environmental Systems - II Chair: Michael Pate** | 1053 | 10:30 - 10:48 | 21766 - Large-scale active thermosyphons for power-plant applications: modeling and experiment | Wei Zhong |
| | | | 10:48 - 11:06 | 22450 - An overview of variable aperture mechanisms in attempt to control temperature inside solar cavity receivers | Cedric Ophoff |
| | | | 11:06 - 11:24 | 24512 - Design and experimental testing of a carbon feeder for a solar thermal receiver | M Helal Uddin |
| | | | 11:24 - 11:42 | 22098 - Effect of mass flow rate on design of primary heat exchanger | Sunil Lee |
| | | | 11:42 - 12:00 | 21590 - Mathematical modelling of a passive scalar transport in lower atmosphere layer from thermal power plants | Alibek Issakhov |
| 10:30 AM - 12:00 PM | **Fundamentals in Fluid Flow and Heat/ Mass and Momentum Transfer - I Chair: Lorenzo Cremaschi** | 1054 | 10:30 - 10:48 | 21868 - Breakup and wrapping of free surface within a laterally oscillating container: Effect of multi-modal evolution of surface energy | Naushita Sharma |
| | | | 10:48 - 11:06 | 21966 - Combined explicit and Implicit methods for time-integration in partial differential equations | Haroldo Fraga de Campos Velho |
| | | | 11:06 - 11:24 | 22692 - Pressure drop analysis between a straight pipe array and branching pipe system | Ahmad Fakheri |
| | | | 11:24 - 11:42 | 21955 - Laminar burning speed of propane/CO2 – air mixtures | Sai Yelishala |
| | | | 11:42 - 12:00 | 24358 - A critique of existing analytical thermoelectric models - Rectifying heat input with a novel approach | Matthew Barry |
| 10:30 AM - 12:00 PM | **Natural and Built Environments Chair: Leitao Chen** | 3028 | 10:30 - 10:48 | 22313 - Energy saving analysis of a metamaterial based radiative cooling system for low-rise residential buildings by integrating with radiant floor | Gang Tan |
| | | | 10:48 - 11:06 | 22326 - Numerical study on combined effect of solar chimney and Earth cooling for building ventilation | Xianchang Li |
| | | | 11:06 - 11:24 | 25091 - Rain propagation into the building interior caused by internal wind flow | Farzaneh Raji |
| | | | 11:24 - 11:42 | 25014 - Holistic testing to determine the efficacy of a retrofit technique for residential buildings | Ziad Azzi |
| | | | 11:42 - 12:00 | 24924 - Large-scale experimentation using the NSF NHERI wall of wind experimental facility to assess and mitigate wind and rain impacts on buildings and infrastructure systems | Amal Elawady |
| 10:30 AM - 12:00 PM | **General Thermodynamics, Fluid, and Heat Transfer - III Chair: Kashif Nawaz** | 3031 | 10:30 - 10:48 | 20802 - Open cell metal foam heat exchangers for air-dehumidification applications | Kashif Nawaz |
| | | | 10:48 - 11:06 | 21094 - Out-of-plane T-shaped constructional theory conducting paths: Alternatives for experimental evaluation | Derli Dias do Amaral Junior |
| | | | 11:06 - 11:24 | 22469 - Thermal analysis of a PEBB-based converter array | Juan Ordonez |
| | | | 11:24 - 11:42 | 21623 - Hydrodynamic and heat transfer characteristics of spreading-splashing transition upon droplet train impingement | Jorge Alvarado |
| | | | 11:42 - 12:00 | 22846 - Experimental study of bulk water removal in two phase flow | Weiwei E |

| Time | Session | Room | Duration | Title | Author |
|---|---|---|---|---|---|
| 10:30 AM - 12:00 PM | **TECH-TALK PANEL: Two-phase Transport in Microsystems Moderators: Yogi Yogendra and Avi Bar-Cohen** | 3032 | Avram Bar-Cohen, University of Maryland at College Park, and Raytheon<br>Pritish Parida, I.B.M. Corporation<br>Justin Weibel, Purdue University<br>Yogendra Joshi, Georgia Institute of Technology | | |
| 10:30 AM - 12:00 PM | **CFD: Phase Change Chair: Sandra Boetcher** | 3034 | 10:30 - 10:48 | 20822 - Melting of a phase change material with natural convection and radiation: A simplified model for engineering applications | Farah Souayfane |
| | | | 10:48 - 11:06 | 21457 - Turbulent heat transfer in a two-phase cubical heat sink | Majid Molki |
| | | | 11:06 - 11:24 | 21642 - Use of wood/phase change material composite in the building envelope for building thermal control and energy savings | Weihuan Zhao |
| | | | 11:24 - 11:42 | 22814 - Mathematica simulation for the numerical resolution of a two-phase flow model | Charis Harley |
| | | | 11:42 - 12:00 | 20801 - Evaporation of water droplets on hot, porous, stainless steel surfaces | Nick Lipson |
| 10:30 AM - 12:00 PM | **Fluid Flow and Heat Transfer in Industrial and Commercial Processes - III Chair: Ehsan Languri** | 3044 | 10:30 - 10:48 | 21685 - CFD analysis of spray nozzle arrangements for multi effect desalination evaporator | Furqan Tahir |
| | | | 10:48 - 11:06 | 21960 - High-contract photonic thermal diode | Alok Ghanekar |
| | | | 11:06 - 11:24 | 21415 - Assessing the performance of three different type of diffusers for a centrifugal compressor applications | Mekuannint Messele |
| | | | 11:24 - 11:42 | 20897 - Dynamic unstructured mesh adaptivity for improved simulation of geothermal water extraction in reservoir-scale models | Pablo Salinas |
| | | | 11:42 - 12:00 | 22074 - A non-thermal gliding arc plasma reformer for syngas production | Howard Pearlman |
| 10:30 AM - 12:00 PM | **Computational Methods/Tools in Thermal-Fluid Systems - III Chair: Hamid Hadim** | 3045 | 10:30 - 10:48 | 21893 - Effect of encapsulation shape on charging and discharging in latent thermal energy storage | Sarng Woo Karng |
| | | | 10:48 - 11:06 | 21930 - Heat-source driven convection in tall cavities | Thomas Reif |
| | | | 11:06 - 11:24 | 22049 - Numerical simulation of stratified oil-water flow using interFoam | Gustavo Bochio |
| | | | 11:24 - 11:42 | 21221 - Partially-averaged Navier-Stokes simulations in engineering flows | Sinisa Krajnovic |
| | | | 11:42 - 12:00 | 20968 - Micro mold cooling optimization using a constructal approach | Miguel Clemente |
| 10:30 AM - 12:00 PM | **Micro/Nano Heat/Mass Transfer - III Chair: Maulik Shelat** | 3047 | 10:30 - 10:48 | 21951 - Thermosyphon performance in dependence of carbon-based nanofluids | Agnieszka Wlazlak |
| | | | 10:48 - 11:06 | 22759 - Effect of contact pressure on the thermal performance of carbon nanotube array thermal interface material at rough surface | Yu Pei |
| | | | 11:06 - 11:24 | 24266 - Characterization and heat transfer analysis of diamond nanofluids | Farzin Mashali |
| | | | 11:24 - 11:42 | 22388 - Simulations of the bluff-body stabilized flame using RANS and LES methods | Lu Chen |
| 10:30 AM - 12:00 PM | **Heat/Mass Transfer Enhancement Techniques - III Chair: Hakan Erturk** | 3049 | 10:30 - 10:48 | 22887 - Experimental study of a latent storage system using vertical-finned tube and shell heat exchanger: Early results | Dominic Groulx |
| | | | 10:48 - 11:06 | 25173 - Frosting and defrosting behavior of slippery surface | Chang Sung Heu |
| | | | 11:06 - 11:24 | 25190 - Effect of air velocity on frost formation under desublimation conditions | Jaehwan Lee |
| | | | 11:24 - 11:42 | 25193 - Statistical analysis of freezing delay characteristics of super-hydrophobic surfaces | Junghan Kim |

| Time | Session | Room | Duration | Title | Author |
|---|---|---|---|---|---|
| 10:30 AM - 12:00 PM | **Fluid Flow and Heat Transfer Multiphase Phenomena - III Chair: Lorenzo Cremaschi** | 3051 | 10:30 - 10:48 | 22062 - Study of hotspot cooling using high speed electrowetting based droplet motion | Arvind Venkatesan |
| | | | 10:48 - 11:06 | 24250 - Critical heat flux on laser-textured hydrophobic surface in vertical flow boiling | Joseph Bottini |
| | | | 11:06 - 11:24 | 22076 - Two-phase flow characteristics of a 3D printed pulsating heat pipe | Masahiro Kawaji |
| | | | 11:24 - 11:42 | 22077 - Void fraction in a novel microbubble-enhanced gas-liquid mixer | Masahiro Kawaji |
| | | | 11:42 - 12:00 | 22082 - Stochastic Lagrangian simulations of plasmonic nanoparticles in liquids and comparison with experiments | Luat Vuong |
| **12:00 PM - 1:00 PM** | **LUNCH BREAK** | **Dr. William Spears Atrium (1062)** | | | |
| **1:00 PM - 1:15 PM** | **Break to walk to sessions** | **Dr. William Spears Atrium (1062)** | | | |
| 1:15 PM - 2:45 PM | **CFD: Phase Change - II Chair: Cedric Ophoff, Co-Chair: M Helal Uddin** | 1048 | 1:15 - 1:33 | 22889 - Computational studies of multi-phase heat transfer in micro-scale heat sinks | Patrick Mensah |
| | | | 1:33 - 1:51 | 21191 - Microchannel definition for two-phase flow boiling: Defining a critical dimension | Arthur Snider |
| | | | 1:51 - 2:09 | 21521 - Analysis to optimize the location of phase change material in buildings | Jyothis Anand Prem Anand Jayaprabha |
| | | | 2:09 - 2:27 | 25069 - On the effect of surface curvature on droplet contact angle: Dissipative particle dynamics study | Anupam Mishra |
| | | | 2:27 - 2:45 | 22058 - Experimental investigation of microscale droplet impingement dynamics on smooth and micro-structured solid surfaces | Kai Chen |
| 1:15 PM - 2:45 PM | **Fundamentals in Fluid Flow and Heat/ Mass and Momentum Transfer - II Chair: Mohammad Reza Shaeri** | 1049 | 1:15 - 1:33 | 21802 - The key role of pumping power in active cooling systems | Mohammad Reza Shaeri |
| | | | 1:33 - 1:51 | 25157 - Study of spray cooling: Drop impact and spray impingement | Ri Li |
| | | | 1:51 - 2:09 | 20457 - Dropwise condensation on hydrophobic microporous powder and the transition to intrapowder droplet removal | Sean Hoenig |
| | | | 2:09 - 2:27 | 21941 - A study on counter-current imbibition phenomena for two phase flow process in a homogenous porous media | Hardik Patel |
| | | | 2:27 - 2:45 | 21666 - The influence of the aortic root geometry on flow characteristics of a bileaflet mechanical heart valve | Fardin Khalili |
| 1:15 PM - 2:45 PM | **Computational Methods/Tools in Thermal-Fluid Systems - IV Chair: Kourosh Shoele** | 1054 | 1:15 - 1:33 | 22324 - Numerical study on aerodynamic loss of a turbine blade with film cooling of forward and backward injections | Xianchang Li |
| | | | 1:33 - 1:51 | 24358 - A critique of existing analytical thermoelectric models - Rectifying heat input with a novel approach | Matthew Barry |
| | | | 1:51 - 2:09 | 22011 - Modelling artificial ground freezing: the case study of two tunnels of the metro in Napoli (Italy) | Gennaro Normino |
| | | | 2:09 - 2:27 | 22059 - Optimal tundish design using OpenFOAM | Prateek Singh |
| | | | 2:27 - 2:45 | 22024 - Plain flow vapor condensation optimization using teaching-learning based optimization (TLBO) | Ravindra Kumar |
| 1:15 PM - 2:45 PM | **Energy and Sustainability - III Chair: Neda Yaghoobian** | 3028 | 1:15 - 1:33 | 20629 - Air entrainment due to a plunging free-surface flow | L. Enrique Ortiz Vidal |
| | | | 1:33 - 1:51 | 20653 - Numerical study on explosion hazards of clean fuel hydrogen cars in a garage | W.K. Chow |
| | | | 1:51 - 2:09 | 20752 - Monte Carlo simulation of collimated solar energy allocation n a water-filled prismatic louver | Yaomin Cai |
| | | | 2:09 - 2:27 | 21025 - Performance evaluation of the steam power plant condenser cooled by a vapor compression refrigeration system using Aspen | Yahya Rothan |
| | | | 2:27 - 2:45 | 21552 - Methods of energy efficiency in compressed air, refrigeration systems and their financial impacts | Anderson Reis |

| Time | Session | Room | Duration | Title | Author |
|---|---|---|---|---|---|
| 1:15 PM - 2:45 PM | **Micro/Nano Heat/Mass Transfer - IV**<br>**Chair: David Pratt** | 3031 | 1:15 - 1:33 | 22272 - Effect of slip on laminar flow friction number in microchannels | Mohamed El-Genk |
| | | | 1:33 - 1:51 | 22343 - Numerical investogation of dual high heat flux thermal management for a phased array antenna with microchannel cooling techniques | Murat Parlak |
| | | | 1:51 - 2:09 | 22155 - Experimental investigation of pillar with free end on heat transfer enhancement | Arash nayebzadeh |
| | | | 2:09 - 2:27 | 22689 - Thermal conductivity of the anisotropic carbonyl iron particle doper magnetorheological elastomers | Hongmei Zhong |
| | | | 2:27 - 2:45 | 20790 - Numerical simulation of nanofluid filled wavy enclosure containing a conducting body with meshfree approach | Sarita Nandal |
| 1:15 PM - 2:45 PM | **PANEL: Heat and Mass Transfer in Extreme Humidity**<br>**Moderators: S.A. Sherif and Lorenzo Cremaschi** | 3032 | | | |
| 1:15 PM - 2:45 PM | **Heat/Mass Transfer Enhancement Techniques - IV**<br>**Chair: Maulik Shelat** | 3034 | 1:15 - 1:33 | 20837 - Flexible polymeric hollow fiber heat exchangers – an experimental research | Miroslav Raudensky |
| | | | 1:33 - 1:51 | 21536 - Power generation and heat transfer analysis of compact shell and conical tube heat exchanger | Aneesha Gogineni |
| | | | 1:51 - 2:09 | 21549 - Enhanced catalytic potential of nickel nanoparticles for carbon sequestration | Seokju Seo |
| | | | 2:09 - 2:27 | 21621 - Tab-Induced counter-rotating vortex pairs For mixing and heat transfer applications | Jorge Alvarado |
| | | | 2:27 - 2:45 | 21622 - Coil heat exchanger with reversed loops | Jorge Alvarado |
| 1:15 PM - 2:45 PM | **Fluid Flow and Heat Transfer Multiphase Phenomena - IV**<br>**Chair: Ahmad Fakheri** | 3035 | 1:15 - 1:33 | 24312 - A nonequilibrium molecular dynamics simulation on the condensation rate of argon | Min Chen |
| | | | 1:33 - 1:51 | 24472 - Experimental study on condensation heat transfer of steam in horizontal tube | Yaoxuan Wang |
| | | | 1:51 - 2:09 | 25060 - Modeling Condensation Induced Jumping of Microscale Droplets using Many-body Dissipative Particle Dynamics | Ting Liu |
| | | | 2:09 - 2:27 | 25089 - Modeling Condensation Induced Jumping of Microscale Droplets using Many-body Dissipative Particle Dynamics | Turki Almudhhi |
| 1:15 PM - 2:45 PM | **Multiphase Flow - IV**<br>**Chair: Michael Pate** | 3044 | 1:15 - 1:33 | 20926 - The shape and motion of gas bubbles in a liquid flowing through a thin annulus | Qinghua Lei |
| | | | 1:33 - 1:51 | 21502 - Motion of elongated bubbles through a local constriction in a pipe – a numerical simulation by Lattice Boltzmann method | Naveen Bhati |
| | | | 1:51 - 2:09 | 21579 - Pool boiling of saturated FC-72 using spherical hollow structures fabricated by selective laser melting | Kin Keong Wong |
| | | | 2:09 - 2:27 | 22078 - Conservative formulation for flow of two-phase polymer-solvent system | Alexander Belozerov |
| | | | 2:27 - 2:45 | 21281 - Mathematical modeling mass transfer of liquid mixes in capillaries under action of electrical and magnetic forces on a basis the Maxwell-Stefan equations | Liudmila Uvarova |
| 1:15 PM - 2:45 PM | **Micro/Nano Heat/Mass Transfer - V**<br>**Chair: Saeid Vafaei** | 3045 | 1:15 - 1:33 | 20658 - Nanofluid heat transfer coefficient enhancement in channels | Saeid Vafaei |
| | | | 1:33 - 1:51 | 25098 - Modelling and simulation of gas-focused micro-jets used in serial femtosecond crystallography | Bozidar Sarler |
| | | | 1:51 - 2:09 | 25212 - Capillary-enhanced filmwise condensation with engineered condenser surfaces | Dion Antao |
| | | | 2:09 - 2:27 | 22804 - Studies of thermal transport properties of carbonyl iron particle doped magnetorheological elastomer | Hongmei Zhong |
| | | | 2:27 - 2:45 | 20789 - Sintering effects of bundle-shaped Titanium Oxide nanofluids on the performance of dye-sensitized solar cells | Saeid Vafaei |

| Time | Session | Room | Duration | Title | Author |
|---|---|---|---|---|---|
| 1:15 PM - 2:45 PM | **Computational Methods/Tools in Thermal-Fluid Systems - V**<br>**Chair: Peiwen Li** | 3047 | 1:15 - 1:33 | 21664 - Determination of wet-bulb temperature and relative humidity of reduced ambient pressure environment: Computer simulation and rainbow thermometry validation | Parida Losangwal |
| | | | 1:33 - 1:51 | 21665 - Multi-objective optimization for a free-piston Vuilleumier heat pump based on an evolutionary algorithm | Hanfei Chen |
| | | | 1:51 - 2:09 | 22114 - Sensitivity of thermal conductivity calculations in silicon to errors in interatomic forces | Greg Walker |
| | | | 2:09 - 2:27 | 22389 - Developing reduced kinetics using chemical reactor networks and sensitivity analysis | Lu Chen |
| | | | 2:27 - 2:45 | 25119 - Chemically Radiative flow of viscoelastic fluid over stretching cylinder with convective condition | Bilal Ashraf |
| 1:15 PM - 2:45 PM | **Computational Methods/Tools in Thermal-Fluid Systems - VI**<br>**Chair: Yogesh Jaluria** | 3049 | 1:15 - 1:33 | 21436 - Effects of impellor blade leading edge shape on hydraulic and suction performances of a high specific speed centrifugal pump | Kwang-Yong Kim |
| | | | 1:33 - 1:51 | 21507 - Transient performance of chemical, biological, radiological and nuclear filter canisters | Samuel Wood |
| | | | 1:51 - 2:09 | 21568 - Numerical investigation on aerodynamic drag reductionof a road vehicle | Jle Cui |
| | | | 2:09 - 2:27 | 21574 - CFD modelling and validation of loss coefficients for penstock bifurcations in hydropower schemes | Kasturi Sukhapure |
| | | | 2:27 - 2:45 | 21721 - Effects of reduced mesh resolution on large eddy simulations of atmospheric boundary layer flow | Matthew McKenna |
| **2:45 PM - 3:00 PM** | **Refreshment break** | **Dr. William Spears Atrium (1062)** | | | |
| 3:00 PM - 4:30 PM | **Computational and Experimental Studies on Thermofluid Systems - I**<br>**Chair: Ahmad Fakheri** | 1048 | 3:00 - 3:18 | 20899 - Experimental estimation with the Steady State Kalman Filter of a heat flux imposed by a laser diode | Henrique da Fonseca |
| | | | 3:18 - 3:36 | 21455 - A low cost, flexible pulsating heat pipe technology | Oguzhan Der |
| | | | 3:36 - 3:54 | 21948 - CFD analysis on flow characteristics of perforated plates in multi-stage high pressure reducing valve | Fu-qiang Chen |
| | | | 3:54 - 4:12 | 22041 - CFD based performance comparison of medium gravity closed spiral separator and hydrocyclone separator | Arjun Kumar Pukkella |
| 3:00 PM - 4:30 PM | **Computational and Experimental Studies on Thermofluid Systems - II**<br>**Chair: Hakan Erturk** | 1049 | 3:00 - 3:18 | 24452 - Equilibrium molecular dynamics simulation of Water-Cu nanofluids and assessment of Green-Kubo formalism | Hakan Erturk |
| | | | 3:18 - 3:36 | 21550 - Dynamics of water evaporation and salt precipitation during CO2 injection to microfluidic chips | Seokju Seo |
| | | | 3:36 - 3:54 | 21907 - Simultaneous measurement of thermal contact resistance between individual carbon fibers and their thermal diffusivity using a laser-flash Raman mapping method | Koki Katakami |
| | | | 3:54 - 4:12 | 22087 - Viscous compressible flow solution using RBF blended interpolation | Michael Harris |
| | | | 4:12 - 4:30 | 21706 - Behavioral spray injection variations of performance aviation fuels | Wilmer Flores |
| 3:00 PM - 4:30 PM | **Computational and Experimental Studies on Thermofluid Systems - III**<br>**Chair: Leitao Chen** | 1053 | 3:00 - 3:36 | Keynote speech by Renwei Mei titled Handling Boundary Condition Discontinuities in Lattice Boltzmann Method for Thermal Fluid Flow Problems | |
| | | | 3:36 - 3:54 | 20656 - Experimental investigation of the effects of nanofluids characteristics on thermal conductivity | Saeid Vafaei |
| | | | 3:54 - 4:12 | 24440 - Multi-modal film boiling simulations on adaptive octree grids | M. Wasy Akhtar |
| | | | 4:12 - 4:30 | 21546 - Thermal characterization of Aluminum Nitride thin films for thermal management of power lasers | Mohammad Rammal |
| **4:30 PM** | **CLOSING CEREMONY** | **Huizenga Hall of Fame (1014)** | | | |

# Registration Information

## REGISTRATION WILL BE AT THE FOLLOWING HOURS

**March 4, Sunday**
10:00 AM – 5:00 PM
Huizenga Hall of Fame (1014)

**March 5, Monday**
8:00 AM – 5:00 PM
Huizenga Hall of Fame

**March 6, Tuesday**
8:00 AM – 5:00 PM
Huizenga Hall of Fame

# Upcoming Conferences of Interest to the Thermal and Fluids Engineering Communities

## 2018 UPCOMING CONFERENCES

### The 16th International Heat Transfer Conference
Chinese National Convention Center, Beijing, China
August 10–15, 2018

### The 13th International Symposium on Numerical Analysis of Fluid Flows, Heat and Mass Transfer - Numerical Fluids 2018
Rhodes, Greece
September 13–18, 2018

## 2019 UPCOMING CONFERENCES

### 4th Thermal and Fluids Engineering Conference
University of Nevada Las Vegas
Las Vegas, NV, USA
April 14-17, 2019

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