Conference Program

ASTFE

7TH THERMAL AND FLUIDS ENGINEERING CONFERENCE (HYBRID)

May 15-18, 2022

www.astfe.org/tfec2022/

Preface

The 2022 American Society of Thermal and Fluids Engineers (ASTFE) Conference (Hybrid) will be held in May 15-18, 2022 partially online virtual and in person at University of Nevada, Las Vegas, NV, USA. ASTFE is the premier international society by and for professionals within the thermal and fluids science and engineering community. The 2022 ASTFE conference, TFEC2022 provides an international forum for the dissemination of the latest research and knowledge in the thermal and fluid sciences.

Authors are invited to submit abstracts covering, but not limited to, the following areas:

- Advanced Energy Systems
- Aerospace Applications
- Atomization
- Combustion, Fire and Fuels
- Computational Methods/Tools in Thermal-Fluid Systems
- Cryogenics
- Electric, Magnetic, Flow and Thermal Phenomena in Micro and Nano-Scale Systems
- Energy and Sustainability
- Energy Storage Systems
- Energy-Water-Food Nexus
- Engineering Equipment and Environmental Systems
- Engineering Fundamentals and Methodology
- Experimental Methods/Tools and Instrumentation in Fluid Mechanics and Heat/Mass Transfer
- Flow and Heat Transfer in Biological Systems
- Flow and Heat Transfer in Materials Processing Science and Manufacturing
- Flow in Internal Multiphase Flows
- Flow Instability
- Fluid Flow and Heat Transfer in Industrial and Commercial Processes
- Fluid Flow and Heat Transfer Multiphase Phenomena
- Fluid Measurements and Instrumentation
- Fluid Mechanics and Rheology of Nonlinear Materials and Complex Fluids
- Fuel Cells
- Fundamentals in Fluid Flow and Heat/Mass and Momentum Transfer
- Heat Exchangers: Compact, Novel, Networks
- Heat Pipes
- Heat Pumps
- Heat/Mass Transfer Enhancement Techniques
- Industry Problems: CO_2 Capture
- Material Issues, Ceramics, Low Thermal Conductivity
- Measurement and Modeling of Environmental Flows
- Multiphase Flows
- Nano and Micro Fluids Applications
- Natural and Built Environments
- Plasma Physics and Engineering
- Refrigeration, Air Conditioning Systems, and Refrigerants
- Solar Energy Equipment and Processes
- Thermo-economic Analysis of Energy Systems
- Thermo-Fluid Education
- Transportation
- Turbulent Flows
- Wind Turbines Aerodynamics and Control

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About ASTFE

The American Society of Thermal and Fluids Engineers **(ASTFE)** was established in July 2014 to promote the science and applications of thermal and fluids engineering and related disciplines.

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.

American Society of Thermal and Fluids Engineers **(ASTFE)** is the U.S. nonprofit organization based in New York operating on web 2.0 IT platform to arrange professional communications, support conferences and professional communities. The organization is supported by individual contributors, private foundations and other governmental bodies. All contributions and donations are tax deductible. **ASTFE** supports Open Access movement.

News

"Executive Committee" formed by ASTFE

April 2022 — The American Society of Thermal and Fluids Engineers **(ASTFE)** has formed an Executive Committee (EC) to assist in leading the Society forward. Reporting to the **ASTFE** Board of Directors, the EC serves in a significant leadership role and aims to develop innovative approaches to advance thermal and fluid scientist and engineer engagement within the **ASTFE** community. The EC will work with **ASTFE** members to appoint conference organization committees, technical committees, and working groups. EC members will also collaborate with other societies on conferences and workshops and focus on enhancing **ASTFE** membership outreach and communication.

The inaugural members of the EC were nominated by the **ASTFE** Board of Directors and include **Prof. Wilson Chiu** (University of Connecticut), **Prof. Lorenzo Cremaschi** (Auburn University, EC-chair), **Prof. Jon Longtin** (Stony Brook University), **Prof. Nesrin Ozalp** (Purdue University Northwest) and **Prof. Ting Wang** (University of New Orleans).

If you are interested in having more information, or if you would like to get involved with **ASTFE** activities, please contact **Dr. Lorenzo Cremaschi** (email: lorenzo.cremaschi@auburn.edu).

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Thermal Fluids Engineering Award

A Thermal and Fluids Engineering Award has been established to recognize substantial contributions to thermal and fluids engineering. This is the part of the honors bestowed by the society on its members for their contributions.

2022 TFEC AWARD WINNER

Sivaramakrishnan (Bala) Balachandar

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Fellowship

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Plenary Speakers

PATRICK J. ROACHE

Affiliation: Consultant

Title: Can Our Models Be Validated?

Abstract: The first part of the presentation criticizes old objections, based on Karl Popper's philosophy of "falsificationism" to even the possibility of model validation. Though still widely accepted in popular culture and by scientists, it has been discredited by both philosophers and historians of science. Even if falsificationism were accepted for science in general, it is argued here that falsificationism is not applicable to model validation. The second part presents a new validation method specific to stochastic simulations. Serious flaws of the widely accepted validation Area Metric are identified. An Alternative Area Metric is proposed which involves no more computational effort and solves the identified flaws. Both parts involve semantic issues, including the often ignored distinction between validation and prediction.

Bio: Dr. Roache specializes in Computational Fluid Dynamics, especially Verification and Validation. He wrote the original (1972) CFD book Computational Fluid Dynamics (translated into Japanese, Russian, and Chinese), the original V&V book Verification and Validation in Computational Science and Engineering (1998), and their successors (1998, 2009). He wrote a chapter for Annual Reviews of Fluid Mechanics (1997), for Handbook of Numerical Heat Transfer (2002) (with Prof. Dominique Pelletier), and two chapters for Computer Simulation Validation: Fundamental Concepts, Methodological Frameworks, and Philosophical Perspectives (2019). In A Defense of Computational Physics (2012) he critiqued philosopher Karl Popper's falsificationism, that scientific theories can only be falsified, removing this impediment to practical model Validation.

Algorithm development contributions include elliptic marching and semi direct methods, domain decomposition, pseudo-spectral and multigrid methods, modified method of characteristics, and solution adaptive and variational grid generation. He and his staff at Ecodynamics were instrumental in Performance Assessments for the DOE WIPP. With Prof. Stanly Steinberg, he contributed to Symbolic Manipulation use in CFD. He was heavily involved in the movement to establish journal publication standards for V&V, with V&V committees of ASME (two ASME/ANSI Standards), AIAA, ASCE (on 3D free-surface flow models,), and (with Prof. Luis Eça) in the three Lisbon V&V Workshops.

His pioneering development of the Grid Convergence Index (GCI) and the Method of Manufactured Solutions (MMS) provided widely accepted standards for Code Verification and Solution Verification respectively.

Dr. Roache began his research career as an experimentalist in flow visualization, first studying shock wave-boundary layer interaction with combined smoke flow and schlieren photography, and later in boundary layer transition with combined smoke flow and .hot wire anemometry. He received his degrees from the University of Notre Dame, including the inaugural PhD. Aerospace Engineering. He has also published work in analytical flight dynamics for maneuvering re-entry vehicles, porous media flow and transport, and electrode design.

Dr. Roache is the recipient of the ASME 1994 Robert T. Knapp Award, the University of Cincinnati1994 R. T. Davis Memorial Lecture Award, the University of Notre Dame 1995 Distinguished Alumnus Engineering Honor Award, and the ASME 2016 Fluids Engineering Award.

Monday — May 16, 2022
8:30-9:30 AM

Plenary Lecture at Ballroom B

PAMELA NORRIS

Affiliation: The George Washington University

Title: Tuning Phonon Transport: From Interfaces to Nanostructures

Abstract: From large-scale data centers to nano-sized transistors, thermal management plays a crucial role in device design and implementation. The effects of unoptimized thermal management, at both length scales, are clear: over half of the energy consumed by data centers is used only for cooling, and switching rates in computer processors are 300% slower today than 2005 projections. To improve these statistics, we must understand, at a fundamental level, the mechanisms which influence thermal transport, and learn to use this knowledge to modify the thermal properties with specific attention to the constraints of the intended applications.

The ability to predict, understand, and control thermal transport in materials and at interfaces remains a critical challenge and goal of nanoscale thermal transport research. In nanostructures where phonons are the primary thermal energy carriers, interfaces between dissimilar materials represent the dominant thermal resistance. An increased understanding of phonon-mediated transport across interfaces is critically needed, so that nanostructured materials can be more effectively designed and implemented.

We approached this problem experimentally, measuring nanoscale

systems with time-domain thermoreflectance (TDTR), computationaly, tracking atomic thermal motion in non-equilibrium molecular dynamics simulations, and with modeling using non-equilbrium Green's functions. This work is complicated by the wide spectra of phonon mean free paths, ranging from a single atomic spacing to the size of the material system.

My research conducted in the Nanoscale Energy Transport Laboratory at the University of Virginia, has combined both computational and experimental techniques to model, measure, and predict phonon dynamics, and the resulting thermal properties, for a wide range technologically relevant systems.

Bio: Dr. Pamela Norris is the newly appointed Vice Provost for Research at George Washington University. She previously served in roles as the Executive Dean, the Executive Associate Dean of Research, and the Associate Dean of Research and Graduate Studies in the University of Virginia School of Engineering and Applied Science and as the Frederick Tracy Morse Professor of Mechanical and Aerospace Engineering. She is a native of Portsmouth, Virginia. She joined the faculty at UVA in 1994 after receiving her undergraduate degree from Old Dominion University, her MS and PhD degrees from Georgia Tech, and completing post-doctoral studies at UC Berkeley. She is recognized globally as a leading expert in nanoscale heat transfer, especially interfacial thermal transport with a focus on thermal management across a range of length scales. She holds patents for innovative thermal management techniques for jet-blast deflectors as well as for applications of aerogels in areas ranging from biological warfare detection to lab-on-a-chip, to thermal insulation. She has served as the PI or Co-PI on over 45 sponsored research projects representing well over $25M from DOD, NSF, Industry and Foundations.

Dr. Norris is well-known for her mentoring skills and for her dedication to increasing diversity in the STEM disciplines. In 2016 she was honored with the Society of Women Engineers Distinguished Engineering Educator Award "for enduring, positive influence on students' lives as a gifted teacher, mentor, and role model; and for promoting greater diversity in STEM higher education". She is also well known for leadership in the field of nanotechnology education, chairing the American Society of Mechanical Engineers (ASME) National Nanotechnology Institute's Committee on Nanotechnology Education from 2003-2010 and organizing the first national Nano-Training Bootcamps, at the leading edge of the field. Just recently she was elected an honorary member of ASME for "international leadership in nano, micro and macroscale thermal science and engineering research; for tireless efforts to advance diversity in STEM fields; and for demonstrating engineering excellence as an outstanding mentor for students and faculty". She currently serves as the Editor-in-Chief of Nanoscale and Microscale Thermophysical Engineering, and recently served as the Vice President of Institutional Councils for the American Society for Engineering Education and as Chair of the Engineering Research Council.

Tuesday — May 17, 2022
8:15-9:15 AM

Plenary Lecture at Ballroom B

JOSEPH KENT

Affiliation: Director of Education at National Atomic Testing Museum

Title: History of the United States' Nuclear Weapons Testing Program

Abstract: Between 1951 and 1992, the United States government detonated over 1,000 nuclear weapons just 65 miles northwest of Las Vegas. During his presentation, the National Atomic Testing Museum's Director of Education Joseph Kent will be speaking about the history of the United States' nuclear weapons testing program, specifically the role of the Nevada Test Site, along with lesser known projects and training performed at the site. Joseph will also be providing details about the National Atomic Testing Museum and discussing the current mission of the Nevada Test Site, now the Nevada National Security Site.

Bio: Joseph Kent has been the Director of Education for the National Atomic Testing Museum since 2019 and previously filled this role from 2013 to 2016. Joseph earned an MA in History, with a concentration in Public History, from the University of Louisiana at Lafayette in 2013 and a BA in History, with a minor in Public History/Museum Studies, from Ohio Northern University in 2010.

Tuesday — May 17, 2022
12:30-1:30 PM

Invited Luncheon Talk at Ballroom B

PETER DE BOCK

Affiliation: Advanced Research Projects Agency-Energy

Title: Exploring the needs and potential for heat transfer fluids of tomorrow

Abstract: The energy landscape is changing, changes in energy sources and energy usage show a rise in electronics as prime conduit or end-use of our produced energy. These changes bring with them needs for exploration of an expansion of our heat transfer fluid space. Where currently most applications are cooled with air, water or oil, potential future needs might require higher performance and higher temperature range electronics. A perspective on these new coolant need areas will be presented.

Bio: Dr. Peter de Bock currently serves as Program Director at the Advanced Research Projects Agency-Energy. His focus at ARPA-E includes electronics thermal management and aviation propulsion systems.

Prior to joining ARPA-E, Dr. de Bock spent nearly 18 years with GE Research, holding various research and development positions and recently completing a focus on a system perspective on electrification of aviation. At GE Research, Dr. de Bock served as a Principal Engineer and Platform Leader for Power and Thermal Management Systems, and principal investigator on advanced programs in the areas of additive heat exchangers and advanced propulsions systems. Dr. de Bock also serves as the chair of the ASME K-16 committee on Heat Transfer in Electronics equipment and holds about 40 patents.

Raised in the Netherlands, Dr. de Bock received his Ph.D. in Mechanical Engineering from the University of Cincinnati and holds degrees from academic institutions in the Netherlands, US and the UK.

Tuesday — May 17, 2022
4:10-5:10 PM

Plenary Lecture at Ballroom B

JAYATHI Y. MURTHY

Affiliation: Ronald and Valerie Sugar Dean Henry Samueli School of Engineering and Applied Science Distinguished Professor, Department of Mechanical and Aerospace Engineering, University of California - Los Angeles

Title: Engineering a Post-Corona Future: Some (Not so Wild?) Speculations

Abstract: The demise of US higher ed has long been predicted, and despite some challenges, it is fair to say that reports of its death are greatly exaggerated. During the last two years, we have learned many lessons, intended and unintended, that have profound implications for engineering education and research.

The remote delivery of engineering education, which provided a lifeline during the pandemic, has now set expectations for flexibility, and opened up new possibilities for reducing cost, exploiting economies of scale, providing lifelong education and significantly expanding our international footprint. At the same time, there are indications that important dimensions of learning are social and that a significant fraction occurs outside the classroom. Remote or hybrid work now seems a permanent part of our future. Can creativity and teamwork be built and sustained through largely remote interactions? What are the implications for physical infrastructure? And finally, there are the enormous inequities that the pandemic has laid bare: equitable access to remote learning infrastructure, the ineffectiveness of remote learning for underserved communities, and disparities in the assumption of household responsibilities are but three examples. In examining these last two extraordinary years, I hope we can learn what works and does not work, what we need to understand better, and creatively engineer an exciting post-corona future.

Bio: Jayathi Murthy is the Ronald and Valerie Sugar Dean of the Henry Samueli School of Engineering and Applied Science at the University of California, Los Angeles. Previously she held the Ernest Cockrell Jr. Chair and served as Department Chair of Mechanical Engineering at The University of Texas at Austin. She also served as Director of the $21M NNSA PRISM Center at Purdue for Prediction of Reliability, Integrity and Survivability of Microsystems during 2008-2014. She received her Ph.D degree from the University of Minnesota in the area of numerical heat transfer and has worked in both academia and in industry. She was an early employee of Fluent Inc., a leading vendor of CFD software, where she developed the widely-used unstructured solution-adaptive finite volume methods that underlie their flagship software Fluent, and the electronics cooling software package ICEPAK. More recently, her research has addressed sub-micron thermal transport, multiscale multiphysics simulations of MEMS and NEMS and uncertainty quantification in these systems. She is the recipient of the IBM Faculty Partnership award 2003-2005, numerous best paper awards, the 2009 ASME EPPD Woman Engineer of the Year Award and the 2012 ASME EPPD Clock Award. In 2012, she was named a distinguished alumna of IIT Kanpur, India. In 2016, she was awarded the ASME Heat Transfer Memorial Award for her contributions to the development of advanced computational techniques. She was inducted into the National Academy of Engineering in 2020. Prof. Murthy serves on the editorial boards of Numerical Heat Transfer and International Journal of Thermal Sciences and is an editor of the 2nd edition of the Handbook of Numerical Heat Transfer. She has served on numerous national committees and panels on electronics thermal management and CFD, and is the author of over 300 technical publications. She is a member of the National Academy of Engineering and is a Foreign Fellow of the Indian National Academy of Engineering.

Wednesday — May 18, 2022
8:15-9:15 AM

Plenary Lecture at Ballroom B

Keynote Speakers

SRINATH EKKAD

Affiliation: North Carolina State University

Title: Detailed Heat Transfer Measurements for Rotating Turbulent Flows in Gas Turbine Systems

Abstract: Detailed understanding of hot gas path flow and heat transfer characteristics in gas turbine systems is imperative in order to design cooling strategies to meet the stringent requirements in terms of coolant usage to maintain critical components below a certain temperature. To this end, extensive research has been carried out over the past four decades on advanced thermal diagnostic methods to accurately measure heat transfer quantities such as Nusselt number and adiabatic film cooling effectiveness. The need to capture local heat transfer characteristics of these complex flow systems drives the development of measurement techniques and the experimental test facilities to support such measurements. This talk provides a comprehensive overview of the state-of-the-art thermal diagnostic efforts pertaining to detailed heat transfer measurements in rotating gas turbine blade internal and external cooling and rotor-stator disc cavity, all under rotating environments. The major investigation efforts have been identified for each of the above three categories and representative experimental results have been presented and discussed. It will be clear that detailed heat transfer measurements in such complex environments provide valuable insight and benchmark data for CFD simulations.

Bio: Dr. S. V. Ekkad is the Department Head and RJ Reynolds Professor in the Mechanical & Aerospace Engineering Department at North Carolina State University since September 2017. He previously served as the Associate Vice President for Research Programs at Virginia Tech. He also held the title of Rolls-Royce Commonwealth Professor for Aerospace Propulsion Systems at Virginia Tech. He was also the Founder and Director of the Rolls-Royce University Technology Center for Advanced System Diagnostics at Virginia Tech, one of 30 centers around the world, prior to joining NC State. He was in the Mechanical Engineering department at Virginia Tech from August 2007 to September 2017 after 9 years at LSU and 2 years at Rolls-Royce Allison Engine Company in Indianapolis. He received his Ph.D. from Texas A&M University and M.S. from Arizona State University. He has over 25 years of experience in heat transfer related research. He has published over 250 journal & conference articles, three patents and co-authored a book and three book chapters. He currently has funding from Solar Turbines, and Trilotus Aerospace Systems/Chromalloy. He has been working on gas turbine cooling and heat transfer issues since 1989 including a stint as a design engineer at Rolls-Royce, Indianapolis before his academic career. Dr. Ekkad has also served as a summer faculty fellow at AFRL, Dayton in 2003. He is well known for his contributions to heat transfer experimental methods. In 2004, he received the inaugural ASME Bergles/Rohsenow Young Investigator in Heat Transfer Award for significant contributions to the field of heat transfer by a researcher under the age of 36. He is also the Editor-in-Chief for the ASME Journal for Thermal Science and Engineering Applications. He recently received the 2022 AIAA Air Breathing Propulsion award.

Monday — May 16, 2022
9:45-10:35 AM

Keynote Speech at Ballroom B

OFODIKE EZEKOYE

Affiliation: The University of Texas at Austin

Title: Characterization of Lithium-Ion Cell Failures and Implications for Fire Safety

Abstract: Lithium ion batteries have significantly impacted and affected mobile and stationary electrical usage because of their high energy densities, low rates of self-discharge, long life, and relatively low maintenance requirements. We find these devices in consumer electronics packages such as cell phones, laptops, and other portable electronics. Increasingly these devices are used in mobile platforms such as robots, cars, cycles, and even planes. At large scales, energy storage systems in residential, commercial, and utility scale applications are incorporating lithium-ion batteries. While there's little publicly available data on the failure rates of lithium-ion cells, estimates are that the failure rates are extremely low and catastrophic failure is infrequent. That said, there are notable examples of failures that have affected the overall penetration and adoption of this technology for certain use cases. In this talk, I first provide an overview of how batteries fail. I will then discuss our work on characterizing single lithium-ion cell failures and the cascading propagation of single cell failures in cell arrays and in modules. Finally, I will also discuss the impact

of failure of battery powered device on ignition of secondary fuel packets and steps that are taken to mitigate these failures.

Bio: Dr. Ofodike (DK) Ezekoye is the J.T. MacGuire Professor of mechanical engineering at the University of Texas at Austin. He has served on the UT faculty since 1993 years and directs the UT Fire Research Group (UTFRG). UTFRG has published extensively on emerging fire and heat transfer topics. Most recently, UTFRG has been conducting research on lithium-ion battery hazards. For lithium-ion battery failures, his group characterizes single cell failures, cell-to-cell propagation, and effects of battery failures on compartment conditions. An objective in these studies is to use experimental results and first principles to develop models at different levels of fidelity and scales to aid in understanding battery failure evolution. Dr. Ezekoye and his group have presented their research findings around the world at engineering and scientific conferences and fire service meetings such as FDIC and the Redmond Safety Symposium. Dr. Ezekoye is a Fellow of the ASME and has received the SFPE D. Peter Lund Award, NFPA Bigglestone best paper award, and National Science Foundation Early Career Award.

Monday — May 16, 2022
10:45-11:35 AM

Keynote Speech at Ballroom B

MARK JACOBSON

Affiliation: Stanford University

Title: A solution to global warming, air pollution, and energy insecurity for 145 countries

Abstract: Global warming, air pollution, and energy insecurity are three of the most significant problems facing the world today. This talk discusses the development of technical and economic roadmaps to convert the energy infrastructures of 145 countries to those powered by 100% wind, water, and sunlight (WWS) for all purposes after energy efficiency measures have been accounted for. All purposes includes electricity, transportation, building heating/cooling, and industry. The talk further discusses the electricity and heat generation technologies and the electricity, heat, cold, and hydrogen storage technologies needed and their current status. It also discusses methods of keeping the electric power grid stable. Results indicate the grid can remain stable at low cost in each of 24 world regions encompassing these 145 countries. Aside from mitigating global warming, these roadmaps have the potential to eliminate 7 million air pollution deaths annually, stabilize energy prices, reduce catastrophic risk, and reduce international conflict over energy. Please see https://web.stanford.edu/group/efmh/jacobson/Articles/I/WWS-145-Countries.html for more information.

Bio: Mark Z. Jacobson is Director of the Atmosphere/Energy Program and Professor of Civil and Environmental Engineering at Stanford University. He is also a Senior Fellow of the Woods Institute for the Environment and of the Precourt Institute for Energy. He received a B.S. in Civil Engineering, an A.B. in Economics, and an M.S. in Environmental Engineering from Stanford in 1988. He received an M.S. and PhD in Atmospheric Sciences in 1991 and 1994, respectively, from UCLA and joined the faculty at Stanford in 1994. His career focuses on better understanding air pollution and global warming problems and developing large-scale clean, renewable energy solutions to them. He has published three textbooks and 173 peer-reviewed journal articles. He received the 2005 American Meteorological Society Henry G. Houghton Award and the 2013 American Geophysical Union Ascent Award for his work on black carbon climate impacts and the 2013 Global Green Policy Design Award for developing state and country energy plans. In 2015, he received a Cozzarelli Prize from the Proceedings of the National Academy of Sciences for his work on the grid integration of 100% wind, water and solar energy systems. In 2018, he received the Judi Friedman Lifetime Achievement Award "For a distinguished career dedicated to finding solutions to large-scale air pollution and climate problems". In 2019, he was selected as "one of the world's 100 most influential people in climate policy" by Apolitical. He has served on an advisory committee to the U.S. Secretary of Energy, appeared in a TED talk, appeared on the David Letterman Show to discuss converting the world to clean energy, and cofounded The Solutions Project (www.thesolutionsproject.org). His work is the scientific basis of the energy portion of the U.S. Green New Deal and laws to go to 100% renewable energy in cities, states, and countries worldwide.

Monday — May 16, 2022
11:45 AM - 12:35 PM

Keynote Speech at Ballroom B

PINAR MENGUC

Affiliation: Ozyegin University, Istanbul – Turkey

Title: Sustainable Energy, Human Element and Complex Systems

Abstract: In this presentation, the impact of sustainable energy and its applications to buildings, regions and industry are discussed. The importance of human-building interactions, understanding and implementation of thermal-visual comfort and their control in operation of buildings are outlined. The need for transdisciplinary approach to streamline these interactions and human involvement in different complex problems are explained. This approach allows systems to be responsive to human needs and to be designed considering the details of system components. The presentation also outlines the research carried out at CEEE during the last decade as related to buildings, cities and industry are outlined and future plans are discussed.

Bio: Professor M. Pinar Mengüç received his BS and MS from ODTU/METU in Ankara, Turkey, and his PhD from Purdue University, USA in 1985, all in Mechanical Engineering. The same year he joined the University of Kentucky, Lexington, KY and became a full professor in 1993. He was a visiting professor at Università degli Studi di Napoli Federico II, Italy during 1991 and at Harvard University, Cambridge, Massachusetts, during 1998-99 academic year. At the end of 2008, he was promoted to Engineering Alumni Association Chair Professor at the University of Kentucky, a title which he still holds. He has six patents and the author of more than 160 articles published in SCI journals, has co-authored more than 220 conference papers and two books. He has worked with more than 65 MS, PhD and Post-Doc researchers, and had more than 135 invited/keynote lectures delivered. He joined Ozyegin University, Istanbul in 2009 as the founding Head of Mechanical Engineering. The same year, he established the Centre for Energy, Environment and Economy (CEEE/EÇEM), which he is still directing. His research areas include radiative transfer, nano-scale transport phenomena, applied optics and sustainable energy applications. He is an elected member of Science Academy of Turkey, a fellow of both ASME (American Society of Mechanical Engineering) and ICHMT (International Center for Heat and Mass Transfer), and a Senior Member of OSA (Optical Society of America). He is in the executive committees of several NGO, including ICHMT and Science Academy. He is one of the Editors-in-Chief Journal of Quantitative Spectroscopy and Radiative Transfer (JQSRT). Mengüç has received several recognitions, including the 2018 ASME Heat Transfer Memorial Award and the 2020 Purdue Outstanding Mechanical Engineering Award, and several other local awards with his research group in Istanbul.

Tuesday — May 17, 2022
10:30-11:20 AM

Keynote Speech at Ballroom B

AKANKSHA MENON

Affiliation: Georgia Institute of Technology

Title: Thermal Science and Engineering for the Water-Energy Nexus: From Desalination to Energy Storage and Personal Thermoregulation

Abstract: The global demand for energy and water is projected to increase by 40% and 55%, respectively, by 2050. Meeting these targets in an efficient, affordable and sustainable manner necessitates significant scientific and technological advances. The challenge with water-energy systems is their inherent complexity owing to interactions that span multiple length- and timescales. However, the shift towards renewable energy (e.g., solar) and nontraditional water sources (e.g., inland or industrial wastewater) presents an opportunity to redesign these legacy systems by leveraging materials that respond to stimuli such as heat and light. With the goal of lowering the carbon footprint and environmental impact of conventional desalination, the first part of this talk will discuss the development of emerging solar desalination technologies that can achieve zero liquid discharge. A combination of radiative or non-contact heating (achieves rapid energy transfer without a heat exchanger or secondary fluid) and thermally responsive materials (with low separation enthalpies) enable energy-efficient and low-cost desalination. With the goal of decarbonizing energy use in the building and industrial sector, the second part of this talk will present concepts for thermal energy storage using composite materials that can facilitate the integration of solar heating and renewable electrification. Finally, leveraging the digital revolution, wearable devices that achieve personal thermoregulation will be discussed. These examples demonstrate the potential to modulate heat and mass transport for the next generation energy and water systems to achieve low-energy separations for clean water, and dynamic buildings optimized for thermal comfort.

Bio: Dr. Akanksha Menon is an Assistant Professor in the Woodruff School of Mechanical Engineering at Georgia Tech and directs the Water-Energy Research Lab. Prior to this, she was an ITRI-Rosenfeld Post-

doctoral Fellow in the Energy Technologies Area at Lawrence Berkeley National Lab. Her research focuses on applying thermal science/engineering and functional materials to develop sustainable technologies for the water-energy nexus. Dr. Menon received her Ph.D. in Mechanical Engineering from Georgia Tech, where she developed organic thermoelectric materials and devices for energy harvesting and wearable electronics. Before this, she was an undergraduate student at Texas A&M University at Qatar where she worked on solar-thermal cracking of methane for hydrogen production. Dr. Menon is a recipient of the 2019 Sigma Xi Dissertation Award and the 2017 Materials Research Society (MRS) Silver Award. She has served as the Co-President of the Energy Club @ Georgia Tech and co-founded the Water Wednesday's initiative at Berkeley Lab.

Tuesday — May 17, 2022
11:30 AM - 12:20 PM

Keynote Speech at Ballroom B

GUILLERMO PANIAGUA

Affiliation: Purdue University West Lafayette

Title: Advances on Internal flow aerodynamics for revolutionary turbines

Abstract: The unstarting of supersonic passages and flow detachment are long-standing, unresolved scientific challenges, causing aerodynamic loss, unsteadiness, noise, and structural vibrations, limiting the operation of internal flow passages relevant to turbomachinery. This keynote will address ongoing fundamental research and connect with industrial products. The objective is to guide the transformation of the aerodynamic design leading to transformative solutions for transportation and energy production. The starting and flow detachment appear to conflict in their response to unsteady interactions. Commercial CFD solvers employed by the industry typically use steady or unsteady Reynolds-averaged Navier Stokes equations, with a limited validity when dealing with detached or highly unsteady flows. Large-Eddy Simulation or Direct Numerical Simulation is capable of more accurate predictions. Alas, their high computational cost limits their use in design and optimization. Our research integrates experimental with computational work. Detailed experimental campaigns are performed at the Purdue Experimental Turbine Aerothermal Lab, including a tri-sonic facility capable of continuous and transient operation.

Bio: Dr. Guillermo Paniagua, Professor of Mechanical Engineering, joined Purdue in 2014 after 18 years at the prestigious von Karman Institute, and founded the Purdue Experimental Turbine Aerothermal Lab (PETAL), developing this nation's largest academic turbine facility. Professor Paniagua has long fostered his global connections to improve research efficiency by merging fundamental studies across multiple labs. In addition to the Office of Naval Research / Air Force Office of Scientific Research funding, he has received international research support from the Israel-USA Binational Foundation, the European Commission, and NATO. His international advisory roles include advisor of the Swedish Aeronautical Research center, and the Minerva Center on Micro Turbine Energy. Dr. Paniagua's awards include the Biennial International Award Iwan Åkerman on innovative research on expansion machines, the European REA Award on Visionary Aeronautics Project Idea, the AIAA Ground Testing Award, the Safran invention of the year, the ASME International Gas Turbine Institute Aircraft Engine Technology Award, and the Humboldt Research Award. He is an AIAA Fellow, an ASME Fellow, and since 2021 a University Faculty Scholar at Purdue.

Wednesday — May 18, 2022
9:30-10:20 AM

Keynote Speech at Ballroom B

MATTHEW BAUER

Affiliation: U.S. Department of Energy (DOE)

Title: Developing the Next Generation of Concentrating Solar-thermal Power

Abstract: Concentrating solar-thermal power (CSP) coupled with thermal energy storage (TES) is unique as a dispatchable form of renewable energy. The US Department of Energy (DOE) supports R&D in new technologies to enable a levelized cost of electricity (LCOE) 5¢/kWh for a systems with 12 or more hours of directly-coupled TES, which could lead to cost competitive deployment of CSP in the US. DOE also supports R&D to apply these new technologies to applications beyond electricity generation, including high-temperature industrial process heating, with the aim to support the administration's goal of complete decarbonization of the energy sector by 2050. This technoeconomic mission has led to the development of a new power cycle based on supercritical CO2, innovative integrated thermal transport and storage systems based on novel heat transfer media, and the launch of new pilot scale demonstrations enabled by a broad foundation of research. This presentation will describe these efforts and go into detail on the development of a new generation of CSP (Gen3 CSP) enabled by a 700 °C power cycle.

Bio: Dr. Matthew Bauer is a technology development manager for the Solar Energy Technologies Office (SETO) Concentrating Solar-Thermal Power (CSP) team. Since 2015 he has worked with the CSP research and development (R&D) community to identify promising CSP-relevant technologies and solve technical risks impeding such technologies from commercial adoption. While primarily focused on CSP for electricity generation, Matthew also develops frameworks for technology advances in related applications including pumped thermal energy storage, solar thermal process heat, and solar thermochemical processes. Recently, he has headed SETO's 2021 SOLAR Receivers and Reactors program, SETO's 2019 FIRM Thermal Energy Storage initiative, SETO's 2018 Advanced CSP Components R&D initiative, as well as the CSP program's reoccurring seedling research initiative, Small Innovative Projects in Solar (SIPS), and parallel National Laboratory Research.

Analysis of viable system concepts where new technologies can be deployed has been an area of focus for Matthew, including: higher temperature molten salt systems, first of a kind integrated particle CSP systems, and integrating CSP with sCO2 power cycles. Matthew's research background is focused on microscale thermal transport phenomena- theory, measurements, and simulations. Prior to joining SETO, Matthew completed his Ph.D. in Mechanical Engineering at the University of Virginia.

DR. AVI SHULTZ

Co-author

Affiliation: U.S. Department of Energy (DOE)

Bio: Dr. Avi Shultz is the program manager for concentrating solar-thermal power (CSP) for the U.S. Department of Energy's Solar Energy Technologies Office (SETO), which supports research, development, and demonstration of solar-thermal components and systems that can enable wide-spread deployment of low-cost CSP with thermal energy storage. Dr. Shultz has been with SETO since 2013, where he started as a science and technology policy fellow, supporting the CSP program on a wide variety of topics.

Before joining SETO, Dr. Shultz was a post-doctoral fellow at the University of Amsterdam, after getting his Bachelor and Doctoral degrees in Chemistry, from Columbia University and Northwestern University, respectively.

Wednesday — May 18, 2022
10:30-11:20 AM

Keynote Speech at Ballroom B

CAREY J. SIMONSON

Affiliation: Professor of Mechanical Engineering, College of Engineering, University of Saskatchewan, Saskatoon Canada

Title: Energy-efficient ventilation for healthy and sustainable buildings

Abstract: The COVID-19 pandemic has highlighted the need for increased ventilation in buildings to reduce the spread of infectious respiratory diseases. Increased ventilation can improve health and productivity because people in developed countries typically spend over 90% of their time in buildings. However, increasing ventilation, increases building energy consumption. Since buildings account for 40% of global energy consumption, increasing energy consumption in buildings affects sustainability and increases the threat of climate change. This seminar will present research on air-to-air energy exchangers as a way to provide improved ventilation without excessive energy consumption, which is critical for healthy and sustainable buildings.

Bio: Carey Simonson is the Associate Dean of Graduate Studies and Strategic Projects in the College of Engineering and a Professor of Mechanical Engineering at the University of Saskatchewan (USask) in Saskatoon, Canada. He has PhD (1998), MSc (1993) and BE (1991) degrees in Mechanical Engineering from USask and has spent 7 years in Finland as a visiting professor at the University of Oulu and researcher at the Technical Research Centre of Finland.

Professor Simonson is in the top 1% of the most-cited scientists in the world in the field of Buildings and Construction and has published over 250 peer-reviewed papers. He is an Associate Editor of the ASME Open Journal of Engineering and an editorial board member of Energy and Buildings. He has received several national and international awards for research and graduate student supervision such as: ASHRAE Fellow, 2014 Synergy Award for Innovation from the Natural Sciences and Engineering Research Council of Canada , Finalist – 2018 Award for Outstanding Graduate Mentorship from the Canadian Association for Graduate Studies, USask Distinguished Graduate Supervisor Award, USask Graduate Student Association Teaching Excellence Award, USask Governor General's Gold Medal, 4 ASHRAE Technical Paper Awards, Adjunct Professor at the Indian Institute of Technology Madras and Docent at the University of Oulu, Finland.

Wednesday — May 18, 2022
11:30 AM - 12:20 PM

Keynote Speech at Ballroom B

TEC Talk Speakers

JAMES KLAUSNER

Affiliation: Michigan State University

Title: Moving Clean Energy Technology from Lab to Market

Abstract: A Michigan State University research group has developed thermochemical battery long duration energy storage technology with support from the U.S. DOE ARPA-E. The thermochemical battery technology has been demonstrated in the laboratory with daily cycling over a several month period. It has been found to provide unprecedented volumetric energy density (2400 MJ/m3) at low capital cost ($10/kWh). The thermochemical battery technology was spun out of the laboratory into a startup venture, RedoxBlox. This talk will discuss the thermochemical battery value proposition, market opportunities, and challenges faced getting clean energy technology to market.

Bio: Dr. James Klausner research interests concern the fundamental physics driving fluid, thermal, and chemical, transport with a focus on contemporary engineering applications that support sustainable energy and a sustainable economy. These include, energy conversion and storage, chemical processing, thermal management, desalination, powder flow, cryogenics, circular economy, and advanced manufacturing. He has done extensive fundamental work on the dynamics of phase change phenomena, including nucleation and bubble dynamics. His current research projects involve electrical and solar energy storage, use of solar energy driven thermochemical water and CO_2 splitting for synthetic fuel production, such as hydrogen and higher order hydrocarbons, using low grade waste heat and un-concentrated solar energy for low temperature desalination, automotive thermal management, and hypersonic thermal management. He has developed a number of phase-change thermal management processes that operate at unprecedented heat fluxes. He has 13 patents and copyrights that resulted from his research work.

Dr. James Klausner is an MSU Foundation Professor. He serves on the board of directors for the American Society of Thermal Fluid Engineers (2018-present) and the International Titanium Association Foundation (2016-present), and he formerly served as Chair of the ASME Heat Transfer Division (2011-2012). For three and a half years he served as a Program Director at the U.S. Department of Energy Advanced Research Projects Agency-Energy (ARPA-E). Prior to that he held the Newton C. Ebaugh Professorship in Mechanical and Aerospace Engineering at the University of Florida (1989-2015). Dr. Klausner has authored more than 150 refereed publications.

Monday — May 16, 2022
1:00-2:30 PM

TEC Talk Session at Ballroom B

THORNTON D. BARNES

Affiliation: CEO of Startel, Inc.

Title: The CIA's Science & Technology Projects and Achievements at Area 51

Abstract: Mr. Barnes, a graduate of the US Army's Nike Ajax, Nike Hercules, and HAWK radar and missile schools, served as a Hypersonic Flight Support Specialist on the NASA High Range. Barnes supported the X-15, XB-70 Mach 3 bomber, the lifting bodies, and the CIA Special Projects at Area 51. Barnes will discuss the CIA's declassified science and technology projects at Area 51.

Bio: Thornton D. "TD" Barnes, author, and entrepreneur, grew up on a ranch at Dalhart, Texas. Barnes's career includes serving as a field engineer at the NASA High Range in Nevada for the X-15, XB-70, lifting bodies and lunar landing vehicles; working on the NERVA project at Jackass Flats, Nevada; and serving in Special Projects at Area 51. Barnes later formed a family oil and gas exploration company, drilling, and producing oil and gas and mining uranium and gold. Barnes currently serves as the CEO of Startel, Inc., a landowner, and is actively mining landscape rock and gold in Nevada.

Eric also acts as Tulane's media contact for energy issues.

Monday — May 16, 2022
1:00-2:30 PM

TEC Talk Session at Ballroom B

TERRI POUSSARD

Affiliation: PE (ME) Vice President, Power Business Development Lead, HDR Engineering Inc.

Title: Impacts of Energy Transition

Abstract: We hear a lot about the Energy Transition. But what exactly is the Energy Transition? The truth is that it means different things to different people, different industries as well as different countries. Wikipedia states that the energy transition is "Significant structure change in an energy system" or "Current transition to renewable energy and other types of sustainable energy largely driven by the goal for decarbonization." And the Energy sector is the major source of global emissions with electricity and heating being the largest emitter followed by Industry, Transportation and Buildings respectively.

More and more the Energy Transition is being driven by changes in Energy Policy such as the Green New Deal, The Recovery Plan for Europe, IEA's Net Zero by 2050 plan, and the Biden administration's policies. Major global companies are developing decarbonization plans. And some of the goals put forth in policy or by companies are very aggressive. The truth is that today's energy system still depends heavily on fossil fuels. Coal, gas, oil and nuclear are still required to meet global power generation needs. To provide secure and sustainable energy systems while meeting these goals comes with a lot of challenges.

During this talk, I will discuss my view of the Energy Transition; impacts to different industries; electrification; challenges; and discuss the role of our existing infrastructure, and the need for infrastructure changes. As a mechanical engineer who spent most of my career in design and development of thermal generation power plants, I am now in the middle of this transition that is changing the way I look at the power industry. It is not only the way we generate electricity but also the way we will be using electricity.

Bio: Terri is a Power Business Development Lead at HDR responsible for client and project development in the Northeast. Terri is a Professional Mechanical Engineer with more than 30 years' experience in power plant design and construction. Terri's experience includes design and development of many different plant configurations including natural gas combined and simple cycle, biomass, solar, wind, microgrids and combined heat and power plants as well as battery energy storage. Terri is responsible for development of market penetration strategies and implementation to capture power and energy business in both engineering and environmental services. Other duties include fostering client relations, client management and serving as technical consultant or project manager on strategic projects.

Monday — May 16, 2022
1:00-2:30 PM

TEC Talk Session at Ballroom B

AKSHAI K. RUNCHAL

Affiliation: President and Founding Partner, ACRi

Title: Building a Consulting Company – Successes & Failures

Abstract: Dr. Runchal was part of the 3-person group that developed the Finite Volume Method (FVM) at Imperial college under the guidance of Prof. Brian Spalding. After completing his Ph, D. he joined academia but then moved to consulting. In this talk he describes why and how he moved to the consulting world and the lessons learnt from establishing and running a consulting company. The talk also touches upon his personal journey in moving from a remote village in India to the 60's of London and the 70's of California.In 2011, founded a non-profit CFD Virtual Reality Institute (www.CFDVRi.org) to further the cause of CFD education, training and R&D.

Bio: Over 50 years of experience in Computational Fluid Dynamics (CFD) and numerical simulation of flow, heat and mass transport processes in engineering and environmental sciences. Key member of the 3-person team led by Prof. D. B. Spalding that invented the Finite Volume Method (FVM) for CFD in mid 1960's.

In 1979, established the ACRi group of companies (www.acricfd.com) that now has offices in Los Angeles (USA), Nice (France) and Bangalore (India).

In 2011, founded a non-profit CFD Virtual Reality Institute (www.CFDVRi.org) to further the cause of CFD education, training and R&D.

Experience spans a range of problems including those related to design, production, operation and environmental impact of industrial and urban projects, specifically the analysis and management of natural and man-made disaster scenarios such as Tsunamis, industrial fires and explosions, and hazardous and nuclear releases in air and water.

Provided services to over 200 leading industrial, government and research organizations in over 25 countries, and consulted with many Fortune 500 corporations including ANDRA, Aerospatiale, Allied Signal, Allison Gas Turbines, ARAMCO, ARCO, BARC, Bechtel, Boeing, BP, BRNS, Brown Boveri, Chevron, Exxon, Fluor, FMC, GE, General Motors, GIE Hyperspace, GTRE, IBM, Idaho National Engineering Laboratory,

NASA, National Academy of Sciences, Oak Ridge National Laboratory, Rockwell, Rolls-Royce, Sandia National Laboratory, Shell, SNECMA, Sohio, Sulzer, TOTAL, Westinghouse, URS, USAF and Woodward Clyde, Dames & Moore and Woodward Clyde.

Principal author of the ANSWER®, PORFLOW®, TIDAL® and RADM CFD software tools, which can deal with a broad spectrum of problems in fluid dynamics, heat and mass transport, and environmental pollution. These tools are widely employed by commercial, academic and research organizations.

Author or co-author for 10 books and over 200 technical publications, and regular reviewer for a number of technical journals. Delivered keynote and invited talks at more than 100 conferences and seminars.

Fellow of the ASME and served as Chairman of the IIT Kanpur Foundation Board. IIT Gandhinagar Advisory Board, and as an advisor to DeitY (Government of India) and the Indian Army.

Monday — May 16, 2022
1:00-2:30 PM

TEC Talk Session at Ballroom B

COLUMBIA MISHRA

Affiliation: Senior Staff Systems Architecture Engineer, Spacecraft Systems Engineering, Maxar Technologies Inc.

Title: Spacecraft Engineering: Designing Thermal Solutions for Different Orbits

Abstract: Modern privatization of space exploration has seen a plethora of companies sending satellites and spacecrafts to different earth orbits as well as multiple missions to different planetary bodies within the solar system and other deep space missions. Most missions target Low-Earth-Orbits (LEO), Geostationary orbits (GEO), Near-Rectilinear Halo Orbit (NRHO), or orbit different planets for a variety of reasons - scientific research, space tourism, communications, on-orbit servicing, earth imagery, intelligence and defense related activities. These different orbits create numerous technical challenges from a thermal perspective. In this TEC talk we will explore the different considerations in thermals for spacecraft design and how each type of orbit represents a different set of obstacles. These challenges call for innovations in the thermal-fluids technologies pertaining to spacecraft engineering. Thermal-fluidic systems do not exist in isolation from the full spacecrafts and as such we will investigate the various interactions of the sub-systems with the thermals in spacecrafts. Finally, we will discuss what the latest space industrialization means for space pollution, how innovations on thermal-fluids technologies can extend time to spacecraft demise and reduce orbital debris generation ultimately in the long term. We will discuss these challenges and opportunities in the context of ongoing and upcoming space missions.

Bio: Dr. Columbia Mishra is a Senior Staff Systems Architecture Engineer of Maxar Technologies, Inc. She holds a Ph.D. in Mechanical Engineering from The University of Texas at Austin, and Columbia received her M.S. and Bachelor's degree in Mechanical Engineering from Texas Tech and Jadavpur University. Columbia presently works in spacecraft systems engineering designing spacecrafts, specifically NASA's Artemis Mission to the Moon, which will land the first woman and next man on the Moon and establish a permanent human presence in Lunar orbit. Prior to the space industry, Dr. Mishra worked as a Senior Thermal Engineer and in computational photolithography at Intel Corporation. Throughout her career she has worked in varied capacities in diverse technology sectors, including for Apple Inc. in California, Stress Engineering Services in Texas, Makino Asia in Singapore, and Tata Motors in India. During 15 years of industry and research experience, Dr. Mishra has developed a deep knowledge of thermal fluids systems, consumer electronics and spacecraft engineering. Dr. Mishra's research has been published in journals such as Nature Materials, Journal of Fluid Mechanics and has been cited over a thousand times. She holds 5 patents pending, 1 granted for her work in thermal architecture and innovation in electronic systems.

Dr. Mishra currently serves on the CTO Technology Advisory Council of the Society for the Advancement of Material and Process Engineering (SAMPE). She has served in multiple leadership roles within the heat transfer community including the Technical Program Chair for the American Society of Mechanical Engineer's 2020 Summer Heat Transfer Conference (SHTC) and topic chairs for the International Mechanical Engineering Congress and Exposition (IMECE). She is a recipient of numerous awards including the 2020 Lakshmi Singh Early Career Leadership Award from the American Society for Mechanical Engineers (ASME) and the Qualcomm Innovation Fellowship.

Columbia was one of ten engineers from across the globe to be selected for ASME's prestigious Early Career Leadership Program to Serve Engineering (ECLIPSE). She works with members of the U.S. Congress to advocate for technology policies, a continuation of her work as the first international graduate student body President of UT Austin. Columbia received the Cockrell School of Engineering Student Leadership Award for her contributions as the graduate student body president representing 13,000 students to the university administration, UT System Board of Regents, City of Austin, and Texas Legislature. She advocated for graduate student policies at the Texas and United States Legislature. As part of Engineers Without Borders at Texas Tech University, she applied her engineering skills to improve the quality of life for elderly residents of Juarez, Mexico.

A passionate space enthusiast, Columbia is en-route to becoming a trained pilot. Columbia mentors first generation high school students, early career engineers and engages with K-12 community across the country. Dr. Mishra uses her title of Miss Asia California Global 2021, and Miss India Oregon 2020 to raise awareness about social issues including representation of women in STEM. Full of zest for life, Columbia performs live music online. She lives in the heart of Silicon Valley in California and enjoys traveling around the globe.

Monday — May 16, 2022
1:00-2:30 PM

TEC Talk Session at Ballroom B

Invited Special Talk Speakers

AKSHAI K. RUNCHAL

Affiliation: President and Founding Partner, ACRi

Title: The Coming Revolution in CFD: Physics Informed Machine Learning

Abstract: Physics Informed Machine Learning (PIML) appears to be a rapidly developing technique with the potential to revolutionize the computing sciences in general and computational fluid dynamics in particular. The first known instance of using the neural network to solve partial differential equations, without using training data, was Lagaris (1998). They used a meshless collocation method and determined the unknown coefficients of the neural network by minimizing the residual of the governing equations at the collocation points.

The development of the physics informed neural network (PINN) by Raissi et.al. (2017) involved the joint use of data driven techniques and the governing equations and sparked widespread interest in this technique. It appears likely that the PINN may take its place alongside the popular numerical techniques like the finite difference, finite volume and the finite element methods in CFD and scientific computing. The neural network is a continuous and differentiable function that is valid over the whole domain, is quick to evaluate and is more compact in terms of storage than the results of a typical numerical method.

The neural network is a powerful function approximator (Hornik 1980). Thus, it can be used to fit data generated by numerical solutions of the governing partial differential equations and/or data generated from experimental / field measurements and by directly minimizing the residuals of the the governing equations. This residual minimization technique can also be used to calibrate unknown coefficients of the governing equations by using experimental / measured data. This method makes the PINN very useful in solving inverse problems, uncertainty quantification and more generally, renders the PINN useful in situations wherever fast surrogate models are desired. Neural networks can also be configured to simultaneously output a prediction confidence interval alongside the actual results, which is useful for uncertainty quantification. This makes the PINN a good choice for embedding inside digital twins (Greaves 2002).

However, in spite of all the above advantages, the PINN has its shortcomings. One difficulty is that the training process is slow and computationally intensive. The convergence of the training (residual minimization) process is slow and often sensitive to the architecture of the network. At present, the PINN only takes the spatial coordinates of the collocation points and time as inputs. This implies that the PINN is trained for a specific boundary and initial condition, which restricts its use in practical systems. Studies that try to generalize PINN to a range of boundary and initial conditions are a matter of active research.

The talk concludes with a case study to illustrate the use of the neural network and PINN in problems related to CFD applications.

Bio: Over 50 years of experience in Computational Fluid Dynamics (CFD) and numerical simulation of flow, heat and mass transport processes in engineering and environmental sciences. Key member of the 3-person team led by Prof. D. B. Spalding that invented the Finite Volume Method (FVM) for CFD in mid 1960's.

In 1979, established the ACRi group of companies (www.acricfd.com) that now has offices in Los Angeles (USA), Nice (France) and Bangalore (India).

In 2011, founded a non-profit CFD Virtual Reality Institute (www.CFDVRi.org) to further the cause of CFD education, training and R&D.

Experience spans a range of problems including those related to design, production, operation and environmental impact of industrial and urban projects, specifically the analysis and management of natural and man-made disaster scenarios such as Tsunamis, industrial fires and explosions, and hazardous and nuclear releases in air and water.

Provided services to over 200 leading industrial, government and research organizations in over 25 countries, and consulted with many Fortune 500 corporations including ANDRA, Aerospatiale, Allied Signal, Allison Gas Turbines, ARAMCO, ARCO, BARC, Bechtel, Boeing, BP, BRNS, Brown Boveri, Chevron, Exxon, Fluor, FMC, GE, General Motors, GIE Hyperspace, GTRE, IBM, Idaho National Engineering Laboratory, NASA, National Academy of Sciences, Oak Ridge National Laboratory, Rockwell, Rolls-Royce, Sandia National Laboratory, Shell, SNECMA, Sohio, Sulzer, TOTAL, Westinghouse, URS, USAF and Woodward Clyde, Dames & Moore and Woodward Clyde.

Principal author of the ANSWER®, PORFLOW®, TIDAL® and RADM CFD software tools, which can deal with a broad spectrum of problems in fluid dynamics, heat and mass transport, and environmental pollution. These tools are widely employed by commercial, academic and research organizations.

Author or co-author for 10 books and over 200 technical publications, and regular reviewer for a number of technical journals. Delivered keynote and invited talks at more than 100 conferences and seminars.

Fellow of the ASME and served as Chairman of the IIT Kanpur Foundation Board. IIT Gandhinagar Advisory Board, and as an advisor to DeitY (Government of India) and the Indian Army.

Monday — May 16, 2022
2:45-4:15 PM — Computational Methods/Tools in Thermal-Fluid Systems - I

Session 1D-P at Room 213

ASHWANI K. GUPTA

Affiliation: Distinguished University Professor, Mechanical Engineering, Maryland Energy Innovation Institute, University of Maryland

Title: High Intensity Distributed Combustion for Near Zero Emission and High Performance

Abstract: Clean fuel burning using a wide variety of fuels is extremely important for good human health and the environment. Colorless Distributed Combustion (called CDC) is a novel method to enhance flame stability, thermal field uniformity, combustion efficiency and significantly reduce pollutants emission, including noise and instability. The CDC is achieved through the use of a carefully prepared fuel-oxidizer mixture along with reactive species generated from within the combustor volume.

Bio: Ashwani Gupta is Distinguished University Professor at the University of Maryland. He received his PhD from the University of Sheffield, UK. He was awarded a Higher Doctorate (DSc) from the University of Sheffield, and also from the University of Southampton, UK. He received Honorary Doctorates from the University of Wisconsin Milwaukee, King Mungkut University of Technology, North Bangkok (bestowed by the Princess of Thailand), and the University of Derby, UK. His main research interests have been in the fields of Combustion, Air pollution, Propulsion, High temperature air combustion, Swirl flows, Diagnostics, Fuel sprays, Fuel reforming, Sensors, Micro-scale combustion, and Wastes to clean energy conversion. He has co-authored three books, published 290+ journal papers, 540+ conference papers, 22 book chapters, and 19 edited books. He is an Honorary Fellow of ASME and RAeS (UK), and a Fellow of AIAA, SAE and AAAS, and Member of the European Academy of Sciences and Arts (EASA).

Tuesday — May 17, 2022
2:30-4:00 PM — Combustion and Energy Systems

Session 3A-P at Room 207

RUSSELL CUMMINGS

Affiliation: Director, Hypersonic Vehicle Simulation Institute at United States Air Force Academy

Title: Simulating Hypersonic Heat: How Can We Improve our Models and Methods?

Abstract: Hypersonic vehicles flying at Mach numbers above five can experience temperatures in excess of several thousand Kelvin. Dealing with the heating caused by these high temperatures can require either passive or active cooling systems, but these thermal protection systems cannot be designed well without accurate simulations or predictions of the heat loads (both instantaneous and integrated over time). Understanding where the high temperatures come from, how they flow around a vehicle, and how they interact with the surface and structure of the vehicle is crucial to the success of the design. Current capabilities in predicting hypersonic heating will be examined, including the impact of current turbulence and transition models on those predictions, and approaches to improving our predictive capabilities will be explored.

Bio: Dr. Cummings is Professor of Aeronautics and Managing Director of the DoD HPCMP Hypersonic Vehicle Simulation Institute at the US Air Force Academy. From 2015-2018 he was the Technical Director at AFOSR's European Office of Aerospace Research & Development in London. Dr. Cummings is a graduate of the University of Southern California where he received his Ph.D. in Aerospace Engineering, and also has earned B.S., B.A., and M.S. degrees from California Polytechnic State University. He currently serves as deputy editor of the Journal of Spacecraft and Rockets, and is an associate editor of the Journal of Aircraft and Aerospace Science and Technology. He is co-author of the Sixth Edition of Aerodynamics for Engineers and lead author for Applied Computational Aerodynamics. Dr. Cummings has previously worked at Hughes Aircraft Company, NASA Ames Research Center, and California Polytechnic State University. He is a Fellow of the American Institute of Aeronautics and Astronautics and the Royal Aeronautical Society.

Tuesday — May 17, 2022
5:20-6:50 PM — Aerospace Applications and Energy Processes

Session 4C-P at Room 211

National Science Foundation

Generous financial support from

National Science Foundation (NSF)

is gratefully acknowledged.

This funding provided support for many students and early career faculty/ researchers to attend the conference.

ASTFE
American Society of Thermal and Fluids Engineers

7TH Thermal and Fluids Engineering Conference (Hybrid)

May 15 – 18, 2022
www.astfe.org/tfec2022/

All the times are in the US Pacific Time Zone

Sunday — May 15, 2022

Time	Session	Room
12:00 PM - 4:00 PM	Conference Registration	Ballroom A, B
1:00 PM - 3:00 PM	ASTFE Board of Directors meeting [CLOSED]	UNLV, Student Union room 205
3:00 PM - 4:00 PM	ASTFE Board of Directors meeting [OPEN]	
4:00 PM - 6:00 PM	Welcome Reception	Ballroom B

Monday — May 16, 2022

Time	Session	Room	Title	Author
8:00 AM - 8:30 AM	Welcome Address, Opening Remarks, Day 1 Announcements	Ballroom B		
8:30 AM - 9:30 AM	Plenary Lecture 1	Ballroom B	Can Our Models Be Validated?	**Dr. Patrick Roache** Consultant **Moderator: Darrell W. Pepper** University of Nevada
9:30 AM - 9:45 AM	Coffee break	Ballroom A		
9:45 AM - 10:35 AM	Keynote 1	Ballroom B	Detailed Heat Transfer Measurements for Rotating Turbulent Flows in Gas Turbine Systems	**Dr. Srinath Ekkad** North Carolina State University **Moderator: Nesrin Ozalp** Purdue University Northwest
10:45 AM - 11:35 AM	Keynote 2		Characterization of Lithium-Ion Cell Failures and Implications for Fire Safety	**Dr. Ofodike Ezekoye** The University of Texas at Austin **Moderator: Nesrin Ozalp** Purdue University Northwest
11:45 AM - 12:35 PM	Keynote 3		A solution to global warming, air pollution, and energy insecurity for 145 countries	**Dr. Mark Jacobson** Stanford University **Moderator: Nesrin Ozalp** Purdue University Northwest
12:45 PM - 2:30 PM	Luncheon	Ballroom A		
1:00 PM - 2:30 PM	TEC Talks	Ballroom B	Moving Clean Energy Technology from Lab to Market	**Dr. James Klausner** Michigan State University **Moderator: Nesrin Ozalp** Purdue University Northwest
			The CIA's Science & Technology Projects and Achievements at Area 51	**Dr. Thornton Barnes** CEO of Startel, Inc. **Moderator: Darrell W. Pepper** University of Nevada
			Impacts of Energy Transition	**Dr. Terri Pousard** HDR Engineering Inc. **Moderator: Nesrin Ozalp** Purdue University Northwest
			Building a Consulting Company – Successes & Failures	**Dr. Akshai K. Runchal** ACRi **Moderator: Darrell W. Pepper** University of Nevada
			Spacecraft Engineering: Designing Thermal Solutions for Different Orbits	**Dr. Columbia Mishra** Maxar Technologies Inc. **Moderator: Nesrin Ozalp** Purdue University Northwest
2:30 PM - 2:45 PM	Break	Ballroom A		

Time	Session	Room	Title	Author
Technical Session 1				
In-Person				
2:45 PM - 4:15 PM	**SESSION 1A-P** **Advanced Energy Systems** **Chair:** **Yi Zheng,** Northeastern University	Room 207	40642 - Numerical modeling of a propeller in air and water environments	Konstantin Matveev Washington State University
			40878 - On the stratification of density at supercritical liquid-like conditions	Leandro Magalhães University of Beira Interior
			40902 - Evaluation of optimal blade design and operation for horizontal axis wind turbine	Azadeh Sohrabi University at Buffalo
			40925 - Optimization Methods for Segmented Thermoelectric Generators	Shane Riley University of Pittsburgh
			43023 - Improved particle heat transfer by way of bimodal particle distributions for high temperature solar thermal energy	Todd Otanicar Boise State University
			41051 - Waste Heat Recovery via Thermoelectric Generation in a Natural Gas Engine: Numerical Modeling and Baseline Analysis	Ratnak Sok Waseda University
2:45 PM - 4:15 PM	**SESSION 1B-P** **Combustion, Fire and Fuels** **Chair:** **Chris Kobus,** Oakland University	Room 209	40810 - Numerical simulation of combusting flow in a pelletizing pilot furnace to investigate the flow pattern before the pellet bed	Masoud Darbandi Sharif University of Technology
			40826 - An experimental and modeling study of oxidation of hydrogen isotopes at trace concentrations	Randy Shurtz Sandia National Laboratories
			40622 - 3D modelling of combusttion for low calorific value fuels and natural gas including nox emission	Jobaidur Khan University at Buffalo
			40691 - Modelling Hypergolic Ignition of Triethylaluminium-Oxygen Mixture Using Detailed Chemical Kinetics	Neeraj Kumbhakarna Indian Institute of Technology Bombay, Mumbai, India.
2:45 PM - 4:15 PM	**SESSION 1C-P** **Flow and Heat Transfer in Biological Systems** **Chair:** **Titan Paul,** University of South Carolina Aiken	Room 211	40627 - Ocean biomass-based hybrid hydrogel for seawater desalination	Xiaojie Liu Northeastern University
			40670 - Compensating bumblebee flight aerodynamics due to wing wear	Munjal Shah University at Buffalo
			40844 - Computational analysis of oxygen transport in a liver-on-a-chip platform	Violeta Carvalho MEtRICs Research Center, University of Minho
			40905 - Analysis of the three-dimensional flow field during pronunciation of the fricative consonant	Tanvir Ahmed Clarkson University
			42971 - Analysis of an Injection-Jet Self-Powered Fontan Circulation to Drop Caval Pressure in a Failing Fontan	Ray Prather Arnold Palmer Hospital for Children
			43054 - Classroom Dispersion: Experiments and Simulations for Understanding Air Flow in Higher Education.	Andrew Rodriguez United States Military Academy
2:45 PM - 4:15 PM	**SESSION 1D-P** **Computational Methods/Tools in Thermal-Fluid Systems - I** **Chair:** **Craig Snoyeink,** University at Buffalo	Room 213	**Session Special Talk (Invited) - The Coming Revolution in CFD: Physics Informed Machine Learning**	**Dr. Akshai K. Runchal** **ACRi**
			40680 - Phase-Change Impes Foam - A CFD Solver for Phase-Change and Two-Phase Flow in Porous Media	Miffat Hasan University of Nevada Reno
			40915 - Combined-mode conduction/radiation heat transfer analysis based on discrete green's functions	Brian Vick Virginia Tech
			40923 - Modeling advanced energy systems using cyber-physical models	Kenneth Bryden Iowa State University
			40912 - Numerical investigation of enhanced air dehumidification applying dielectrophoresis principal of moist airflows	Maliha Yel Mahi Auburn University
Virtual				
2:45 PM - 4:15 PM	**SESSION 1A-V** **Computational Methods/Tools in Thermal-Fluid Systems - II** **Chair:** **Gayathri Shivkumar,** AbbVie Inc. USA		40293 - A Conjugate Nusselt Number Correlation for a Computer Central Processing Unit Cooler	Shuva Das Southern Illinois University Edwardsville
			40323 - Characterization of remaining effective stabilizer in a representative propellant geometry	Ken Blecker CCDC-AC
			40698 - Modeling conditions associated with topology changes in a fixed topology CFD model with particle flow application	Laurie Florio US ARMY DEVCOM-AC
			41152 - Applying an Artificial Neural Network to Model Intube Heat Transfer in Laminar Flow	Parimah Kazemi Heat Transfer Research, Inc.
			40962 - Numerical investigation of a novel curved magneto-hydrodynamic (MHD) micromixer	Marzieh Khezerloo The University of Newcastle
			40857 - Investigation of particle motion in porous media	Yusaku Abe Waseda university

Time	Session	Room	Title	Author
2:45 PM - 4:15 PM	**SESSION 1B-V** **Advanced Energy and Energy Storage Systems** **Chair:** **Kenneth Blecker,** Stevens Institute of Technology		40256 - An Investigation on the Effect of Window Tinting on Thermal Comfort inside Office Buildings	Mohamed Salem Australian University
			40646 - Numerical Analysis of the Performance of Atmospheric Water Harvesting System	Sarit Kumar Das Indian Institute of Technology Madras
			40737 - An inverse identification of the air mass flow rate distribution in the air channels of an air-PCM heat exchanger	Martin Zalesak Brno University of Technology
			40804 - Analysis of Dynamic Water transport in PEM Fuel Cell Gas Diffusion Layers Using Long Short Term Memory	Jingru Benner Western New England University
			40779 - Effect of air supply distribution on the performance of a small open top reburn gasifier	Zeba Naaz IIT-Delhi
			41000 - Reactor scale simulation of atomic layer deposition in a multi-wafer viscous flow reactor	Betelhiem Mengesha University of the District of Columbia
2:45 PM - 4:15 PM	**SESSION 1C-V** **Multiphase Flows-I** **Chair:** **Aziz Rahman,** Texas A&M University at Qatar		41083 - Numerical study for Erosion Prediction on a Ball control valve in a Gas Pipe using CFD code	Mohsen Hedayati College of North Atlantic - Qatar
			43022 - Oscillation dynamics of droplet's impact on solid surface: frequencies, damping and bouncing	Menghan Zhao Michigan Technological University
			41182 - Boiling flow simulations for DEBORA experiment using Eulerian CFD approach	Daniel Vlcek CTU in Prague
			40982 - Simulations of free bubble growth with a mechanistic interfacial mass transfer model	Giovanni Giustini Imperial College London
			41381 - Fluid Solid Interaction Modeling Development for Vertical Jet Impingement Erosion Studies	Mahyar Pourghadsemi The University of New Mexico
			40935 - Experimental Investigation of non-Darcy Flow in Compressible and Incompressible Flow Through Porous Media Around Perforation Tunnel	Abadelhalim Elsanoose Memorial University
2:45 PM - 4:15 PM	**SESSION 1D-V** **Computational Methods/Tools in Thermal-Fluid Systems - I** **Chair:** **S.A. Sherif,** University of Florida		42871 - Meshless Computations of Heat Conduction in Complex Geometries with Discontinuous Thermal Conductivities	Surya P. Vanka University of illinois at Urbana-Champaign
			42872 - Consistency and Convergence of a High Order Accurate Meshless Method for Solution of Incompressible Flows	Surya P. Vanka University of illinois at Urbana-Champaign
			41225 - Matrix Product State for Simulation of a Convection-Diffusion-Reaction Equation	Robert Pinkston University of Pittsburgh
			40936 - Falkner-Skan similarity flow solutions subject to wall curvature and passive scalar transport	Miguel A. Ramírez University of Puerto Rico-Mayaguez
			40951 - Effect of various sinusoidal wall temperatures on heat transfer characteristics	Emel Selamet Researcher
			40225 - HeatQuiz: An open-access framework for heat transfer education with game-based learning elements	Wilko Rohlfs University of Twente
4:15 PM - 4:30 PM	**Break**	**Ballroom A**		
Technical Session 2				
In-Person				
4:30 PM - 6:15 PM	**SESSION 2A-P** **Energy Storage Systems** **Chair:** **Craig Snoyeink,** University at Buffalo	Room 207	40895 - Analysis of Variable Heat Transfer Fluid Parameters in a Latent Heat Thermal Energy Storage Unit Enhanced by Fins	Saeed Tiari Gannon University
			40966 - Sorption thermal energy storage systems with embedded membranes for improved power density	Ikechukwu Okoh Michigan Technological University
			41892 - An Experimental and Numerical Study to Characterize Thermal Performance of a Tubular Solar Reactor for Long-Duration Energy Storage	Assad Al Sahlani Purdue University Northwest
			41027 - Effect of undelivered energy and dynamic demand on overall district energy system efficiency	Yong Tao Cleveland State University
			40809 - Role of Thermophoresis on Binary Phase-Change Materials for Thermal Energy Storage	Udit Sharma Michigan Technological University
			40674 - Natural leaf-guar-derived solar desalinator for efficient clean water generation	Yi Zheng Northeastern University

Time	Session	Room	Title	Author
4:30 PM - 6:15 PM	**SESSION 2B-P** **Electric, Magnetic, Flow and Thermal Phenomena in Micro and Nano-Scale Systems** **Chair:** **Todd Otanicar,** Boise State University	Room 209	40727 - Ultrahigh-rectification near-field radiative thermal diode using infrared-transparent film backsided phase-transition metasurface	Liu Yang Northeastern University
			42955 - Near-field radiative heat transfer between thin membranes	Livia Mantuano Correa University of Utah
			40792 - First-principles calculations of acoustic phonon tunneling between silicon surfaces	Takuro Tokunaga NHK International Corp.
			40726 - Dynamic tuning of near-field radiative transport between an overlapping pair of movable comb-like metamaterials	Liu Yang Northeastern University
			40631 - Harnessing Stretchable Elastomer for Tunable Optical Transmittance	Fangqi Chen Northeastern University
			40672 - Magnetic tuning of terahertz emissivity with InSb-based metamaterials	Andrew Caratenuto Northeastern University
			40630 - High-Performance Photothermal Conversion of Electrospun Polymer/ Carbon Composite Materials	Fangqi Chen Northeastern University
4:30 PM - 6:15 PM	**SESSION 2C-P** **Fluid Flow and Heat Transfer Multiphase Phenomena** **Chair:** **Prasanna Jayaramu,** New Mexico State University	Room 211	43055 - Thermal transport during impact and solidification of high weber number droplets on marine surfaces	Lisa Lam Memorial University of Newfoundland
			40963 - Dewatering of thin liquid-desiccant films constrained by a vapor venting membrane: role of solution and air transport conditions	Behnam Ahmadi Michigan Technological University
			40970 - Experimental study of heat transfer enhancement in wake regions of intermittent flow boiling	Xiang Zhang Penn State University
			40972 - Lateral migration of a melting particle in a vertical Poiseuille flow	Reza Kaviani University of Oklahoma
			40772 - Air-side heat transfer characteristics of a fin-and-tube heat exchanger coated with carbon nanotubes	Changho Han Korea University
			42838 - Conductive Heat Transfer in Architected Foams	Wilson Chiu University of Connecticut
4:30 PM - 6:15 PM	**SESSION 2D-P** **Micro/Macro Thermal and Fluid Systems Applications** **Chair:** **Chris Kobus,** Oakland University	Room 213	40812 - The effect of geometry and symmetries on near-field radiative heat transfer between dielectric nanoparticles	Lindsay Walter University of Utah
			40743 - A reduced order model for dynamic simulation of district heating networks	Mengting Jiang Eindhoven university of Technology
			43021 - Fluid Flow in Human Carotid Artery Bifurcation	Jun Zhou Penn State Erie, The Behrend College
			40917 - The CFD Simulation of Complex Tube Bundles; Special Focus on Turbulence Model Implementation	Gerald (Gerry) Schneider University of Waterloo
			40944 - The effect of Joule heating on the height rise of aqueous solutions between electrodes	Gaurav Anand University At Buffalo, SUNY
Virtual				
4:30 PM - 6:15 PM	**SESSION 2A-V** **Aerospace Applications** **Chair:** **Ravinder Yerram,** GE Gas Power		40879 - Characteristics of a Leading-edge Separated Shear Layer over a Bi-scaled Rough Surface	Ganesh K T SASTRA Deemed to be University
			41236 - Evaluation of Different Turbulence Models for an Internal Bounded Flow at Low Reynolds Number	Fardin Khalili Embry-Riddle Aeronautical University
			40832 - Direct numerical simulation on the drag reduction of turbulent flow over streamwise constant grooves	Yixiao Li South China Normal University
			40784 - Integrated Stage Cycle Analysis of an all LOX-LCH4 Indian Micro Launcher	Kiran Mohan LPSC, ISRO
			40789 - Aerothermal analysis of flow over a flat plate in atmospheric re-entry condition using dsmc method	KS Santhosh College of Engineering Trivandrum
			40791 - Heat transfer and entropy generation analysis Past a Blunt Headed Cylinder with corner modification	Ashish Pawar IIT Bombay
			40842 - Effects of Turbulence Models on Flutter Characteristics of the AGARD 445.6 Wing in Transonic Flow using Strongly Coupled Two-way Fluid-Structure Interaction	Amit Thawait Indian Institute of Technology Bombay

Time	Session	Room	Title	Author
4:30 PM - 6:15 PM	**SESSION 2B-V** **Combustion, Fire and Fuels** **Chair:** **Kazim Ayuzulu,** The University of New Orleans		42170 - Potential thermal fire hazard of smart phones and tablets in use and during battery-charging	Dick Fung Szeto The Hong Kong Polytechnic University
			40666 - A numerical study to determine the stretch-corrected laminar burning velocity for hydrogen flames using constant volume method	Vikas Jangir Indian Institute of Technology
			40690 - Investigation of organometallic additives for soot mitigation through droplet combustion experiments	Anand Sankaranarayanan Indian Institute of Technology Bombay
			41140 - Radiation modeling on methanol whirling flame	Naveen Kumar IIT Roorkee
			40704 - Effects of Burner Inlet Configurations on Combustion and Thermal Flow Characteristics	Myeong-Ki Jung Sungkyunkwan University
			41409 - Biomimicry: Fighting Fires With the Power of the Bombardier Beetle	Elijah Yoder Liberty University
			40745 - Design and experimental evaluation of hydraulic lift-off seal for a LOX-kerosene staged combustion cycle engine turbopump	Fahd Bin Abdul Hasis Liquid Propulsion Systems Centre, ISRO
4:30 PM - 6:15 PM	**SESSION 2C-V** **Flow and Heat Transfer in Biological Systems** **Chair:** **Eduardo Divo,** Embry-Riddle Aeronautical University		41184 - CFD simulation and Characterization of Coughs and sneezes: Airborne droplet transmission to humans during COVID 19	Nazia Afrin Assistant Professor
			41205 - Parametric analysis of the thermal ablation treatment of cardiac arrhythmia	Eber Dantas Federal University of Rio de Janeiro
			41235 - Fluid Dynamics of Bileaflet Mechanical Heart Valve Leaflets Opening And Closing Phases During Systole And Diastole	Fardin Khalili Embry-Riddle Aeronautical University
			41417 - Smart Atomization of Banana Puree in Pulsing Twin-Fluid Injector	Daniel Wilson Liberty University
			40920 - Development of a single-phase blood-mimicking fluid with the rheological properties of human blood	Ahmed Mahfouz Texas A&M University
			41192 - Thermal Image Applications in Estimation of Fruit Ripeness Level and Calculation of Human Body Heat Transfer Coefficients	Sathish Kumar Gurupatham Kennesaw State University
			40929 - Rheological Investigation of Asphalt Binder Modified with Aluminum Oxide nano Particles	Rahaf Homssi Texas A&M University at Qatar
4:30 PM - 6:15 PM	**SESSION 2D-V** **Analysis and Optimization of Thermal-Fluid Systems** **Chair:** **Khalil Khanafer,** Australian College of Kuwait		40872 - Thermal conductivity analysis of biomass reinforced composites	Birce Dikici Embry-Riddle Aeronautical University
			41429 - Rosette Nano-Structures and Analysis of Micro-Mixing Capabilities	Arianna Verbosky Liberty University
			41416 - A Novel HPC Scaling Optimization Methodology	Reid Prichard Liberty University
			40677 - Experimental Investigation of Gas Kick Behavior During Wellbore Shut-in	Chinemerem Obi Texas A&M University
			40865 - Analysis of thermal performance for supercritical fluid flowing in a microchannel heat sink utilizing internal fins	Nitesh Kumar IIT Guwahati
			41123 - Design and Development of Additively Manufactured Microchannel Heat Exchangers of Different Cross Sections and Aspect Ratios	Jiajun Xu University of the District of Columbia
			40802 - Volumetric flow measurement inside a water ladle model with Shake-The-Box system	Yun Liu Purdue University Northwest
6:15 PM - 6:30 PM	**Break**	**Ballroom A**		
6:30 PM - 7:30 PM	**Networking**	**Ballroom A, B**		

Tuesday — May 17, 2022

Time	Session	Room	Title	Author
8:00 AM - 8:15 AM	**Day 2 Announcements**	**Ballroom B**		
8:15 AM - 9:15 AM	**Plenary Lecture 2**	**Ballroom B**	**Tuning Phonon Transport: From Interfaces to Nanostructures**	**Dr. Pamela Norris** The George Washington University **Moderator: Nesrin Ozalp** Purdue University Northwest
9:15 AM - 9:30 AM	**Coffee break**	**Ballroom A**		
9:30 AM - 10:20 AM	**Technical Committees session** **Chairs:** **Nesrin Ozalp,** Purdue University Northwest **Wilson Chiu**, University of Connecticut	**Ballroom B**	**Energy and Sustainability – Chair: Wilson Chiu, Co-Chair: Lorenzo Cremaschi** **Natural and Built Environment – Chair: Sandra Boetcher, Co-Chair: SA Sherif** **Science, Research and Engineering Fundamentals and Methodology – Chair: Darrell Pepper, Co-Chair: Nesrin Ozalp** **Equipment: Design and Processes – Chair: Ahmad Fakheri, Co-Chair: TS Ravigururajan** **Education – Chair: Pratap Vanka, Co-Chair: Zenghui Zhao**	
10:30 AM - 11:20 AM	**Keynote 5**		**Sustainable Energy, Human Element and Complex Systems**	**Dr. Pinar Menguc** Ozyegin University, Istanbul **Moderator: Nesrin Ozalp** Purdue University Northwest
11:30 AM - 12:20 PM	**Keynote 6**		**Thermal Science and Engineering for the Water-Energy Nexus: From Desalination to Energy Storage and Personal Thermoregulation**	**Dr. Akanksha Menon** Georgia Institute of Technology **Moderator: Nesrin Ozalp** Purdue University Northwest
12:30 PM - 2:15 PM	**Lunch**	**Ballroom B**		
12:30 PM - 1:30 PM	**Invited Luncheon Talk**	**Ballroom B**	**History of the United States' Nuclear Weapons Testing Program**	**Dr. Joseph Kent** National Atomic Testing Museum **Moderator: Darrell W. Pepper** University of Nevada
1:30 PM - 2:15 PM	**Awards**	**Ballroom B**		
2:15 PM - 2:30 PM	**Break**	**Ballroom A**		
Technical Session 3				
In-Person				
2:30 PM - 4:00 PM	**SESSION 3A-P** **Combustion and Energy Systems** **Chair:** **Chris Kobus,** Oakland University	Room 207	**Session Special Talk (Invited) - High Intensity Distributed Combustion for Near Zero Emission and High Performance**	**Dr. Ashwani Gupta** **University of Maryland**
			42687 - Modeling on boiler and post-boiler equipment enhancement for pulverized coal-firing power plant applications	Kwangkook Jeong Arkansas State University
			40932 - Validating a Fire Simulation Tool with a Large-scale Helium Plume Dataset	Alexander Brown Sandia National Labs
			43061 - Numerical Analysis of Blue Energy Harvesting Under Extreme Conditions for Ocean Water Desalination	Hunter Pigg East Carolina University
			41231 - Feasibility of Waste Heat Capture, Storage, and Transportation for Utilization in Decentralized Produced Water Treatment	Brandi Grauberger Colorado State University
2:30 PM - 4:00 PM	**SESSION 3B-P** **Fluid Flow and Heat Transfer Multiphase Phenomena** **Chair:** **Prasanna Jayaramu,** New Mexico State University	Room 209	40825 - Effect of Packed Bed Geometry on the Performance of Direct Contact Cross Flow Condensers	Tan Xu Michigan State University
			43065 - Analytical Study of the Heat Transfer Characteristics under Supercritical Conditions	Kenneth Weddle College of Technology and Computer Science
			41334 - Development of an Approximate Deconvolution Method for chemical source modeling using high-order discretization schemes	Lena Caban Czestochowa University of Technology
			41379 - Inverse Heat Conduction Method to Estimate the unknown Surface Heat Flux during Quenching Process	Suresh Babu Gopalkrishna Institute of Fluid Dynamics and Thermodynamics - OVGU
			41592 - A Systematic Approach for the Optimization of Heat Exchanger Networks	Ahmad Fakheri Bradley University
2:30 PM - 4:00 PM	**SESSION 3C-P** **Fluid Flow and Heat Transfer in Industrial and Commercial Processes - II** **Chair:** **Titan Paul,** University of South Carolina Aiken	Room 211	40629 - Dynamically regulated radiative cooling with continuously variable emission	Xiaojie Liu Northeastern University
			41240 - Characteristics of Flows Driven by Two-Stage EHD Gas Pumps with Various Electrode Alignments	A K M Monayem Mazumder Saginaw Valley State University
			40964 - Performance characterization of ordered porous volumetric solar receivers	Rasoul Bayaniahangar Michigan Technological University
			40960 - Effect of surface texture on performance of liquid-desiccant-based air dehumidifiers	Masoud Ahmadi Michigan Technological University
			40913 - Simulations of a new plate heat exchangers for high-temperature and high-pressure applications	Sai Guruprasad Jakkala IIT Madras

Time	Session	Room	Title	Author
2:30 PM - 4:00 PM	**SESSION 3D-P** **Fundamentals in Fluid Flow and Heat/Mass and Momentum Transfer - II** **Chair:** **Assaad Al Sahlani,** Purdue University Northwest	Room 213	40788 - Dendritic network for passive water transportation	Xuewei Zhang Villanova University
			40999 - Toward a natural optimum	Yogesh Jaluria Rutgers University
			40969 - Characterization of laminar and turbulent supercritical carbon dioxide slot jet impingement heat transfer	Alex Rattner Pennsylvania State University
			40722 - Importance of turbulence model in accurate thermofluid prediction of flow through dimpled tubes	Gerald (Gerry) Schneider University of Waterloo
			40750 - Numerical approach to generate heat correlations for the flow through smooth and dimpled tubes	Gerald (Gerry) Schneider University of Waterloo
Virtual				
2:30 PM - 4:00 PM	**SESSION 3A-V** **Aerospace Applications** **Chair:** **Like Li,** Mississippi State University		41320 - A Numerical Analysis of Sweeping Air Jet Impingement Cooling from a Fluidic Oscillator	Ramy Abdelmaksoud University of New Orleans
			43052 - Effect of Passive Bleeding on Aerodynamics of a Non-slender Delta Wing in Ground Effect	Oğuzhan Yılmaz TOBB ETÜ
			40889 - Influence of hydrophobic surface on frictional drag	Yuxuan Li IVY Experimental School
			43074 - Electro-Thermo-Fluid Dynamic Modelling of Natural and Forced Convection Air Flow in Generator Circuit Breakers	Yanyan Huang Hitachi Energy
			40781 - Spreading dynamics of an electrically actuated water droplet over a hydrophobic surface	Supriya Upadhyay Indian Institute of Technology Kanpur
			41124 - Design and Development of a Smart Multilayer Coating with Variable Emissivity Capability for Spacecraft Thermal Control Systems	Jiajun Xu University of the District of Columbia
2:30 PM - 4:00 PM	**SESSION 3B-V** **Flow and Heat Transfer in Biological Systems** **Chair:** **Eduardo Divo,** Embry-Riddle Aeronautical University		41714 - Computational modeling of the interactions of thrombi as a deformable body	Fardin Khalili Embry-Riddle Aeronautical University
			42972 - Numerical Analysis of Free Forced Convective Flow with multiple slip effects through vertical cone containing Gyrotactic Microorganism	Nayema Islam Nima PhD Student
			40908 - On The Ejection Scale Problem of Expiratory Events from Theory and Simulations	Nadim Zgheib University of Florida
			40910 - A statistical approach to viral airborne risk assessment using high-fidelity simulations	Krishnaprasad Kalivelampatti Arumugam, University of Florida
			42110 - Multi-Objective Optimization of the LVAD Outflow Graft Orientation Aimed at Reducing Thrombolization using Multi-Scale Computational Fluid Dynamics Modeling	Alain Kassab University of Central Florida
			42938 - 3D numerical simulations of mixed convective heat transfer for a standing human body	Zubieda Alali Kansas State University
2:30 PM - 4:00 PM	**SESSION 3C-V** **Flow and Heat Transfer in Materials Processing Science and Manufacturing - I** **Chair:** **Ri Li,** University of British Columbia		40714 - Numerical dimensionless time of steady state heat transfer in an anisotropic cylindrical medium submitted to a lateral flux	Rabiaa Idmoussa Faculté des sciences aïn chock
			40800 - Thermal analysis of preform fabrication for Flow Mold Casting	Jingru Benner Western New England University
			40806 - Thermo-Viscoelastic Performance of a Liquid Metal Polymer Composite	Ashley Emery University of Washington
			41171 - Support vector regression based thermal performance assessment of photovoltaic panel	Vikas Kumar Malaviya National Institute of Technology Jaipur
			40921 - Simulation of Photo-Polymerization in Additive Manufacturing	Forooza Samadi Virginia Tech
			40673 - Microfabrication Of Multilayer Liquid Metal-Based Flexible Band-Pass Frequency Selective Surfaces	Arkadeep Mitra The University of Texas at Dallas
2:30 PM - 4:00 PM	**SESSION 3D-V** **Fundamentals in Fluid Flow and Heat/Mass and Momentum Transfer - I** **Chair:** **Khalil Khanafer,** Australian College of Kuwait		40236 - Fluid dynamics and Heat transfer from nine square prisms in square array	Zhanying Zheng Harbin Institute of Technology
			40348 - Turbulent heat transfer from short cylinders positioned parallel to uniform flow	Majid Molki Southern Illinois University Edwardsville
			40904 - Numerical investigation of inclined liquid jet under cross flow	Robin Kumar IIT Jodhpur
			40464 - Entropy generation in transient conduction-radiation heat transfer in a radiatively participating medium	Shashikant Cholake BLDEACET Bijapur
			41275 - Large Eddy Simulation study of Aluminum Smelting process using OpenFOAM	Nithin S Panicker Oak Ridge National Lab
			40881 - Numerical modeling of freezing water droplets	Andre Silva Universidade da Beira Interior

Time	Session	Room	Title	Author
4:00 PM - 4:10 PM	**Break**	**Ballroom A**		
4:10 PM - 5:10 PM	**Plenary Lecture 3**	**Ballroom B**	**Exploring the needs and potential for heat transfer fluids of tomorrow**	**Dr. Peter De Bock** Advanced Research Projects Agency-Energy **Moderator: Ankur Jain** The University of Texas at Arlington
5:10 PM - 5:20 PM	**Break**	**Ballroom A**		
		Technical Session 4		
		In-Person		
5:20 PM - 6:50 PM	**SESSION 4A-P** **Flow and Heat Transfer in Materials Processing Science and Manufacturing** **Chairs:** **J.R. Mahan,** Virginia Tech **Shima Hajimirza,** Stevens Institute of Technology	Room 207	43851 - Energy Flow Modeling the US Manufacturing Industries	Ifeatu Ezenwe Purdue University Northwest
			43024 - Laser-assisted energy manufacturing	David Hwang State University of New York at Stony Brook
			40771 - Study on the boiling characteristics of novel cooling channel with additive manufacturing	Sewon Lee Ph.D Course
			41066 - Development and Investigation of an Additively Manufactured Heat Pipe	Jason Durfee Magna International
			40998 - Off-Specular Reflection from Multilayer Gold-Black Coatings	J.R. Mahan Virginia Tech Department of Mechanical Engineering
			41778 - Heat transfer surfaces made of polymeric hollow fibers - features and utilization	Miroslav Raudensky Brno University of Technology
5:20 PM - 6:50 PM	**SESSION 4B-P** **Fundamentals in Fluid Flow and Heat/Mass and Momentum Transfer - I** **Chair:** **Todd Otanicar,** Colorado State University	Room 209	41593 - Flow in Branching Pipes	Ahmad Fakheri Bradley University
			41299 - Directional dependency of thermal and salinity gradients in double diffusive convection	Ila Thakur IIT Bombay
			42114 - High Leading Edge Film Cooling Blowing Ratio Effect on the Main stream Flow in a Linear Vane Cascade	Adeola Shote Olabisi Onabanjo University
			43064 - Poroelastic Vocal Fold Modeling	Cooper Thacker Brigham Young University
			40715 - Analyzing indoor pathogen dispersion and ventilation strategies to reduce the risk of coronavirus infection	Vedant Joshi University at Buffalo
			40579 - Weakly nonlinear solutions for a thermal convective flow in a porous layer with variable permeability	Dambaru Bhatta UTRGV
5:20 PM - 6:50 PM	**SESSION 4C-P** **Aerospace Applications and Energy Processes** **Chair:** **Matthew Barry,** University of Pittsburgh	Room 211	**Session Special Talk (Invited) - Simulating Hypersonic Heat: How Can We Improve our Models and Methods?**	**Dr. Russ Cummings** **HSVI, U.S. Air Force Academy**
			43029 - Heat transfer analysis in hypersonic flow over compression corner	Sogol Pirbastami University of Nevada
			41153 - Redwire's thermal control solutions for spacecraft thermal management	Jacob Moulton Private company
			40927 - Mathematical Modeling of a Thermoelectric Generator Unicouple	Sarah Wielgosz University of Pittsburgh
			40933 - Distributed GPU-accelerated Ray-tracing for Determination of Radiation View Factors using CUDA	Matthew Barry University of Pittsburgh
5:20 PM - 6:50 PM	**SESSION 4D-P** **Thermal and Energy Systems** **Chair:** **Darrell Pepper,** University of Nevada	Room 213	43198 - CFD Characterization of a Carbonized Microvascular Solar Receiver	Matt Zuzelski Boise State University
			41218 - Numerical simulations of the effect of different catalysts in a Sabatier micro channel reactor	Vinay Chandraker Indian Institute of Technology Bombay
			40984 - Ceramic 3D-printed heat exchangers for high-temperature heat recovery	Behzad Ahmadi Michigan Technological University
			42956 - Impacts of temperature aging and thermal losses on the performance of a Pyromark-coated central solar receiver	Katie Bezdjian University of Utah
			40446 - Application of thermal and cavitation effects for heat and mass transfer process intensification in multicomponent liquid media	Anatoliy Pavlenko Kielce University of Technology
			43015 - Extraction of High-Grade Heat from Long Duration Solid-State Solar Fuel	Michael Hayes Michigan State University

Time	Session	Room	Title	Author
			Virtual	
5:20 PM - 6:50 PM	**SESSION 4A-V** **Fundamentals in Fluid Flow and Heat/Mass and Momentum Transfer - II** **Chair:** **Kenneth Belcker,** Stevens Institute of Technology		41148 - Numerical investigation of viscous losses in pin array stack in oscillatory flows	Armando Di Meglio Università degli Studi di Napoli
			41226 - A Numerical Study of Natural Convective Heat Transfer across a Horizontal Rectangular Enclosure with an Inclined Cooled Upper Surface	Patrick H Oosthuizen Queen's University
			41390 - Numerical Study of Steady and Unsteady Turbulent Mixed Convection in Shear Driven Cavity Flow	Kazim Akyuzlu University of New Orleans
			41084 - Parametric study on heat transfer enhancement from flow past a heated grooved cylinder via Taguchi method	Javad Farrokhi Derakhshandeh AUM
			41277 - Numerical Simulation of a Two-phase Flow Mixer for Liquid Metal Magnetohydrodynamic Generator	Hulin Huang Nanjing University of Aeronautics and Astronautics
			40891 - Numerical Study on the Breakup of non-Newtonian/Newtonain Compound Droplet	Krishna Kant Indian Institute of Technology Hyderabad
5:20 PM - 6:50 PM	**SESSION 4B-V** **Fluid Flow and Heat Transfer Multiphase Phenomena** **Chair:** **Like Li,** Mississippi State University		40931 - Frost Deposition in Turbulent Flow over a Cold Plate using Direct Numerical Simulation	S.A. Sherif University of Florida
			41371 - Numerical studies on the drag coefficient of a condensing ellipsoidal bubble	Sampath Bharadwaj Kota Indian Institute of Technology-Madras
			40942 - Steady State Multiphase Modeling of Heat and Mass Transfer Inside Transport Membrane Condenser	Cheng-Xian Lin Florida International University
			41478 - Corona discharge enhanced condensation in the presence of non-condensable gas	Tian Ye Chongqing University
			40846 - Electric Redesign of Wastewater Evaporators Using Porous Carbon Material to Minimize Heat Loss During Evaporation	Abdel Rahman Zaro Undergraduate Researcher
			41224 - Modeling of Liquid Jet Impingement Heat Transfer on a Rotating Disk: Moving Reference Frame Versus Moving Mesh	Corey Klinkhamer University of Windsor
5:20 PM - 6:50 PM	**SESSION 4C-V** **Solar Energy Equipment and Processes** **Chair:** **Apurv Kumar,** Federation University		40685 - Deposition and sintering of semiconductor layer for photovoltaic applications	Harshini Vasudevanallur Subramanian Bradley University
			40678 - 3-Stage Control of a Variable-Refrigerant-Flow Heat Pump for Solar Domestic Hot Water Applications	Julian Howarth University of Waterloo
			40790 - Investigation of improved heat and mass transfer in a low thermal inertia type solar still	Pankaj Kumar Srivastava Rewa Engineering College, Rewa (M.P.)
			42831 - Solar collector tube with high-efficiency heat collection and heat preservation properties based on microcapsules	Kuan Zhao Shanghai Polytechnic University
			40839 - Transient modelling of three zone heat extraction from a salt gradient solar pond	Sunirmit Verma IIT Ropar
			41214 - Solar thermal energy storage with phase change material for domestic active space heating	Pushpendra Kumar Shukla IIT Mandi
5:20 PM - 6:50 PM	**SESSION 4D-V** **Fundamentals in Fluid Flow and Heat/Mass and Momentum Transfer - III** **Chair:** **Gayathri Shivkumar,** AbbVie Inc.		40874 - Theoretical Modelling of Miniature Loop Heat Pipe	Chandan Nashine IIT Guwahati
			40867 - Thermodynamic approach to determine the hydraulic and thermal losses in fluid flow through triangular miniature channels	Rohit Kumar Research Scholar
			42986 - Numerical simulation on atomization characteristics of supercritical coal water slurry	Chuan Zhang Xi'an Jiaotong University
			40861 - Evaporation and Micro Explosion of Dodecane –Water Emulsion Droplets	P Vinod Kumar Naidu IIT Tirupati
			41383 - Passive Temperature Reduction Techniques in Electric Vehicle Batteries	Sohail Zaidi San Jose State University
			Numerical Study of Soret and Dufour Effects on Hybrid Nano- Fluid over a Rotating Sheet	Bandari Shanker CVR College of Engineering
6:50 PM - 7:00 PM	**Break**	**Ballroom A**		
7:00 PM - 7:30 PM	**Networking**	**Ballroom A, B**		

Wednesday — May 18, 2022

Time	Session	Room	Title	Author
8:00 AM - 8:15 AM	Day 3 Announcements	Ballroom B		
8:15 AM - 9:15 AM	Plenary Lecture 4	Ballroom B	Engineering a Post-Corona Future: Some (Not so Wild?) Speculations	**Dr. Jayathi Murthy** Ronald and Valerie Sugar Dean Henry Samueli School of Engineering and Applied Science Distinguished Professor, Department of Mechanical and Aerospace Engineering, University of California - Los Angeles **Moderator: Nesrin Ozalp** Purdue University Northwest
9:15 AM - 9:30 AM	Coffee break	Ballroom A		
9:30 AM - 10:20 AM	Keynote 7	Ballroom B	Advances on Internal flow aerodynamics for revolutionary turbines	**Dr. Guillermo Paniagua** Purdue University West Lafayette **Moderator: Nesrin Ozalp** Purdue University Northwest
10:30 AM - 11:20 AM	Keynote 8		Developing the Next Generation of Concentrating Solar-thermal Power	**Dr. Matthew Bauer** U.S. Department of Energy (DOE) **Moderator: Krishna Kota** New Mexico State University
11:30 AM - 12:20 PM	Keynote 9		Energy-efficient ventilation for healthy and sustainable buildings	**Dr. Carey Simonson** College of Engineering, University of Saskatchewan, Saskatoon Canada **Moderator: Yong Tao** Cleveland State University
12:30 PM - 2:15 PM	Coffee break	Ballroom A		
12:45 PM - 2:15 PM	Panel on Multiphase CFD: Risks, Rewards, and Remorse	Ballroom B	**Panelists:** **Drs. Wayne Strasser, Yassin Hassan, Marcus Herrmann, Keith Walters, Stephane Zaleski, Lei Zhao** **Moderator: Wayne Strasser,** Liberty University	
2:15 PM - 2:30 PM	Coffee break	Ballroom A		
Technical Session 5				
In-Person				
2:30 PM - 4:00 PM	**SESSION 5A-P** **Heat/Mass Transfer Enhancement Techniques-II** **Chairs:** **Shima Hajimirza,** Stevens Institute of Technology **J.R. Mahan,** Virginia Tech	Room 211	41167 - CFD prediction of turbulent convective heat transfer in additive manufactured rough channels	Mohammadreza Kadivar Institution of Technology Sligo
			40965 - Air gap membrane distillation systems with a tuned thermal conductivity	Shiying Cai Michigan Technological University
			41330 - Computational analysis of diffusion flames around various shape conical bluff-bodies	Agnieszka Wawrzak Czestochowa University of Technology
			41146 - Corona wind assisted evaporation enhancement of heavy hydrocarbon evaporating from microliter well cavity	Digvijay Shukla IIT Kanpur
			41702 - Degassing Dissolved Oxygen Through Bubbles under a Vacuum Condition	Yong-Du Jun Kongju National University
			41628 - Theoretical Design Framework for a Cryogenic Heat Recuperator	Prasanna Jayaramu New Mexico State University
2:30 PM - 4:00 PM	**SESSION 5B-P** **Energy and Sustainability - II** **Chair:** **Assaad Al Sahlani,** Purdue University Northwest	Room 218	40919 - A verification of energy savings in air compressors under load/unload conditions through receiver storage	Miles Nevills TnTech IAC
			40858 - Energy Efficiency Improvement of Compressed Air Systems through Accurate Leak Flow Measurement utilizing Acoustic Imaging Technology	Patrick Swiecichowski Tennessee Technological University
			40796 - Energy and Water, no Carbon: Integrated Nuclear Power and Large-scale Desalination at Diablo Canyon	Andrew Bouma Massachusetts Institute of Technology
			41230 - Energy Efficiency Study for Two-Story House Using Thermal Network Model	Amy Chang High School Student
			41234 - Feasibility and performance of commercial small-scale Organic Rankine Cycle (ORC) systems using modern working fluids: A case study based on two co-generation installations	Joakim Wren Linkoping University
			40668 - A Study of Cogeneration Combined Steam Turbine Power Plant With Absorption Chiller of HVAC	Yongjian Gu US Merchant Academy

Time	Session	Room	Title	Author
			Virtual	
2:30 PM - 4:00 PM	**SESSION 5A-V** **Multiphase Flows-II** **Chair:** **Aziz Rahman,** Texas A&M University		40445 - Sublimation of naphthalene spheres in a natural convection environment	William Janna University of Memphis
			40653 - Numerical analysis of multiphase flow of the aeration process in an aerated pond	Luis Velazquez Araque University of Guayaquil
			40736 - Computational study of force balance during nucleate boiling	Yohei Sato Paul Scherrer Institute
			40748 - Bubble Manipulation by Surface Wettability Pattern and Its Application in Pool Boiling	Yakang Xia The University of British Columbia
			42926 - Heat Transfer Coefficient Correlation for Lance & Offset Fin of a Compact Heat Exchanger for R1234yf using CFD Analysis	Sankaraiah Mada Aeronautical Development Agency
			41237 - Experimental Study on Flow Boiling Enhancement via Micro-Porous Structured Sidewalls in Silicon-based Microchannels	Kai Luo University of South Carolina
2:30 PM - 4:00 PM	**SESSION 5B-V** **Nano and Micro Fluids Applications** **Chair:** **Saeid Vafaei,** Bradley University		40892 - Advances of nanofluid in thermophysical properties – A review	Macduff Mahiyani Khoza Tshwane University of Technology
			41595 - Nanofluid thermal conductivity: Effects of nanofluid characteristics	Joshua Beck Bradley University
			43008 - Direct numerical simulation of interphase momentum, heat, and mass transfer in supercritical water gasification of coal	Zhisong Ou Xi'an Jiaotong University
			40937 - Prediction of nanofluid thermal conductivity	Joshua Beck Bradley University
			40888 - Effect of non-Newtonian Rheology on Bag Breakup at Different Liquid to Gas Density Ratios	Krishna Kant Indian Institute of Technology Hyderabad
			41177 - The effect of surfactant on stability and thermophysical properties of aluminium doped zinc oxide-based hybrid nanofluid	Zafar Said University of Sharjah
2:30 PM - 4:00 PM	**SESSION 5C-V** **Experimental Methods/Tools and Instrumentation in Fluid Mechanics and Heat/Mass Transfer** **Chair:** **Hamed Abedini,** Katholieke Universiteit Leuven		41362 - A CFD solver based on the lattice Boltzmann method to solve thermally driven flows and coupled molecular gas radiation: comparison and validation against a benchmark solution	Félix Schmitt Univ Lyon, INSA Lyon, CNRS, CETHIL
			40805 - Thermal conductivity of liquids measured with the transient hot-wire technique	Sofia Mylona Thermtest Inc.
			41156 - Calculation of interfacial thermal resistance in equilibrium and non-equilibrium conditions by using molecular dynamics simulations	Xingyu Zhang Osaka University
			41157 - A spectral analysis of relationships between overall and local thermal transport across nanostructured solid-liquid interfaces	Kunio Fujiwara Osaka University
			42990 - Optimal Design of Supercritical Water Gasification Reactor by a Novel Mathematical Modeling	Jialing Xu Xi'an Jiaotong University
			40883 - Wind Turbine Performance: Hands-on Projects for Clean Energy Systems Course	Birce Dikici Embry-Riddle Aeronautical University
2:30 PM - 4:00 PM	**SESSION 5D-V** **Experimental Methods/Tools and Instrumentation in Fluid Mechanics and Heat/Mass Transfer - I** **Chair:** **S.A. Sherif,** University of Florida		40900 - Comparison and Uncertainty Quantification of Wind-tunnel Measured Roof Pressure in the NIST and TPU Aerodynamic Databases	Erick Shelley Cleveland State University
			40527 - The frequency variation of particle oscillations due to temperature of liquid in spontaneous dispersion	Sathish Kumar Gurupatham Kennesaw State Univeristy
			41211 - Spectroscopic and pyrometric temperature measurements of heated Type B and S thermocouples	Yuan Yao Northeastern University
			41272 - Experimental investigation of dynamic permeability in oscillating flows	Elio Di Giulio University of Naples
			40732 - Sensor Selection Algorithm for Post Processing of PSP Data using Digital Annealer	Tomoki Inoue Waseda University
			42802 - The overlooked and hidden mechanism inside the hydraulic system curve spawns a new framework in flow network analysis	Victor Manuel Soto Frances Universitat Politècnica de València
4:00 PM - 4:15 PM	**Break**	**Ballroom A**		
			Technical Session 6	
			In-Person	
4:15 PM - 5:45 PM	**SESSION 6A-P** **Experimental Methods/Tools and Instrumentation in Fluid Mechanics and Heat/Mass Transfer -II** **Chair:** **Matthew Barry,** University of Pittsburgh	Room 211	40940 - Classifying Thermal Conductivity of Fluids with Artificial Neural Networks	Andrew Jarrett University of North Texas
			40987 - Flow Induced by a Two Stage EHD Gas Pump with Uneven Applied Voltages	A.K.M Monayem Mazumder Saginaw Valley State University
			40922 - Calculation of Radiation Distribution Factors from Geometrical Factors	J.R. Mahan Virginia Tech
			40794 - Characterization Methods for Biomass Materials and Optimizing Heat Transfer by using Genetic Algorithms (GA)	Hussein Saad Embry-Riddle Aeronautical University
			40708 - Integration of Computational Fluid Dynamics into an Introductory Fluid Mechanics Course	Samantha Wismer University of Pittsburgh
			40819 - Incorporate engineering equation solver (ees) in themal-fluid courses	Liyong Sun Penn State Erie

Time	Session	Room	Title	Author
4:15 PM - 5:45 PM	**SESSION 6B-P** **Multiphase Flows, Nano and Microfluids** **Chair:** **Assaad Al Sahlani,** Purdue University Northwest	Room 218	40786 - The Influence of Liquid Film Thickness on Crown Development: Crown Sheet Angle	Daniela Ribeiro AEROG - Universidade da Beira Interior
			40752 - Characterization of dropwise condensation shedding kinematics using different surface coatings in microgravity	Roger Kempers York University
			41195 - Nanoparticle Size Effect on Stability of Ionic Liquids (ILs) Based Nanofluids	Anna Hawcroft University of South Carolina - Aiken
			41289 - Conformal maps for thermal slip accounting for large meniscus curvature between parallel ridges	Lisa Lam Memorial University of Newfoundland
			40896 - Developing an auxiliary cooling system in a pelletizing plant using the capacity of an available process fan	Masoud Darbandi Sharif University of Technology
			40853 - Validation of A Dynamic Model for Cooling Tower Energy Efficiency Analysis	Spencer Jones Tennessee Tech University
Virtual				
4:15 PM - 5:45 PM	**Session 6A-V** **Heat/Mass Transfer Enhancement Techniques-I** **Chair:** **Khalil Khanafer,** Australian College of Kuwait		42958 - Enhancement of heat and mass transfer using aerogels for efficient adsorption heat pumps	Duckjong Kim Gyeongsang National University
			43002 - PCM based heat sinks for transient passive cooling of an electronic device with localized power generation	Elad Koronio Ben-Gurion University
			43036 - Experimental investigation of PCM melting in a vertical capsule	Tomer Shockner BGU
			41406 - Reducing Computational Cost of Industrial CFD Through Nonlinear Control Methods	Eric Turman Liberty University
			41227 - Improving the Heat Pipe Performance by Sustainable Dropwise Condensation	Kai Luo University of South Carolina
			42608 - Experimental study of pressure drop of two-phasegas-liquid flows through singularities	Lucas Mello Universidade Estadual de Campinas
4:15 PM - 5:45 PM	**Session 6B-V** **Refrigeration, Air conditioning systems and Multiphase Flows** **Chair:** **Laurie Florio,** US ARMY DEVCOM-AC		40503 - Heating load calculations in a multi-storied educational building	Aneesha Gogineni Saginaw Valley State University
			40869 - Comparative performance assessment of multi-stage absorption air-conditioning under warm-humid climate	Gaurav Singh IIT, Ropar
			41360 - The effect of dewar operating pressure on the thermal performance of liquid nitrogen cooled cryoprobe	Anish Gunjal IIT, Bombay
			42774 - The effects of machine room air-cooled cooling unit layout on the condensing heat exhaust performance	Yew Khoy Chuah National Taipei University of Technology
			40773 - Cavitation Effects on Bubble Breakup Characteristics in a Venturi Tube	Noor Saffreena Hamdan University of Tsukuba
			41165 - Modelling and simulating the microclimate of a modular plant growth chamber designed for indoor farming	Jonathan Hey A*STAR, Singapore
4:15 PM - 5:45 PM	**Session 6C-V** **Energy and Sustainability - II** **Chair:** **Ravinder Yerram,** GE Gas Power		41190 - Numerical simulation of the flow generated by the discharge of a sewage pipe to a canal of a sewer system	Luis Velazquez Araque University of Guayaquil
			40893 - Economic Viability of Thermal Energy Storage to Support Flexible Operation of Natural Gas Power Plants with Carbon Capture	Braden J. Limb Colorado State University
			40977 - Ligand-Assisted Low-Temperature Growth of SnO2 Nanoaggregates	Harshini Vasudevanallur Subramanian Bradley University
			41241 - Methodology of Reliable Startup of Oscillation Heat Pipe	Hiroki Nagai Institute of Fluid Science, Tohoku University
			40854 - Development of Ignition Pellets for Biomass Cookstoves	Manish Gupta IIT Delhi
			41006 - Modeling of the Flash Hydrolysis of Algae for Biofuel Production	Noah LeGrand Old Dominion University
4:15 PM - 5:45 PM	**Session 6D-V** **Fundamentals in Fluid Flow and Heat/Mass and Momentum Transfer - IV** **Chair:** **Apurv Kumar,** Federation University		40939 - Numerical study of yaw angle and Reynolds number effects on the aerodynamic characteristics of a road vehicle	Maziar Mosavati The University of Windsor
			40934 - Effects of inter-vehicle spacing on the flow structure around two in-line Ahmed bodies	Maziar Mosavati The University of Windsor
			41350 - Experimental investigation of the effect of viscosity of Newtonian blood analog fluids in physiological flows described by Womersley solution	Kartik Bulusu The George Washington University
			40491 - Understanding the influence of the pressure disturbance on the transition of stratified flow to slug flow	Cheng-Xian (Charlie) Lin Florida International University
			40647 - Numerical Investigation of Photothermal Membrane Distillation	Sarit Kumar Das IIT Madras
			40828 - Radiation analysis of a particle curtain using polydisperse particle size Eulerian granular CFD modelling	Apurv Kumar Federation University
5:45 PM - 6:00 PM	**Break**	**Ballroom A**		
6:00 PM - 6:30 PM	**Closing Ceremony**	**Ballroom B**		

Conference Program

7TH THERMAL AND FLUIDS ENGINEERING CONFERENCE (HYBRID)

May 15–18, 2022

www.astfe.org/tfec2022/

UPCOMING CONFERENCES

The International Symposium on Convective Heat and Mass Transfer, CONV-22

Izmir, Turkey
June 5 – 10, 2022

16th International Conference on Heat Transfer, Fluid Mechanics and Thermodynamics and Editorial Board Of Applied Thermal Engineering

Amsterdam, Netherlands
August 8 – 10, 2022

8th Thermal and Fluids Engineering Conference, TFEC-2023

University of Maryland, College Park, MD
May, 2023

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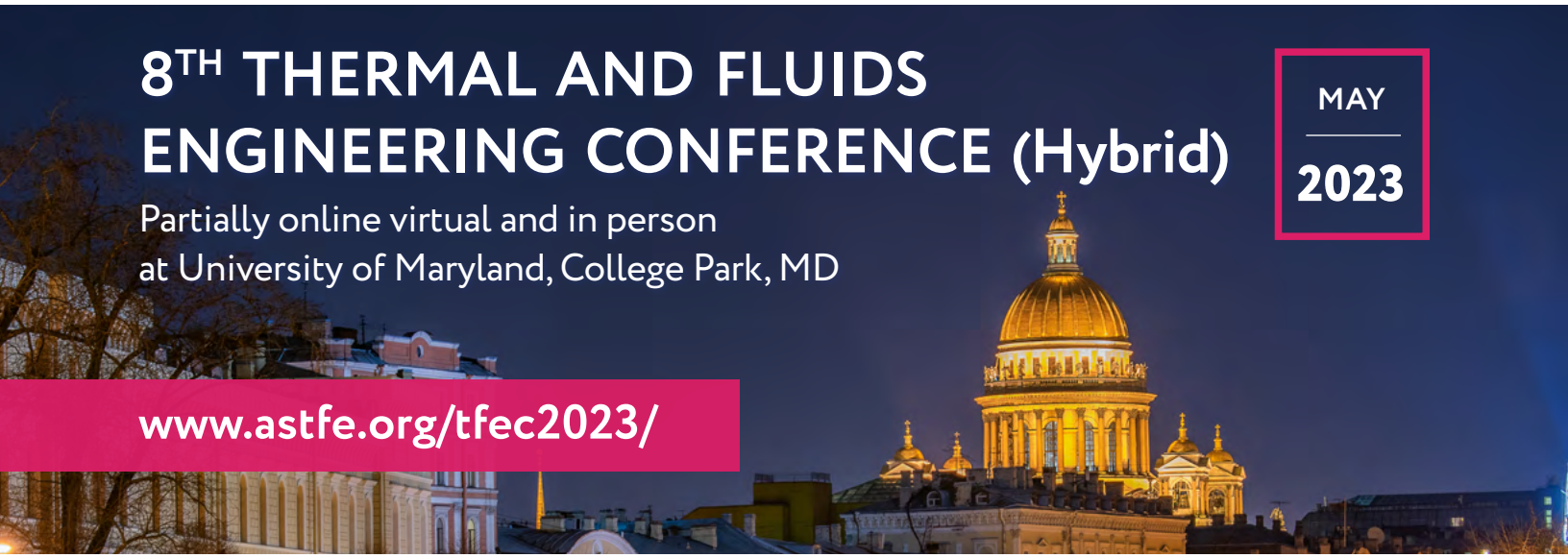

8TH THERMAL AND FLUIDS ENGINEERING CONFERENCE (Hybrid)

MAY 2023

Partially online virtual and in person
at University of Maryland, College Park, MD

www.astfe.org/tfec2023/

The 2023 American Society of Thermal and Fluids Engineers (ASTFE) Conference (Hybrid) will be held in May 2023 partially online virtual and in person at University of Maryland, College Park, MD, USA. ASTFE is the premier international society by and for professionals within the thermal and fluids science and engineering community. The 2023 ASTFE conference, TFEC 2023 provides an international forum for the dissemination of the latest research and knowledge in the thermal and fluid sciences. Authors are invited to submit abstracts covering, but not limited to, the following areas:

- Advanced Energy Systems
- Aerospace Applications
- Atomization
- Combustion, Fire and Fuels
- Computational Methods/Tools in Thermal-Fluid Systems
- Cryogenics
- Electric, Magnetic, Flow and Thermal Phenomena in Micro and Nano-Scale Systems
- Energy and Sustainability
- Energy Storage Systems
- Energy-Water-Food Nexus
- Engineering Equipment and Environmental Systems
- Engineering Fundamentals and Methodology
- Experimental Methods/Tools and Instrumentation in Fluid Mechanics and Heat/Mass Transfer
- Flow and Heat Transfer in Biological Systems
- Flow and Heat Transfer in Materials Processing Science and Manufacturing
- Flow in Internal Multiphase Flows
- Flow Instability
- Fluid Flow and Heat Transfer in Industrial and Commercial Processes
- Fluid Flow and Heat Transfer Multiphase Phenomena
- Fluid Measurements and Instrumentation
- Fluid Mechanics and Rheology of Nonlinear Materials and Complex Fluids
- Fuel Cells
- Fundamentals in Fluid Flow and Heat/Mass and Momentum Transfer
- Heat Exchangers: Compact, Novel, Networks
- Heat Pipes
- Heat Pumps
- Heat/Mass Transfer Enhancement Techniques
- Industry Problems: CO2 Capture
- Material Issues, Ceramics, Low Thermal Conductivity
- Measurement and Modeling of Environmental Flows
- Multiphase Flows
- Nano and Micro Fluids Applications
- Natural and Built Environments
- Plasma Physics and Engineering
- Refrigeration, Air Conditioning Systems, and Refrigerants
- Solar Energy Equipment and Processes
- Thermo-economic Analysis of Energy Systems
- Thermo-Fluid Education
- Transportation
- Turbulent Flows
- Wind Turbines Aerodynamics and Control

Authors will have options to present their research work as presentation only, extended abstract (maximum of 4 pages), or full-length paper (5-10 pages). The conference proceedings will contain both peer-reviewed extended abstracts and papers, and will be distributed in a digital form, the ASTFE Digital Library. Authors will also have the option to submit their full conference papers to a technical journal of their choice after the conference. The full conference papers should have significant changes made before submitting to any journals. The same full conference papers cannot be submitted to any journal publications. Authors may share their original manuscripts with the public but must include a citation and a link to the published paper (conference paper or journal paper).

SUBMIT YOUR PAPER ABSTRACT BY SEPTEMBER 17, 2022 TO: http://submission.astfe.org

Please check http://astfe.org/tfec2023/ regularly for conference updates or contact any member of the organizing committee for further inquiries.

DEADLINES

September 17, 2022
Abstract Due

September 27, 2022
Notification of Abstract Accept / Decline

October 21, 2022
Draft Paper / Extended Abstract Due

November 11, 2022
Draft Paper / Extended Abstract Reviews Completed

December 16, 2022
Authors Notified of Paper / Abstract Status

January 31, 2023
Revised Manuscript Due

January 31, 2023
Presentations Only Abstracts Deadline / Final Paper / Extended Abstract Due

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