

# ASME 2016 HT/FE/ICNMM

Heat Transfer, Fluids Engineering, & Nanochannels,  
Microchannels, and Minichannels Conferences

CONFERENCE  
July 10–14, 2016

Hyatt Regency Washington on  
Capitol Hill, Washington, DC

# Program



# Welcome from the Chairs

On behalf of the three organizing committees of the ASME 2016 Heat Transfer, Fluids Engineering, and Nano-, Micro- and Mini-channels Conference (HT/FE/ICNMM2016), we welcome you to Washington, D.C., USA. We are excited to have your participation in the HT/FE/ICNMM Conference; which is a co-location of the traditional Fluids Engineering Division Summer Meeting (FEDSM), Summer Heat Transfer Conference (SHTC), and the 14th International Conference of Nanochannels, Microchannels, and Minichannels Conference (ICNMM). These co-located conferences are hosted by two ASME divisions, Heat Transfer Division and Fluids Engineering Division. Along with FEDSM2016, special events to celebrate FED 90th Anniversary are also planned.

The co-location of these conferences has attracted considerable interest and participation. The technical program consists of 423 papers and 828 presentations; with participation of more than 2,000 authors from close to 50 countries. Additionally, there are nine plenary lectures; five distinguished speakers from each of the Fluids Engineering Division, Heat Transfer Division, and ICNMM.

The FEDSM plenary Speakers include: Dr. Patrick J. Roache, Fluids Engineering Award recipient, Consultant; Prof. Mohamed Gad-El-Hak, Virginia Commonwealth University, Dr. Joseph T. Arcano, Jr., Naval Surface Warfare Center, Carderock Division, and Prof. Goodarz Ahmadi, Freeman Scholar Award recipient, Clarkson University, Potsdam, NY; In addition, Dr. William Morgan, former Head of the Hydromechanics Directorate at the US Navy David Taylor Model Basin, will give the FED 90th anniversary history lecture. Dr. Dan Mote, Jr., President of National Academy of Engineering will provide an introduction about NAE.

The SHTC plenary speakers include: Professor Vijay K. Dhir, Dean of Engineering and Professor, Mechanical Engineering, University of California, Los Angeles (UCLA); Professor C. Thomas Avedisian, Cornell University; and Arun Majumdar, Jay Precourt Professor, Department of Mechanical Engineering, Stanford University.

The ICNMM plenary speakers include: Prof. Narayana Aluru, Richard W. Kritzer Distinguished Professor in Mechanical Science and Engineering Department and Director of Computational Science and Engineering at University of Illinois Urbana-Champaign, Prof. James L. McGrath, Biomedical Engineering at University of Rochester, and Prof. Patrick Phelan, Arizona State University.

Our sincere thanks and gratitude to these speakers for the time and commitment they have given in generously sharing their knowledge with the attendees.

This HT/FE/ICNMM Conference is a unique opportunity for technical interactions between international researchers and engineers having interests in a broad spectrum of technical area. Registration for one conference allows attendance at all "three" conferences and includes the DVD proceedings for all three conferences, one Award Banquet from any of the three conferences, three conference lunches, and multiple refreshment breaks.

The outstanding technical program was made possible by the hard work of ASME staff and many volunteers. We especially want to thank ASME staff: Norma Johnston, Jimmy Le, Laraine Lee, Nhora Cortes-Comerer, for their dedication, patience, and timely responses to the many inquiries from authors and organizers and for producing the technical program and conference proceedings. We are grateful to the track and session organizers, technical reviewers, and authors for their contributions to an interesting and high-quality technical program.

With our very best wishes to the conference attendees,



**Yu-Tai Lee**, Fluids Engineering Conference General Chair



**Sumanta Acharya**, Heat Transfer Conference General Chair



**Ali Beskok**, 14th ICNMM General Chair



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## EXHIBITS INFORMATION

### Location:

Regency Foyer (Ballroom Level)

### Hours:

Monday, July 11, 10:00 AM – 4:00 PM

Tuesday, July 12, 10:00 AM – 4:00 PM

Wednesday, July 13, 10:00 AM – 4:00 PM

## AUDIOVISUAL EQUIPMENT IN SESSION ROOMS

All technical sessions are equipped with one LCD projector and one screen. Laptops will NOT be provided in the sessions. Presenters MUST bring their own or arrange in advance to share.

## BADGE REQUIRED FOR ADMISSION

All conference attendees must wear the official ASME 2016 HTFEICNMM badge at all times in order to gain admission to technical sessions, exhibits and other conference events. Without a badge, you will NOT be allowed to attend any conference activities.

## CONFERENCE AWARD BANQUETS (TICKET REQUIRED)

Three wonderful banquets will take place during the conference to recognize and celebrate a select group of individuals for their contributions and achievements in heat transfer, fluids and nanotechnology engineering. The schedule is as follows:

Heat Transfer Division Award Banquet. Monday, July 11, 6:30 – 9:00 PM, Regency A

Fluids Engineering Division 90th Anniversary Celebration and Award Banquet. Tuesday, July 12, 6:30 – 9:00 PM, Regency A

ICNMM Award Banquet. Wednesday, July 13, 6:30 – 9:00 PM, Regency A

## CONFERENCE LUNCHES

Conference lunches will be held from 12:15 – 1:55 PM on Monday, Tuesday, and Wednesday of the conference. Please join your fellow attendees for three fantastic lectures all done over a warm sit down meal.

## CONFERENCE EVENT CONNECT APP

Download the new ASME Event Connect App and hold the entire program in the palm at your hand! The new ASME Event Connect App allows you to easily look up sessions, search for papers or people, message with other attendees, post to various social media platforms, and create your own schedule.

The ASME Event Connect App is available at the App Store, Google Play, and Windows Market.

## CONFERENCE PROCEEDINGS

Each attendee receives a conference DVD that includes all of the papers accepted for presentation at the conference. The official conference archival proceedings will be published after the conference and will not include accepted papers that were not presented at the conference. The official conference proceedings is registered with the Library of Congress and are submitted for abstracting and indexing. The proceedings is published on the AMSE Digital Library

## CONFERENCE REFRESHMENT BREAKS

Three morning breaks and three afternoon breaks will be provided in the exhibition area (Regency Foyer). Come and meet the exhibitors, and join your fellow attendees for a few minutes of networking and discussion. The schedule is as follows:

Monday, July 11, 10:15 AM and 3:40 PM

Tuesday, July 12, 10:15 AM and 3:40 PM

Wednesday, July 13, 10:15 AM and 3:40 PM

## EMERGENCY INFORMATION

In the event of an emergency, please dial 55 on any hotel phone to connect with the hotel emergency hotline. The hotel will communicate with the local authorities. The hotel also has 24-hour security, and officers trained in first aid, CPR & AED service.

## PRESENTER ATTENDANCE POLICY

According to ASME's Presenter Attendance Policy, if a paper is not presented at the conference, the paper will not be published in the official Archival Proceedings, which are registered with the Library of Congress and are abstracted and indexed. The paper also will not be published in the ASME Digital Collection and may not be cited as a published paper.

## MEMBERSHIP TO ASME (ONE-YEAR FREE)

Registrants who paid the non-member conference registration fees will receive a complimentary one-year ASME Membership. ASME will automatically activate this complimentary membership for qualified attendees. Please allow approximately four weeks after the conclusion of the conference for your membership to become active. Visit [www.asme.org/membership](http://www.asme.org/membership) for more information about the benefits of ASME Membership.



## REGISTRATION INFORMATION

### Location:

Regency Foyer (Ballroom Level)

### Hours:

Sunday, July 10, 10:00 AM – 5:00 PM

Monday, July 11, 7:30 AM – 5:30 PM

Tuesday, July 12, 7:30 AM – 5:30 PM

Wednesday, July 13, 7:30 AM – 5:30 PM

# Program At-A-Glance

<b>Heat Transfer Sessions</b>	<b>Fluids Engineering Sessions</b>	<b>ICNMM Sessions</b>	<b>Interdisciplinary Sessions</b>
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	<b>SUNDAY</b>	<b>MONDAY</b>					
	7/10/2016	7/11/2016					
<b>ROOM NAME</b>	9:00am – 4:30pm	8:30am – 10:10am	10:30am – 12:10pm	Lunch Event	2:00pm – 3:40pm	4:00pm – 5:40pm	Evening Event
<b>Grand Teton</b>		3-2-1	1-1	Lunch with FED Lecture on National Academy of Engineering by NAE President Dan Mote Jr. (12:15pm - 1:55pm) (Regency A)	3-2-2	3-3-1	HT Banquet (6:30pm - 9:00pm) (Regency A)
<b>Bruce</b>			5-1		4-6-1	4-6-3	
<b>Regency D</b>		4-1-1			4-1-2	4-1-3	
<b>Yosemite</b>		20-1-1	7-1		5-1	5-2	
<b>Regency BC</b>		FED Plenary (33-4)	HT Plenary (19-1-1)		ICNMM Plenary (18-1)	FED Federal Funding Panel (36-1)	
<b>Glacier</b>		1-1-1	X		1-2-1	1-2-3	
<b>Everglades</b>		4-5-1	19-1		4-7-1	4-7-2	
<b>Yellowstone</b>	Measurement Uncertainty Workshop	8-1-1	21-1		8-1-2	8-2-1	
<b>Sequoia</b>			10-1		10-2	20-1	
<b>Congressional C</b>			13-1		13-2	13-3	
<b>Congressional D</b>			2-4		2-1	2-2	
<b>Bunker Hill</b>			1-1		9-1	12-1	
<b>Thornton A</b>		6-1	6-2		3-1	3-2	
<b>Concord</b>		3-1	3-2			3-3	
<b>Lexington</b>		4-1	4-2		4-4-1	5-1	
<b>Thornton B</b>		2-1	2-2			2-3	
<b>Thornton C</b>		15-1-1		15-2-1	15-2-3		
<b>Redwood</b>		4-1		4-2	4-3		
<b>Thornton Lounge</b>		11-1-2		11-1-3	11-1-4		

## THURSDAY

7/14/2016

Conference Technical Tours to The George Washington University, NASA Goddard, and Naval Surface Warfar Center, Carderock Division

# At-A-Glance

TUESDAY						WEDNESDAY					
7/12/2016						7/13/2016					
8:30am – 10:10am	10:30am – 12:10pm	Lunch Event	2:00pm – 3:40pm	4:00pm – 5:40pm	Evening Event	8:30am – 10:10am	10:30am – 12:10pm	Lunch Event	2:00pm – 3:40pm	4:00pm – 5:40pm	Evening Event
3-4-1	3-4-2	Lunch with FED History Lecture by W.B. Morgan (12:15pm - 1:55pm) (Regency A)	22-1	13--1-1	FED Banquet (6:30pm - 9:00pm) (Regency A)	28-1	6-1-1	Lunch with HT Lecture by Eric Rohfling (12:15pm - 1:55pm) (Regency A)	6-1-2	6-1-4	ICNMM Banquet (6:30pm - 9:00pm) (Regency A)
4-6-4	8-5-1		26-1	3-5-1		6-1	3-5-2		9-1-1		
4-3-1	4-3-2			8-7-1			4-2-1		4-2-2	4-3-3	
12-2	1-1		1-2	1-3		1-4	1-5		2-1	3-1	
ICNMM Plenary (18-2)	FED Plenary (33-1)		HT Plenary (19-1-2)	HTD Federal Funding Panel (21-1-1)		HT Plenary (19-1-3)	FED Freeman Scholar Lecture (33-3)		FED Plenary (33-2)	ICNMM Plenary (18-3)	
1-3-1	1-3-2		11-1	1-4-1		27-1			2-1-1	2-1-2	
8-1	4-8-1		8-2	4-8-2		9-6	8-3-2		8-4-1	9-7	
14-1	8-8-3-1		14-2	17-1-1		14-3	5-1-1		5-1-2	5-2-1	
20-2			11-1	11-2			10-1-1		10-1-2		
			4-1	4-2		24-1	15-1		15-2	24-2	
2-3			15-1	15-2		29-1	13-1		13-2	29-2	
9-2			9-4	9-5			15-3-4		15-5-1		
3-3			3-4	3-5		3-6					
25-1	3-4		25-2	25-3					4-9-1	4-9-2	
4-4-2	4-4-3		30-1	30-2			17-1-2		17-1-3	17-1-4	
5-1-3	8-1		10-1	10-2		10-3	10-4		12-1		
15-3-1	15-3-3	8-2	8-3	9-1	9-2	9-3					
11-1-5	11-2-1		12-1-1			7-1					

# Committee Meetings

TITLE	DAY	DATE	START TIME	END TIME	ROOM
<b>FED Executive Committee</b>	Sunday	7/10	01:00 PM	04:45 PM	Bryce
<b>FED Executive Committee with TC Chairs/Vice Chairs</b>	Sunday	7/10	04:45 PM	05:45 PM	Bryce
<b>FED Graduate Student Steering Committee</b>	Sunday	7/10	05:30 PM	06:00 PM	Sequoia
<b>FED FASTC</b>	Monday	7/11	08:30 PM	09:30 PM	Bryce
<b>FED MFTC</b>	Monday	7/11	07:30 PM	08:30 PM	Bryce
<b>FED MNFDTC</b>	Monday	7/11	08:00 PM	09:00 PM	Sequoia
<b>FED Towne Hall Assembly</b>	Monday	7/11	06:00 PM	07:30 PM	Regency BC
<b>FED Advisory Board and Executive Committee</b>	Tuesday	7/12	02:30 PM	03:30 PM	Redwood
<b>FED Executive Committee with ASME Staff</b>	Tuesday	7/12	03:30 PM	04:30 PM	Redwood
<b>FED AE Dinner Meeting</b>	Wednesday	7/13	05:30 PM	07:00 PM	Thornton A
<b>FED CFDTC</b>	Wednesday	7/13	05:30 PM	06:30 PM	Thornton B
<b>FED Executive Committee</b>	Wednesday	7/13	04:30 PM	05:30 PM	Sequoia
<b>FED Executive Committee with TC Chairs/Vice Chairs</b>	Wednesday	7/13	08:30 PM	09:30 PM	Thornton C
<b>FED FMITC</b>	Wednesday	7/13	07:30 PM	08:30 PM	Thornton B
<b>FED FMTC</b>	Wednesday	7/13	06:30 PM	07:30 PM	Thornton C
<b>HTD Executive Committee meeting (CLOSED session)</b>	Sunday	7/10	02:00 PM	04:00 PM	Congressional CD
<b>HTD Executive Committee meeting (OPEN session)</b>	Sunday	7/10	05:00 PM	07:00 PM	Congressional CD
<b>HTD Executive meeting with JHT, JTSEA TE, Pub Comm Rep, K-3 Chair</b>	Sunday	7/10	04:00 PM	05:00 PM	Congressional CD
<b>HTD Journal of Heat Transfer Editorial Board</b>	Monday	7/11	01:30 PM	03:30 PM	Concord
<b>2017 HTD Summer Heat Transfer Conference Planning</b>	Tuesday	7/12	10:30 AM	12:30 PM	Redwood
<b>HTD K-10</b>	Tuesday	7/12	06:00 PM	08:00 PM	Yellowstone
<b>HTD K-12</b>	Tuesday	7/12	06:00 PM	08:00 PM	Everglades
<b>HTD K-13</b>	Tuesday	7/12	06:00 PM	08:00 PM	Sequoia
<b>HTD K-14</b>	Tuesday	7/12	06:00 PM	08:00 PM	Lexington
<b>HTD K-16</b>	Tuesday	7/12	06:00 PM	08:00 PM	Thornton B
<b>HTD K-18</b>	Tuesday	7/12	06:00 PM	08:00 PM	Thornton C
<b>HTD K-20</b>	Tuesday	7/12	06:00 PM	08:00 PM	Thornton Lounge
<b>HTD K-22</b>	Tuesday	7/12	06:00 PM	08:00 PM	Yosemite
<b>HTD K-3</b>	Tuesday	7/12	06:00 PM	08:00 PM	Grand Teton
<b>HTD K-6</b>	Tuesday	7/12	06:00 PM	08:00 PM	Bryce
<b>HTD K-8</b>	Tuesday	7/12	06:00 PM	08:00 PM	Glacier
<b>2016 HTD IMECE Planning</b>	Wednesday	7/13	04:30 PM	06:30 PM	Redwood
<b>HTD Journal of Thermal Science and Engineering Applications Editorial Board</b>	Wednesday	7/13	10:30 AM	12:30 PM	Redwood
<b>HTD K-11</b>	Wednesday	7/13	06:00 PM	08:00 PM	Sequoia
<b>HTD K-15</b>	Wednesday	7/13	06:00 PM	08:00 PM	Concord
<b>HTD K-17</b>	Wednesday	7/13	06:00 PM	08:00 PM	Lexington
<b>HTD K-19</b>	Wednesday	7/13	06:00 PM	08:00 PM	Bunker Hill
<b>HTD K-2</b>	Wednesday	7/13	06:00 PM	08:00 PM	Grand Teton
<b>HTD K-21</b>	Wednesday	7/13	06:00 PM	08:00 PM	Yosemite
<b>HTD K-5</b>	Wednesday	7/13	06:00 PM	08:00 PM	Bryce
<b>HTD K-7</b>	Wednesday	7/13	06:00 PM	08:00 PM	Glacier
<b>HTD K-9</b>	Wednesday	7/13	06:00 PM	08:00 PM	Yellowstone
<b>ICNMM 2017 Planning Meeting</b>	Tuesday	7/12	06:00 PM	07:00 PM	Concord
<b>ICNMM Technical Committee Meeting</b>	Monday	7/11	06:00 PM	07:30 PM	Concord



# Workshops, Special Sessions and Luncheon Speakers

## WORKSHOP TITLE: **MEASUREMENT UNCERTAINTY WORKSHOP**

DATE/TIME: SUNDAY, JULY 10, 9:00 AM – 4:30 PM

Room: Yellowstone

### Presenters:



**Barton Smith**, Utah State University



**Douglas Neal**, LaVision Inc.

### Workshop Description:

The workshop will cover the following topics:

- Introduction to Measurement Error and Uncertainty
- Uncertainty of a Single Variable
- Propagation of Uncertainty Using Taylor Series and Monte Carlo Methods
- A Priori Uncertainty Quantification for Experiment Planning
- A Posteriori Uncertainty Quantification

## **FED FEDERAL FUNDING PANEL**

DATE/TIME: MONDAY, JULY 11, 4:00 – 5:40 PM

Room: Regency BC

### Presenter:

**William Olbrich**, National Science Foundation (NSF)  
**Michael McKittrick**, U. S. Department of Energy (DOE)  
**Jay Dryer**, National Aeronautics and Astronautics Administration (NASA)  
**Thomas Fu**, Office of Naval Research (ONR)  
**Robert Kraus**, Air Force Office of Scientific Research (AFOSR)

## **HEAT TRANSFER DIVISION FEDERAL FUNDING PANEL**

DATE/TIME: TUESDAY, JULY 12, 4:00 – 5:40 PM

Room: Regency BC

### Presenter:

**Jose Lage**, National Science Foundation (NSF)  
**Mark Spector**, Office of Naval Research (ONR)  
**Addison Stark**, Advanced Research Project Agency – Energy (ARPA-E)  
**Patrick Phelan**, U.S. Department of Energy (DOE) Building Technologies Office  
**Joseph Stekli**, U.S. Department of Energy (DOE) Sunspot Program

## LUNCHEON LECTURE: **NAE GRAND CHALLENGE SCHOLARS PROGRAM**

DATE/TIME: MONDAY, JULY 11, 12:15 – 1:55 PM

Room: Regency A

### Presenter:



**C. D. Mote, Jr.**, President of the National Academy of Engineering

### Session Description:

The Grand Challenges for Engineering is possibly the clearest and most compelling description of engineering for students and the public alike. The solutions to fourteen NAE Grand Challenges for Engineering were proposed in 2008 as the goals necessary to realize the vision: “Continuation of life on the planet as we know it in this century.” Each of these challenges is a global-scale engineering system problem, like reverse-engineer the brain, provide access to clean water, manage the nitrogen cycle and secure cyberspace. Solutions to each require global engagement because none is primarily nationally focused. This presentation describes an engineering educational platform to prepare students for global problems like these grand challenges.

### Speaker Bio:

C. D. Mote, Jr. is President of the National Academy of Engineering and Regents’ Professor on leave from the University of Maryland, College Park. His science policy work includes serving on the committee that authored the National Academies’ “Rising above the

Gathering Storm” report and chairing the committee on Global Science and Technology Strategies and Their Effect on the U.S. National Security that published the report “S&T Strategies of Six Countries” among others. He is internationally recognized for his research on the dynamics of gyroscopic systems and the biomechanics of snow skiing. He has produced more than 300 publications and is a Fellow of the American Academy of Arts and Sciences, the American Academy of Mechanics, the American Association for the Advancement of Science, the Acoustical Society of America, and an Honorary Fellow of the American Society of Mechanical Engineers. He is the 2005 recipient of the Founders Award from the National Academy of Engineering and the 2011 recipient of the American Society of Mechanical Engineers ASME Medal in recognition of his comprehensive body of work on the dynamics of moving flexible structures and his leadership in academia. He served as President of the University of Maryland for 12 years and on the University of California, Berkeley faculty for 31 years where he held an endowed chair in Mechanical Systems, was Chair of Mechanical Engineering, and served as Vice Chancellor.

# Workshops, Special Sessions and Luncheon Speakers

## LUNCHEON LECTURE: EVENTS IN FED'S HISTORY

DATE/TIME: TUESDAY, JULY 12, 12:15 – 1:55 PM

Room: Regency A

### Presenter:



**William B. Morgan**, American naval architect

### Session Description:

The presentation will consist of a discussion of various events that happened during the 90 years of FED and the “Movers and Shakers” that caused them to happen.

### Speaker Bio:

Dr. William B. Morgan is an American naval architect and renowned expert in propeller design. Morgan was born in Iowa, received his B.S. in Marine Engineering from the US Merchant Marine Academy in 1950, M.S. in Mechanics and Hydraulics in 1951 from the University of Iowa, and a doctorate in Naval Architecture from the University of California, Berkeley, in 1961, and devoted his entire professional career to the Carderock Division (David Taylor Model Basin), Naval Surface Warfare Center, Bethesda, Maryland.

Morgan started working with UNIVAC I and UNIVAC II computers in 1954. He introduced computers into naval engineering and thereby revolutionized propeller design. He published numerous studies of sub-cavitating, super-cavitating, and contra-rotating propellers; annular airfoil and ducted propeller theory; propeller blade strength; hydrodynamic properties of blade sections; and propeller cavitation, ventilation and noise. Perhaps most significantly, he led development of the highly skewed propeller with its superior vibration and acoustic properties. Morgan ultimately was named head of the hydromechanics directorate, David Taylor Model Basin, responsible for all hydromechanics research concerning U.S. Navy ships and submarines, and managing three hundred employees, a \$70 million budget and Navy testing facilities estimated at almost \$2 billion nationwide. He directed the acquisition of major facilities including the Maneuvering and Seakeeping Basin, Rotating Arm, 36-inch Variable Pressure Water Tunnel, and the Large Cavitation Channel (now named in his honor).

Morgan was given numerous awards from national and international technical societies, academia, and the Navy. He is the only U.S. citizen to receive the William Froude Medal from the Royal Institute of Naval Architects. In 1992 he entered the National Academy of Engineering and in 1997 was awarded the Gibbs Brothers Medal by the National Academy of Science. He was chair of the ASME Polyphase Flow Committee 1972-1974 and Chair of FED 1981-82.

## LUNCHEON LECTURE: AN OVERVIEW OF THE ADVANCED RESEARCH PROJECTS AGENCY – ENERGY (ARPA-E)

DATE/TIME: WEDNESDAY, JULY 13, 12:15 – 1:55 PM

Room: Regency A

### Presenter:



**Eric A. Rohlfling** is the Deputy Director for Technology of the Advanced Research Projects Agency–Energy (ARPA-E)

### Session Description:

The Advanced Research Projects Agency-Energy (ARPA-E) advances high-potential, high impact energy technologies that are too early for private-sector investment and have the potential to radically improve U.S. economic prosperity, national security, and environmental well-being. The agency funds technology-focused, applied research and development aimed at creating real-world solutions to important problems in energy. This presentation is an opportunity to learn about ARPA-E, its programs and projects, and how it solicits and manages research awards to advance potentially disruptive energy technologies.

### Speaker Bio:

Dr. Eric A. Rohlfling is the Deputy Director for Technology of the Advanced Research Projects Agency–Energy (ARPA-E), responsible for oversight of all technology issues relating to ARPA-E's programs. Dr. Rohlfling joined ARPA-E from the Department of Energy's Office of Science, where he most recently served as Director of the Chemical Sciences, Geosciences, and Biosciences Division in the Office of Basic Energy Sciences (BES). As Director, Dr. Rohlfling provided leadership and direction in establishing vision, strategic plans, goals, and objectives for the research activities supported by the Division. He joined BES in 1997 and later served as program manager for the Atomic, Molecular and Optical Sciences program (2000-2003) and team leader for Fundamental Interactions (2003-2006) before becoming Director. Dr. Rohlfling held postdoctoral appointments at Exxon Research and Engineering Company and Los Alamos National Laboratory before joining the staff at the Combustion Research Facility at Sandia National Laboratories in 1986. His research interests include the experimental characterization of transient molecules relevant to combustion processes, linear and nonlinear laser spectroscopies, trace detection of pollutants, molecular beam and mass spectrometric studies of carbon and metal clusters, and vibrational relaxation dynamics. He is the author of approximately 50 peer-reviewed articles, holds membership in the American Chemical Society and the American Physical Society, and is a fellow of the American Association for the Advancement of Science. Dr. Rohlfling received a B.S. degree in chemistry from the University of Virginia in 1977 and a Ph.D. in physical chemistry from Princeton University in 1982.

## HEAT TRANSFER DIVISION AWARD BANQUET WITH SPECIAL INVITED LECTURE FROM DR. JOHN H. LIENHARD, UNIVERSITY OF HOUSTON

MONDAY, JULY 11, 6:30 PM – 9:00 PM

Regency BC

Join the Heat Transfer Division for dinner as it celebrates its achievements.

### Dinner Speaker:



Dr. John H. Lienhard, University of Houston

*REMEMBERING AND FORGETTING HEAT TRANSFER: Is History Useful or Is It an Impediment?*

### Abstract:

Most of us function with a fairly thin knowledge of our past. Our literature searches usually connect with only the most recent layer of that past. But before we decide that we should act differently, we need to ask why we give our forbears short shrift. Is there some hidden value in forgetting? What is the real cost-balance between retaining the past, and leaving it behind?

### Speaker Bio:

John Lienhard is Prof. Emer. of Mech. Engr., and of History, at the Univ. of Houston. He is also the founding author and voice of The Engines of Our Ingenuity, a daily program heard nationally on Public Radio for over 28 years. His BS, MS, and PhD are from Oregon State College, the Univ. of Washington, and the Univ. of California at Berkeley. A 66-year member of ASME, he holds its Heat Transfer Memorial Award, Engineer Historian Award, and Honorary membership, among other honors. Lienhard is a member of the National Academy of Engineering.

## FLUIDS ENGINEERING DIVISION AWARD BANQUET AND A SPECIAL CELEBRATION OF THE 90TH ANNIVERSARY OF THE FLUIDS DIVISION

TUESDAY, JULY 12, 6:30 PM – 9:00 PM

Regency BC

Join the Fluids Engineering Division as it celebrates and recognizes the outstanding services and achievements of the awardees. 2016 marks the 90th Anniversary of the Fluids Engineering Division. A special program will commence to celebrate not only the rich history of the division, but the many distinguished members, past and present, who dedicated their time and energy to the outstanding success of the Fluids Engineering Division.



## ICNMM AWARD BANQUET

WEDNESDAY, JULY 13, 6:30 PM – 9:00 PM

Regency BC

Join ICNMM as it celebrates and recognizes the outstanding services and achievements of the awardees.

### Outstanding Early Career Award

This award recognizes a researcher early in her/his career whose emerging work on mini scale, micro scale, or nano scale thermofluid phenomena and/or systems represents an exceptional contribution to current and future directions of research in this field. The award is intended for early career researchers who have completed their graduate degree no more than 10 years prior to the year of application, and who are recognized by their peers as emerging leaders in their respective field of research

The ASME ICNMM 2016 Outstanding Early Career Award is presented to:

**Chen Li**, University of South Carolina

### ICNMM Prominent Researcher Award

This award honors a person with significant research record in the field of thermofluid transport phenomena at the mini-, micro- and nanoscale, and a stellar service to the ICNMM community, whose vision and leadership have been instrumental to the advancement of an area pertinent to the scope of the conference in the recent past.

The ASME ICNMM 2016 Prominent Researcher Award is presented to: **Yoav Peles**, University of Central Florida

### ICNMM Outstanding Leadership Award

This award recognizes a person whose service within the ICNMM is exemplary; the recipient of the award contributed significantly to the lasting success of the conference. Nominations are limited to professionals who have been involved for at least three years with the conference.

The ASME ICNMM 2016 Outstanding Leadership Award is presented to: **Afshin Ghajar**, Oklahoma State University

# Plenary Sessions

## PLENARY TITLE: **VERIFICATION AND VALIDATION IN FLUIDS ENGINEERING: SOME CURRENT ISSUES (FLUIDS ENGINEERING)**

DATE/TIME: MONDAY, JULY 11, 8:30 AM – 10:10 AM

Room: Regency BC

### Presenter:



Patrick J. Roache

### Session Description:

The presentation will begin with a very brief review of some basic accepted concepts familiar to V&V specialists in Computational Fluid Dynamics and similar fields: concepts of Verification, Validation, and Uncertainty Quantification; use of the Method of Manufactured Solutions and other benchmarks for Code Verification; the Grid Convergence Index and some variants, especially Least Squares GCI, for Solution Verification; an alternative success metric for discretization error estimates; and the ASME V&V20 method for evaluating a Validation Metric. Then more current issues will be considered: the forthcoming ASME V&V20 Supplement addressing multiple set points in space and/or time; application of the GCI to unstructured grids; a natural range for the factor of safety in the GCI; "roll-up" (propagation) of uncertainty estimates through complex systems; combining disparate types of uncertainties (aleatory and epistemic); the important concept of a validation experiment; the possible "immunity" of a good Validation exercise to model form uncertainty; the weakest link in CFD Validation, which is uncontrolled experiments; the falsificationism of philosopher of science Karl Popper as (mis)applied to computational physics; trend Validation of climate models; and personal opinions on current State of the Art, and State of the Practice, in V&V.

### Speaker 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. He wrote a chapter for Annual Reviews of Fluid Mechanics and, with Prof. Dominique Pelletier, for Handbook of Numerical Heat Transfer. Algorithm development contributions included elliptic marching and semidirect methods, domain decomposition, pseudospectral 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, in V&V committees of ASME, AIAA and ASCE, and 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. 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.

## PLENARY TITLE: **HOW CAN THERMAL SCIENCE AND ENGINEERING HELP DECARBONIZE THE GLOBAL ENERGY SYSTEM (HEAT TRANSFER)**

DATE/TIME: MONDAY, JULY 11, 10:30 AM – 12:10 PM

Room: Regency BC

### Presenter:



Arun Majumdar, Stanford University

### Session Description:

It is now undoubtedly clear that over the next several decades the world should and will decarbonize the global energy system, which will introduce massive changes to how we provide for electricity, heating and cooling, and mobility. These changes naturally provoke the questions: How can we achieve this in the most economical manner? What are the science and engineering challenges involved? Where does thermal science and engineering and transport phenomena fit into this larger landscape? What thoughtful policies should we create to accelerate development and adoption such technologies?

In many ways, this is a strategically opportune time for engineers to rise to the occasion and deliver solutions during a period of changing global paradigms. This talk will discuss a number of strategic opportunities and engineering challenges that, if adequately addressed, could be game-changing for transforming our energy system.

### Speaker Bio:

Arun Majumdar is the Jay Precourt Professor at Stanford University, where he serves on the faculty of the Department of Mechanical Engineering and is the co-Director of the Precourt Institute for Energy that integrates and coordinates research and education activities across all seven Schools and the Hoover Institution at Stanford. He is currently leading major initiatives at Stanford such as modernizing the electricity grid, renewable fuels and energy access in emerging economies all of which coherently integrate innovations in technology, economics, markets, finance, business models, regulatory frameworks and policies, with deep engagement from global corporations, early-stage companies, non-governmental organizations and policy makers. Prior to joining Stanford, Dr. Majumdar was the Vice President for Energy at Google, where he led several initiatives that integrated energy and information technologies, and advised the company broadly on its energy strategy. In October 2009, Dr. Arun Majumdar was nominated by President Obama and confirmed by the Senate to become the Founding Director of the Advanced Research Projects Agency - Energy (ARPA-E), where he served till June 2012 and helped ARPA-E become a model of excellence for the government with bipartisan support from Congress and other stakeholders. Between March 2011 and June 2012, Dr. Majumdar also served as the Acting Under Secretary of Energy with a portfolio that consisted of the Office of Energy Efficiency and Renewable Energy, the Office of Electricity Delivery and Reliability, the Office of Nuclear Energy and the Office of Fossil Energy, all reporting to him. Furthermore, he was a Senior Advisor to the Secretary of Energy on a variety of matters related to management,

budget, and policy. Prior to joining the Department of Energy, Dr. Majumdar was the Almy and Agnes Maynard Chair Professor of Mechanical Engineering and Materials Science and Engineering at the University of California, Berkeley and the Associate Laboratory Director for Energy and Environment at Lawrence Berkeley National Laboratory. His research career includes the science and engineering of nanoscale materials and devices as well as large engineered systems. Dr. Majumdar is a member of the National Academy of Engineering and the American Academy of Arts and Sciences. He currently serves as the Vice Chairman of the US Secretary of Energy's Advisory Board and is also a Science Envoy for the US Department of State with focus on energy and technology innovation in the Baltics and Poland. He is a member of the Councils of the National Academy of Engineering, the Electric Power Research Institute, as well as the Science Board of the Stanford Linear Accelerator Center (SLAC) and the Oak Ridge National Laboratory. He is a member of the International Advisory Panel for Energy of the Singapore Ministry of Trade and Industry and the US delegation for the US-India Track II dialogue on climate change and energy. Dr. Majumdar received his bachelor's degree in Mechanical Engineering at the Indian Institute of Technology, Bombay in 1985 and his Ph.D. from the University of California, Berkeley in 1989.

## PLENARY TITLE: IMPACT OF THERMAL ENGINEERING RESEARCH ON BUILDING ENERGY EFFICIENCY (ICNMM)

DATE/TIME: MONDAY, JULY 11, 2:00 – 3:40 PM

Room: Regency BC

### Presenter:



Patrick Phelan, Arizona State University

### Session Description:

Buildings consume approximately 40% of the primary energy around the world, and thermal processes are responsible for a significant fraction of that energy. Thermal engineering research, therefore, plays a crucial role to reduce building energy consumption and thereby reduce associated greenhouse gas emissions. This report attempts to estimate the quantitative impacts of improved thermal transport in the buildings sector, such as more effective heat exchangers, improved HVAC cycles, better thermal insulation materials and windows, etc. The objective here is, first of all, to encourage more research & development activity in this vital area. The second objective is to provide examples of how the broader impacts of research can be quantified and described so that stakeholders without deep expertise can appreciate and value the research.

### Speaker Bio:

Patrick Phelan received his BS degree from Tulane University in New Orleans, his MS degree from MIT, and his PhD from UC Berkeley, all in mechanical engineering. Following a two year post-doctoral fellowship at the Tokyo Institute of Technology, he started his academic career as an Assistant Professor at the University of Hawaii in 1992. In 1996 he moved to Arizona State University (ASU), where he is a Professor of Mechanical & Aerospace Engineering, and a Senior Sustainability Scientist. While on

leave from ASU he served as the Director of the NSF Thermal Transport Processes Program from 2006 to 2008. He is again on leave from ASU, and through July 2016 is serving as the Program Manager for Emerging Technologies in the Building Technologies Office, Energy Efficiency and Renewable Energy, US Department of Energy.

## PLENARY TITLE: THE BENEFITS OF BEING THIN: HOW ULTRATHIN MEMBRANES WILL REVOLUTIONIZE BIOLOGY AND MEDICINE (ICNMM)

DATE/TIME: TUESDAY, JULY 12, 8:30 AM – 10:10 AM

Room: Regency BC

### Presenter:



James McGrath, University of Rochester

### Session Description:

Nearly a decade after we first used silicon microfabrication to create free-standing ultrathin nanoporous membranes, the materials are beginning to realize their potential to create paradigm shifts in multiple disciplines. Today, as a team of more than two dozen faculty, students, entrepreneurs, and engineers at multiple academic institutions and one company, we manufacture and apply a variety of nanoporous and microporous membranes with the common characteristics that they are ultrathin (15 nm - 300 nm) and made from silicon-containing materials. Because these 'nanomembranes' are orders-of-magnitude thinner than conventional membranes, they are orders-of-magnitude more permeable to both diffusing molecules and pressurized flow. Molecular scale thickness also enhances the resolution of separations when the membranes are used as sieves. High permeability and high resolution sieving, as well as other expected and unexpected characteristics of nanomembranes, have sparked research programs on topics as disparate as electroosmotic pumps and hemodialysis. This talk will first review our progress in establishing the basic science of ultrathin porous membranes. Through modeling and experimentation we have developed a fundamental understanding of convective and diffusive flows, sieving behavior, fouling, mechanics, and electrokinetic properties. We will then review progress on each of four major applications areas that have emerged as nanomembranes have become reliably manufactured and affordable in recent years: 1) biological separations, 2) electromechanical devices, 3) barrier tissue models and 4) biosensors. Of all the applications we are currently pursuing, none holds greater promise for improving the human condition than the development of a wearable device for continuous hemodialysis. While much work remains until this disruptive technology is used to dramatically improve the life of patients with end-stage-renal disease, proof-of-principle data in rats has been achieved. The inspired pursuit of this 'medical moon shot' is also generating spin-off technology and know-how that is enhancing the use of nanomembranes in other applications.

### Speaker Bio:

James McGrath is a Professor of Biomedical Engineering at the University of Rochester. He holds degrees from MIT in both Mechanical Engineering

# Plenary Sessions

(MS '04) and Biological Engineering (PhD '08) and trained as a post-doctoral fellow in Biomedical Engineering at Johns Hopkins University. Professor McGrath joined the University of Rochester faculty in 2001 where he has also served as the director of the Graduate Program in BME and as the co-director the University's core facility for microfabrication and metrology: UR Nano. While historically Professor McGrath's research focused on the phenomena of cell migration, in 2007 his research turned to a breakthrough ultrathin porous membrane material termed silicon nanomembranes. McGrath founded and served as past-president of SIMPore, a Rochester based company established to achieve high volume and high quality manufacturing of nanomembranes. He also established the multidisciplinary Nanomembrane Research Group (NRG) to advance both the material science and application of nanomembranes. The NRG has grown into a multi-institutional and international collection of faculty, entrepreneurs, students, and senior scientists, developing and applying the breakthrough ultrathin membrane technology. Through more than a dozen patent applications and two dozen peer-reviewed journal publications, the NRG has pioneered the use of nanomembranes for therapeutic and laboratory separations, for 3D tissue models, for molecular sensing, and for various lab-on-a-chip applications.

## PLENARY TITLE: NINE DECADES OF FLUID MECHANICS (FLUIDS ENGINEERING)

DATE/TIME: TUESDAY, JULY 12, 10:30 AM – 12:10 PM

Room: Regency BC

### Presenter:



**Mohamed Gad-el-Hak**, Virginia Commonwealth University

### Session Description:

As the ASME Division of Fluids Engineering celebrates its 90th anniversary, I make a broad-brush sweep of progress in the field of fluid mechanics during this period. Select theoretical, numerical, and experimental advances are described. The inventions of laser and computer have profound effect on humanity, but their influence on fluid mechanics is particularly elucidated in this lecture.

### Speaker Bio:

Mohamed Gad-el-Hak received his B.Sc. (summa cum laude) in mechanical engineering from Ain Shams University in 1966 and his Ph.D. in fluid mechanics from the Johns Hopkins University in 1973. Gad-el-Hak has since taught and conducted research at the University of Southern California, University of Virginia, University of Notre Dame, Institut National Polytechnique de Grenoble, Université de Poitiers, Friedrich-Alexander-Universität Erlangen-Nürnberg, Technische Universität München, and Technische Universität Berlin, and has lectured extensively at seminars in the United States and overseas. Dr. Gad-el-Hak is currently the Inez Caudill Eminent Professor of mechanical & nuclear engineering at Virginia Commonwealth University. From 2002 to 2009, Gad-el-Hak was the chair of mechanical engineering at VCU. Dr. Gad-el-Hak has published over 600 articles, authored/edited 20 books and conference proceedings, and

presented 300 invited lectures. He is the author of the book "Flow Control: Passive, Active, and Reactive Flow Management," and editor of the books "Frontiers in Experimental Fluid Mechanics," "Advances in Fluid Mechanics Measurements," "Flow Control: Fundamentals and Practices," "The MEMS Handbook" (first and second editions), "Transition and Turbulence Control," and "Large-Scale Disasters: Prediction, Control and Mitigation." Professor Gad-el-Hak is a fellow of the American Association for the Advancement of Science, the American Physical Society, the American Society of Mechanical Engineers, and the American Academy of Mechanics. In 1998, Professor Gad-el-Hak was named the Fourteenth ASME Freeman Scholar. In 1999, Gad-el-Hak was awarded the prestigious Alexander von Humboldt Prize, Germany's highest research award for senior U.S. scientists and scholars in all disciplines. In 2002, Gad-el-Hak was named ASME Distinguished Lecturer, as well as inducted into the Johns Hopkins University Society of Scholars. In 2016, he was awarded the ASME Medal for significant contributions to the advancement of the science and practice of fluids engineering.

## PLENARY TITLE: NUCLEATE POOL BOILING HEAT TRANSFER AT DIFFERENT LEVELS OF GRAVITY (HEAT TRANSFER)

DATE/TIME: TUESDAY, JULY 12, 2:00 – 3:40 PM

Room: Regency BC

### Presenter:



**Vijay Dhir**, University of California, Los Angeles

### Session Description:

Rate of pool boiling heat transfer is influenced by the magnitude of gravity through bubble dynamics and associate subprocesses. Experiments have been conducted at earth normal gravity, in parabolic flights (1/100th of earth normal gravity), and on the International Space Station (one millionth or less of earth normal gravity), and results from these experiments will be described. The experimental work is accompanied by numerical simulations of the process. In the simulations the domain of interest is divided into micro and macro-regions. Conservation equations are solved for both phases and a level set formulation is used to capture the interface in the macro region. The interface shape obtained for the two regions is matched at the outer edge of micro layer. Numerical simulations consistent with experiments show that vapor bubble dynamics and vapor removal mechanisms remain similar up to 1/100th of earth normal gravity in that bubbles after growing to a certain size, move away from the surface as a result of buoyancy. However, under microgravity conditions, a large vapor bubble is found to persist in the middle of the test surface and smaller bubbles move radially inward and merge into it. This large bubble acts as a vapor sink near the surface as opposed to vapor removal away from the surface under earth normal and reduced gravity conditions. Rate of nucleate boiling heat transfer is found to degrade as level of gravity is reduced.

### Speaker Bio:

Vijay K. Dhir, distinguished professor of mechanical and aerospace

engineering, was named Dean of UCLA's Henry Samueli School of Engineering & Applied Science in March 2003. Born in India, Dhir received his Bachelor of Science degree from Punjab Engineering College in Chandigarh, India, and his Master of Technology degree from the Indian Institute of Technology in Kanpur, India. He received his Ph.D. from the University of Kentucky. Dhir joined the faculty at UCLA in 1974 and served in a number of leadership roles before his appointment as Dean. In 2006, he was elected to the National Academy of Engineering – among the highest honors awarded to engineers – for his work in boiling heat transfer and nuclear reactor thermal hydraulics and safety. Dhir received the 2004 Max Jakob Memorial Award of ASME and AIChE and was selected to deliver the Thurston Lecture of ASME in 2008. He is a fellow of ASME and the American Nuclear Society. In 2004, he was selected as an inductee into the University of Kentucky's Engineering Hall of Distinction. He has also received the American Society of Mechanical Engineers (ASME) Heat Transfer Memorial Award in the Science category and the Donald Q. Kern award from the American Institute of Chemical Engineers (AIChE). He is recipient of the Technical Achievement Award of the Thermal Hydraulics Division of the American Nuclear Society. Twice he has received the Best Paper Award for papers published in ASME Journal of Heat Transfer. He received an honorary Ph.D. in Engineering from University of Kentucky, Lexington and a Lifetime Achievement Award at the ICCES conference. He is also an honorary member of ASME and received the 75th Anniversary Medal from the Heat Transfer Division of ASME. He was recognized in 2013 as Educator of the Year by the Engineering Council. Dhir served as senior technical editor for the American Society of Mechanical Engineers' Journal of Heat Transfer from 2000 to 2005. Prior to being named senior technical editor, he also served as the Journal's associate editor. He is a former assistant editor of Applied Mechanics Review. He has served on the advisory boards of several other journals. Recently Dhir completed his service to the National Research Council's Steering Committee on the "Decadal Survey on Biological and Physical Sciences in Space." He currently serves on the National Research Council's Aeronautics and Space Engineering Board and the National Academy of Science's Committee on Lessons Learned from the Fukushima Nuclear Accident for Improving Safety and Security of U.S. Nuclear Plants including Spent Fuel Pools. Dr. Dhir leads the Boiling Heat Transfer Lab, which has conducted pioneering work in fundamental and applied sciences involving boiling, an efficient process of heat removal. Currently the lab is involved in the study of flow boiling, micro-gravity boiling, and nuclear reactor thermal hydraulics. Since 1999 a team of researchers led by Dhir has been taking part in a NASA research program to examine the effects of microgravity on boiling. The activity culminated with an experiment aboard the International Space Station. More than forty PhD students and forty MS students have graduated under Dhir's supervision. He is author or co-author of over 325 papers published in archival journals and proceedings of conferences.

## PLENARY TITLE: COMBUSTION OF BIO AND SURROGATE FUELS: A HOT SUBJECT WITH COOL FLAMES (HEAT TRANSFER)

DATE/TIME: WEDNESDAY, JULY 13, 8:30 AM – 10:10 AM

Room: Regency BC

### Presenter:



C. Thomas Avedisian, Cornell University

### Session Description:

The dwindling supplies of petroleum-based liquid fuels have generated renewed interest in alternative energy systems. Even after petroleum fuels are gone (e.g., within a hundred years according to some estimates) there will continue to be a demand for liquid fuels that may be filled in part by fuels derived from non-food feedstocks (e.g., algae, camelina, soybean, etc.). Developing the understanding of such fuels in the complex environment of a combustion engine is difficult owing to the turbulent and swirling flow field, the multicomponent nature of real fuels, and the interactive effects among droplets in a spray that are present. Approaches that reduce the complexity of the fuel burning process while maintaining relevance are attractive. This consideration is addressed in two ways. Firstly, droplets represent the sub-grid scale of sprays and maintain many processes found in sprays including moving boundary effects, phase equilibrium, combustion chemistry, transient liquid and gas transport, and radiation. Secondly, blends of a few miscible components - surrogate fuels - may still incorporate the combustion physics of complex transportation fuels comprised of hundreds of miscible species. A particularly attractive burning configuration is that of a one-dimensional droplet flame that arises when external convective effects are removed. Such flames are well positioned to reveal the complex thermo/chemical processes intrinsic to combustion of liquid fuels, including the influence of droplet size and fuel type on burning and formation of particulates, and to provide data for validating detailed numerical models of droplet burning that are a stepping stone to a direct numerical simulation capability of spray combustion in engines.

In this presentation, the droplet burning characteristics of several real fuels (jet, diesel, gasoline), biofuels (e.g., derived from algae, camelina and tallow), and surrogate fuels are discussed that show the influence of droplet size and fuel composition on combustion, as well as the unique sooting dynamics found in the one-dimensional droplet flame configuration. The influence of blending real fuels with biofuels and alcohols (e.g., algae/diesel, butanol/gasoline mixtures) shows in some cases the potential for the blend to be a 'drop-in' replacement of the real fuel. An interesting effect of varying droplet diameter is discussed in which flame extinction promoted by radiative losses is followed by a transition to a combustion regime characterized by flame temperatures which are substantially lower ("cool" flames) than the hot flames typical of steady burning. Some results of detailed numerical modeling of the droplet burning process are presented, and the value of scale analysis to predict the influence of flame temperature on burning rate and droplet diameter is demonstrated.

# Plenary Sessions

## FLUIDS ENGINEERING FREEMAN SCHOLAR LECTURE: **PARTICLE TRANSPORT, DEPOSITION AND REMOVAL - ENVIRONMENTAL AND BIOLOGICAL APPLICATIONS**

**DATE/TIME: WEDNESDAY, JULY 13, 10:30 AM – 12:10 PM**

**Room: Regency BC**

### Presenter:



**Goodarz Ahmadi**, Clarkson University, Robert R. Hill Professor of Mechanical and Aeronautical Engineering, Clarkson University

### Session Description:

Applications of particle transport, deposition and removal in environmental and biological flows are presented. The mechanics of particulate pollutant transport and deposition in turbulent flows are discussed. Numerical simulations of airflow with the use of the Reynolds averaged Navier-Stokes (RANS) equation, as well as DNS and LES are described. The stochastic models for simulation of instantaneous fluctuation velocity are also discussed. The Lagrangian particle trajectory analysis method is presented, and the effects of various forces including drag, lift, gravity and Brownian are described. The nature of particle adhesion and removal from surfaces, as well as particle re-entrainment in turbulent flows are discussed. It is shown that the particle deposition and removal processes in turbulent flows are strongly affected by the near wall flow structures. Examples of computational modeling of gas-solid flows in ducts, as well as, in indoor and outdoor air are presented. Particular attention is given to simulation of compact spherical and elongated particulate pollutant transport and deposition in human upper airways. It is shown that computational modeling provided an efficient tool for studying gas-solid flows in complex passages.

### Speaker Bio:

Professor Goodarz Ahmadi received his B.S. degree from Tehran University, and his M.S. and Ph.D. degree in Mechanical Engineering from Purdue University. He is currently a Distinguished Professor, and Robert R. Hill Professor of Mechanical and Aeronautical

Engineering at Clarkson University. He has served as Chair of Department of Mechanical and Aeronautical Engineering and more recently as Dean of Coulter School of Engineering at Clarkson University (2005-2015). He is a Fellow of ASME, ISME and ISCE. His research interests include multiphase flows, particle transport and deposition, particle resuspension, turbulent flows, granular flows, air pollution, and flow through porous and fractured media. His research has been supported by the National Science Foundation, the Environmental Protection Agency, Department of Energy, NASA, AFOSR, Corning, IBM, Xerox, Dura Pharmaceutical, and NYSTAR. He has authored three books and over 580 publications in archival journals. He also has made more than 1100 presentations at national and international conferences and has given more than 180 invited talks and short courses at different institutions. He is serving as a member of the editorial board and/or editorial advisor board of eleven international journals.

### Speaker Bio:

Tom Avedisian is on the faculty of Mechanical and Aerospace Engineering at Cornell University where his research has cut across a variety of disciplines in experimental heat transfer and energy systems. Recent interests include the combustion dynamics of biofuels and their mixtures with conventional transportation fuels, film boiling for chemical processing of organic liquids, and understanding the phase change dynamics of metastable superheated liquids under impulsive heating conditions. Tom has been a Guest Researcher at the National Institute of Standards and Technology (Gaithersburg, Md.) since 1988 and he was a Science Fellow at the U.S. Department of Energy's Vehicle Technologies Office in 2008/2009 where he assisted with program review and development. He is a Fellow of ASME and the American Institute of Aeronautics and Astronautics, is on the editorial board of *Frontiers of Heat and Mass Transfer*, and previously served on the editorial boards of the *AIAA Journal of Propulsion and Power*, the *ASME Journal of Energy Resources Technology*, the *ASME Journal of Heat Transfer*, and *Atomization and Sprays*. Tom received a doctorate from Princeton University in 1980 and also holds degrees from Massachusetts Institute of Technology (S.M.) and Tufts University (B.S.).

## PLENARY TITLE: **NAVY SHIP DESIGN PERSPECTIVE IN FLUIDS ENGINEERING (FLUIDS ENGINEERING)**

**DATE/TIME: WEDNESDAY, JULY 13, 2:00 – 3:40 PM**

**Room: Regency BC**

### Presenter:



**Joseph T. Arcano**, Naval Surface Warfare Center Carderock Division

### Session Description:

Conventional naval ship design depends heavily on model tests. This plenary lecture will provide some historical background in predicting ship powering, seakeeping performance, and maneuvering including methodologies and facilities used to obtain these data. Recent state-of-the-art ship designs use not only improvements on the traditional test methods, but also much more sophisticated experiments such as the velocity



mapping of ship wakes using 3D particle image velocimetry (PIV) and other advanced systems to explore finer flow details around ships. In addition to the experimental efforts used to support newer ship designs, computational fluid dynamics (CFD) is becoming a main stream of the ship design tools applied to design ship hull and shipboard machinery.

At Naval Surface Warfare Center, engineers are encouraged to work with industry, academia and others including foreign government agencies to advance ship design technologies. The existing programs such as summer faculty program, various summer intern programs, technology transfer and Cooperative Research and Development Agreements (CRADAs) are discussed

#### Speaker Bio:

Dr. Joseph T. (Tim) Arcano, Jr., a member of the Senior Executive Service since November 2011, was appointed as the technical director for Naval Surface Warfare Center (NSWC) Carderock Division in May 2013. He leads more than 3,000 employees who provide the Navy a broad range of technical support specializing in hull, mechanical and electrical engineering. Prior to his assignment at NSWC Carderock Division, Dr. Arcano served as the director of the National Oceanic and Atmospheric Administration (NOAA) Office of Ocean Exploration, where he was responsible for advising NOAA and the U.S. Department of Commerce in the field of ocean exploration, research and advanced technology development. Prior to his assignment at NOAA, he served as Corbin A. McNeill Endowed Chair in Naval Engineering at the U.S. Naval Academy, and as Deputy Chief of nuclear safety at the U.S. Department of Energy (DOE). He also served as technical director and technical authority (ship design manager) for the VIRGINIA-class Submarine Program, as technical authority for advanced submarines at Naval Sea System Command and as a program manager on technical staff at the Defense Nuclear Facilities Safety Board. For the National Science Foundation, he served as a member of the Replacement Human Occupied Vehicle (HOV) Oversight Committee, overseeing the development of the replacement for the HOV ALVIN. Dr. Arcano served for 30 years of active and Reserve commissioned service in the Navy as an engineering duty officer qualified in submarines, as a salvage diving officer and as an acquisition professional. He retired as a Navy captain. He earned a bachelor of science degree in ocean engineering from the U. S. Naval Academy; a master of science degree in mechanical engineering and an ocean engineering degree from the Massachusetts Institute of Technology; a master of science degree in national resource strategy from the National Defense University Industrial College of the Armed Forces; and a Ph.D. in civil and environmental engineering from the University of Maryland.

## PLENARY TITLE: NANOSCALE HYDRODYNAMICS (ICNMM)

DATE/TIME: WEDNESDAY, JULY 13, 4:00 - 5:40 PM

Room: Regency BC

#### Presenter:



Narayana Aluru, University of Illinois

#### Session Description:

Understanding fluid physics at nanometer scale is important for many applications including water purification, gas separations, energy storage, DNA sequencing, etc. Molecular scale phenomena such as finite size of the molecule compared to the pore/slit size, restricted translational and rotational motions, ballistic diffusion, etc. pose challenges to the classical continuum theory of fluids. To overcome the limitations of the classical theory, molecular approaches such as quantum techniques, molecular dynamics and Monte Carlo methods are popularly used. However, these approaches are limited to small length and short time scales. Here, we discuss the development of a quasi-continuum theory to predict the structure and transport of confined fluids. Quasi-continuum theory seamlessly integrates molecular scale physics into classical theory and we demonstrate the accuracy of the approach by considering several examples.

#### Speaker Bio:

N. R. Aluru received the B.E. degree from the Birla Institute of Technology and Science (BITS), Pilani, India, in 1989, the M.S. degree from Rensselaer Polytechnic Institute, Troy, NY, in 1991, and the Ph.D. degree from Stanford University, Stanford, CA, in 1995. He is currently a Richard W. Kritzer Professor in the Department of Mechanical Science and Engineering at the University of Illinois at Urbana-Champaign (UIUC) and Director of the Computational Science and Engineering Program at Illinois. He is also affiliated with the Beckman Institute for Advanced Science and Technology, National Center for Supercomputing Applications, Department of Electrical and Computer Engineering, and the Bioengineering Department at UIUC. He was a Postdoctoral Associate at the Massachusetts Institute of Technology (MIT), Cambridge, from 1995 to 1997. In 1998, he joined the University of Illinois at Urbana-Champaign (UIUC) as an Assistant Professor.

# Technical Sessions Heat Transfer

MONDAY, JULY, 11

## TRACK 1 HEAT TRANSFER IN ENERGY SYSTEMS (K6) ENERGY CONVERSION

### ENERGY CONVERSION 1-1 ENERGY CONVERSION

**Glacier** **8:30am - 10:10am**

Session Chair: Sophia Haussener, École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland

Session Co-Chair: Ying Sun, Drexel University, Philadelphia, PA, United States

#### High Temperature Concentrated Solar Power Using Liquid Metal

8:30am **Technical Presentation. HT2016-7298**

**Asegun Henry**, Georgia Institute of Technology, Atlanta, GA, United States

#### Thermal Model of a Thin Film Pulsed Pyroelectric Generator

**Technical Paper Publication. HT2016-7437**  
8:55am

**Nicholas R. Jankowski, Brendan M. Hanrahan**, U.S. Army Research Laboratory, Adelphi, MD, United States, **Andrew N. Smith**, U.S. Naval Academy, Severna Park, MD, United States

#### Techno-economics of Waste Heat Harvesting

9:20am **Technical Presentation. HT2016-7508**

**Ravi Prasher**, Lawrence Berkeley National Lab, Berkeley, CA, United States

#### A Computational and Experimental Study of a High Velocity Oxy-fuel System for MHD Generation System Development

9:45am **Technical Presentation. HT2016-7532**

**Hyoungkeun Kim, David Huckaby**, U.S. Dept. of Energy, National Energy Technology L, Morgantown, WV, United States, **Rigel Woodside, Thomas Ochs, Eric Zeuthen**, U.S. Dept. of Energy, National Energy Technology Laboratory, Albany, OR, United States

## FUNDAMENTALS

### 2-1 FUNDAMENTALS I

**Glacier** **2:00pm - 3:40pm**

Session Chair: Laurent Pilon, University of California, Los Angeles, Los Angeles, CA, United States

Session Co-Chair: Nesrin Ozalp, KU Leuven, Leuven, OO, Belgium

#### Boiling Heat Transfer Characteristics over the Tube Bundle in a Pool

**Technical Presentation. HT2016-7094**  
2:00pm

**Naihua Wang, Yongsheng Tian, Zheng Cui, Feng Luo, Lin Cheng**, Shandong University, Jinan, Shandong, China

#### Heat Transfer in Two-Phase Vertical Co-Flow in the presence of a Mesh-Type Bubble Breaker

2:00pm **Technical Paper Publication. HT2016-7122**

**Alan Kalbfleisch**, Western University, London, ON, Canada, **Kamran Siddiqui**, University of Western Ontario, London, ON, Canada

#### Melting in a Rectangular Cavity

2:40pm **Technical Paper Publication. HT2016-7210**

**Yoram Kozak, Genna dy Ziskind**, Ben-Gurion University of the Negev, Beer-Sheva, Israel,

#### Characterization Phase Change Materials (PCM) Using T-History Method

3:00pm **Technical Paper Publication. HT2016-7310**

**Navin Kumar, Debjyoti Banerjee**, Texas A&M University, College Station, TX, United States

#### Design of Cooling Channels in a Lithium Ion Battery Module for an Electric Vehicle

3:20pm **Poster Paper Presentation. HT2016-7527**

**Mustafa Fazil Serincan**, Gebze Technical University, Kocaeli, Turkey, **Mahdi Tabatabaei Malazi**, Istanbul Bilgi University, Istanbul, Turkey

## FUNDAMENTALS

**2-3 FUNDAMENTALS II****Glacier****4:00pm - 5:40pm**

Session Chair: Nesrin Ozalp, KU Leuven, Leuven, OO, Belgium

Session Co-Chair: Sophia Haussener, École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland

4:00pm **Experimental Characterization of Mixed Convection across a Tube Bank****Technical Presentation. HT2016-7217****Hamidreza Shabgard, Ying Sun, Matthew McCarthy**, Drexel University, Philadelphia, PA, United States4:25pm **Effect of Prandtl Number on the Heat Transfer from a Rotating Disk: An Experimental Study****Technical Paper Publication. HT2016-7062****Christian Helcig, Stefan aus der Wiesche**, Muenster University of Applied Sciences, Steinfurt, Germany4:50pm **Tuning Optical Resonances in Ultrathin Planar Films for Solar Energy Conversion Systems****Technical Presentation. HT2016-7141****Dong Liu**, Nanjing University of Science and Technology, Nanjing, China5:15pm **Analysis of the Role of Thermal Capacitance and Thermal Conductivity on Thermal Transient Rectification****Technical Presentation. HT2016-7323****Francisco Herrera, David Go, Tengfei Luo**, University of Notre Dame, Notre Dame, IN, United States**TUESDAY, JULY, 12**

## APPLICATIONS

**3-1 APPLICATIONS I (MEMBRANES, SUPERCRITICAL FLOWS, AND RADIATION)****Glacier****8:30am - 10:10am**

Session Chair: Alexander Rattner, The Pennsylvania State University, University Park, PA, United States

Session Co-Chair: Greg Walker, Vanderbilt University, Nashville, TN, United States

8:30am **Evaluation of the Cover Glasses in Solar Cookers Box-type Considering Conduction Heat Losses in Four Different Solar Cookers****Poster Paper Publication. HT2016-7142****Hilario Terres, Sandra Chavez, Arturo Lizardi, Araceli Lara, Raymundo Lopez**, Universidad Autonoma Metropolitana, Distrito Federal, Mexico8:50am **Retrieving the Conductive and Radiative Properties of Soda-lime Silicate Glassmelts of Soda-lime Silicate Glassmelts from Temperature Measurements****Technical Presentation. HT2016-7071****Hua Liu, Xin-lin Xia**, Harbin Institute of Technology, Harbin, Heilongjiang, China, **Rei Kitamura**, Asahi Glass Corporation, Yokohama-shi, Kanagawa, Japan, **Laurent Pilon**, University of California, Los Angeles, Los Angeles, CA, United States9:10am **Numerical Investigation of Heat Transfer and Condensation Rate in Two-Stage Transport Membrane Condenser Heat Exchanger Units****Technical Paper Publication. HT2016-7291****Soheil Soleimanikutanaei, Cheng-xian Lin**, Florida International University, Miami, FL, United States, **Dexin Wang**, Gas Technology Institute, Des Plaines, IL, United States9:30am **Numerical Investigation on Heat Transfer Enhancement of Supercritical CO<sub>2</sub> Flowing in Heated Vertically Upward Tubes****Technical Paper Publication. HT2016-7300****Qian Zhang, Huixiong Li, Xianliang Lei, Xiangfei Kong, Jialun Liu, Weiqiang Zhang**, Xi'an Jiaotong University, Xi'an, Shaanxi, China9:50am **A New Correlation for Heat Transfer Coefficient Prediction of Supercritical Pressure Water Flowing in Vertical Upward Tubes****Technical Paper Publication. HT2016-7304****Xiangfei Kong, Huixiong Li, Changjiang Liao, Xianliang Lei, Qian Zhang**, Xi'an Jiaotong University, Xi'an, Shaanxi, China

# Technical Sessions Heat Transfer

## APPLICATIONS

### 3-2 APPLICATIONS II (PHASE CHANGE MATERIALS, ABSORPTION SYSTEMS, HEAT PUMPS, AND FOOD PROCESSING)

#### Glacier

10:30am - 12:10pm

Session Chair: Alexander Rattner, The Pennsylvania State University, University Park, PA, United States

Session Co-Chair: Greg Walker, Vanderbilt University, Nashville, TN, United States

10:30am **Numerical Investigation on a Latent Thermal Energy Storage with Aluminum Foam**

Technical Paper Publication. HT2016-7255

**Bernardo Buonomo, Davide Ercole, Oronzio Manca, Sergio Nardini,** Seconda Universita' degli Studi di Napoli, Aversa, Caserta, Italy

10:50am **Hybrid Absorption-based Water Heater Dehumidification System for Humid Climate**

Technical Presentation. HT2016-7356

**Devesh Chugh, Saeed Moghaddam,** University of Florida, Gainesville, FL, United States

11:10am **A Novel Double-Pipe Heat Storage Unit**

Technical Paper Publication. HT2016-7394

**Avi Rozenfeld, Yoram Kozak, Tomer Rozenfeld, Gennady Ziskind,** Ben-Gurion University of the Negev, Beer-Sheva, Israel

11:30am **Evaluation of Heating Process of Apple, Eggplant, Zucchini and Potato by means of their Thermal Properties**

Poster Paper Publication. HT2016-7140

**Hilario Terres, Sandra Chavez, Araceli Lara, Raymundo Lopez, Arturo Lizardi,** Universidad Autonoma Metropolitana, Distrito Federal, Mexico

11:50am **A Study on Operation Strategies of the Raw-water Source Heat Pump System for Energy Saving**

Technical Presentation. HT2016-7384

**Young-Jun KIM, Yong Cho, Hyeon-A LEE,** K-Water, Daejeon, OO, Korea (Republic)

## DESIGN AND PERFORMANCE ANALYSIS

### 4-1 DESIGN AND PERFORMANCE ANALYSIS

#### Glacier

4:00pm - 5:40pm

Session Chair: Fatouh Al-Ragom, Kuwait Institute For Scientific Research, Safat 13109, Kuwait

Session Co-Chair: Ben Xu, Drexel University, Philadelphia, PA, United States

4:00pm **Flow and Heat Transfer Characterization of Highly Porous Wire Mesh Heat Exchangers**

Technical Presentation. HT2016-7276

**Ben Xu, Arif A. Rokoni, Han Hu, Matthew McCarthy, Ying Sun,** Drexel University, Philadelphia, PA, United States

4:20pm **Determination of Temperature Distributions of Fully Wet Rectangular, Triangular, and Parabolic Fins**

Technical Presentation. HT2016-7024

**Abraham Mansouri, Amir Hossein Shourideh, Wael Bou Ajram,** American University in Dubai, Dubai, Dubai, United Arab Emir., Jalal Al Lami, Dubai, United Arab Emir.

4:40pm **Numerical Study on the Thermo Hydraulic Performance of Porous Media of Various Thermal Conductivities Inserted in a Tube**

Technical Paper Publication. HT2016-7056

**Tariq Amin Khan, Wei Li,** Zhejiang University, Hang-Zhou City, China

5:00pm **Designing a Low-pressure Water Evaporation/Boiling System for Refrigeration Systems**

Technical Presentation. HT2016-7418

**Carlos Rios Perez, Carlos Hidrovo, Arjun Venkataramanan, Malcolm LeClair,** Northeastern University, Boston, MA, United States

5:20pm **Experimental Measurement of Flue Gas Temperature versus Ash Accumulation**

Technical Paper Publication. HT2016-7189

**Yuetao Shi, Xiaojuan Wang, Da Chu, Fengzhong Sun,** Shandong University, Jinan, China, **Zhixiong Guo,** Rutgers University, Piscataway, NJ, United States

**WEDNESDAY, JULY, 13****TRACK 2 THERMOPHYSICAL PROPERTIES (K7)****MEASUREMENTS & COMPUTATIONS OF THERMOPHYSICAL PROPERTIES****1-1 INTERFACES, FILMS AND FIBERS****Glacier 2:00pm - 3:40pm**

Session Chair: Nick Roberts, Utah State University, Logan, UT, United States

Session Co-Chair: Heng Ban, Utah State University, Logan, UT, United States

2:00pm **Parallel Measurement of Conductive and Convective Thermal Transport of Micro/Nanowires Based on Raman Mapping**

**Technical Presentation. HT2016-7018**

**Yanan Yue**, Wuhan University, Wuhan, MI, China

2:25pm **Prediction of Thermal Boundary Conductance at the Interface with Phonon Wave-Packet Simulations: The Roles of Vibrational Spectra Differences, Interface Bond Strength, and Inelastic Scattering**

**Technical Paper Publication. HT2016-7177**

**ChangJin Choi, William Tanner Yorgason, Nick Roberts**, Utah State University, Logan, UT, United States

2:50pm **Thermal Boundary Conductance across a Wide Array of Metal/Substrate Combinations**

**Technical Presentation. HT2016-7299**

**John Gaskins, Patrick Hopkins**, University of Virginia, Charlottesville, VA, United States, **Elizabeth Paisley, Jon F. Ihlefeld**, Sandia National Laboratories, Albuquerque, NM, United States

3:15pm **Two-Step Raman Method for Interface Thermal Resistance and In-Plane Thermal Conductivity Characterization of Graphene Interface Materials**

**Technical Paper Publication. HT2016-7362**

**Man Li, Yanan Yue**, Wuhan University, Wuhan, MI, China

**MEASUREMENTS & COMPUTATIONS OF THERMOPHYSICAL PROPERTIES****1-2 THERMOPHYSICAL PROPERTIES OF FLUIDS AND SOLIDS****Glacier 4:00pm - 5:40pm**

Session Chair: Nick Roberts, Utah State University, Logan, UT, United States

Session Co-Chair: Heng Ban, Utah State University, Logan, UT, United States

4:00pm **Improving the Resolution of Steady-State, Infrared-Based Thermal Interface Resistance Measurements Using High-Precision Metrology to Determine In-Situ TIM Thickness**

**Technical Paper Publication. HT2016-7043**

**Ronald Warzoha, Andrew N. Smith, Maurice Harris**, United States Naval Academy, Annapolis, MD, United States

4:20pm **Thermal Conductivity of Cementitious Composites Containing Microencapsulated Phase Change Materials**

**Technical Presentation. HT2016-7070**

**Alexander Ricklefs, Alexander Thiele, Gabe Falzone, Gaurav Sant, Laurent Pilon**, University of California, Los Angeles, Los Angeles, CA, United States

4:40pm **Effect of Carbon Powder on the Fluid Properties of PAM Solution**

**Technical Paper Publication. HT2016-7172**

**Meng Zhang, Hongna Zhang, Sining Li, Xiaobin Li, Fengchen Li**, Harbin Institute of Technology, Harbin, China

5:00pm **Thermophysical Properties of Two-Phase Refrigerant Based Nanofluids in a Refrigeration Cycle**

**Technical Paper Publication. HT2016-7192**

**Bilgehan Tekin, Aselsan Inc., Ankara, Turkey, Almila Guvenc Yazicioglu**, Middle East Technical University, Ankara, Turkey

5:20pm **Numerical Study of Heat Conduction of High Porosity Open-Cell Metal Foam/Paraffin Composite at Pore Scale**

**Technical Paper Publication. HT2016-7386**

**Yuanpeng Yao, Huiying Wu, Zhenyu Liu**, Shanghai Jiao Tong University, Shanghai, Shanghai, China

# Technical Sessions Heat Transfer

**MONDAY, JULY, 11**

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## TRACK 3 THEORY & FUNDAMENTALS IN HEAT TRANSFER (K8)

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### FUNDAMENTALS OF NANOSCALETRANSPORT IN FLOWS 2-1 FUNDAMENTALS OF MICRO/NANOSCALE HEAT TRANSPORT IN FLOWS 1

**Grand Teton** **8:30am - 10:10am**

Session Chair: Yi Zheng, University of Rhode Island, Kingston, RI, United States

Session Co-Chair: Ning Gu, ASML US Inc., San Jose, CA, United States

8:30am **Review of Molten Salt Nanofluids**

**Technical Paper Publication. HT2016-7316**

**Farzam Mortazavi, Debjyoti Banerjee**, Texas A&M University, College Station, TX, United States

8:55am **Selective Emission Properties and vdW Energy of Micro/  
Nano-Sized Spherical Shapes**

**Technical Paper Publication. HT2016-7494**

**Alok Ghanekar, Yi Zheng**, University of Rhode Island, Kingston, RI, United States, **Weixing Zhang, Zongqin Zhang**, R&D Center, Canatal Co., Nanjing, Jiangsu, China, University of Rhode Island, Kingston, RI, United States

9:20am **Model of Nanostructure-Enhanced Liquid Delivery in Thin  
Film Evaporation**

**Technical Presentation. HT2016-7129**

**Arif A. Rokoni, Han Hu, Ying Sun**, Drexel University, Philadelphia, PA, United States

9:45am **Effects of Microscopic Interfacial Interaction on Convective  
Heat Transfer of Water Flow in Graphene Nanochannel**

**Technical Presentation. HT2016-7522**

**Drew C. Marable, Seungha Shin**, University of Tennessee, Knoxville, Knoxville, TN, United States

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### FUNDAMENTALS OF NANOSCALETRANSPORT IN FLOWS 2-2 FUNDAMENTALS OF MICRO/NANOSCALE HEAT TRANSPORT IN FLOWS 2

**Grand Teton** **2:00pm - 3:40pm**

Session Chair: Liqiu Wang, University of Hong Kong, Hong Kong, Hong Kong

Session Co-Chair: Yi Zheng, University of Rhode Island, Kingston, RI, United States

2:00pm **Suspended Particle Streaming in an Oscillatory Mini/Micro  
Bifurcation Network Flow**

**Technical Paper Publication. HT2016-7487**

**Zongqin Zhang, Weixing Zhang**, R&D Center, Canatal Co., Nanjing, Jiangsu, China, **Chandler Liu, Donna Meyer**, Yi Zheng, University of Rhode Island, Kingston, RI, United States,

2:50pm **Beyond Classical Heat Transfer**

**Technical Presentation. HT2016-7019**

**Liqiu Wang**, University of Hong Kong, Hong Kong, Hong Kong

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### FUNDAMENTALS OF NANOMATERIALS AND NANOSTRUCTURES FOR ENERGY APPLICATIONS

#### 3-1 FUNDAMENTALS OF NANOMATERIALS AND NANOSTRUCTURES FOR ENERGY APPLICATIONS

**Grand Teton** **4:00pm - 5:40pm**

Session Chair: JUN JI, Shanghai Maritime University, Shanghai, Shanghai, China

Session Co-Chair: Yi Zheng, University of Rhode Island, Kingston, RI, United States

4:00pm **Spectral Tuning of Radiative Heat Transfer Using  
Nanoparticles**

**Technical Paper Publication. HT2016-7493**

**Alok Ghanekar, Yi Zheng**, University of Rhode Island, Kingston, RI, United States, **Laura Lin**, TU Braunschweig, Braunschweig, Germany, **Zongqin Zhang, Mingdi Sun**, R&D Center, Canatal Co., Nanjing, Jiangsu, China,

4:20pm **A Mie-metamaterial based Thermal Emitter for TPV Applications**

**Technical Paper Publication. HT2016-7123**

**Alok Ghanekar, Yi Zheng**, University of Rhode Island, Kingston, RI, United States

4:40pm **Conformal Map Solutions for Apparent Thermal Slip in the Presence of Meniscus Curvature**

**Technical Presentation. HT2016-7037**

**Lisa Lam**, Merrimack College, Stow, MA, United States, **Marc Hodes**, Tufts University, Medford, MA, United States

5:00pm **Optimized Silica Aerogel Solar Thermal Absorbers**

**Technical Presentation. HT2016-7048**

**A. Alperen Gunay, Naveen Nagarajan, Michael Atten, Jesus Sotelo, Nenad Miljkovic**, University of Illinois at Urbana-Champaign, Urbana, IL, United States,

5:20pm **Heat Transport in Amorphous Silicon and Nanostructured Amorphous Silicon Germanium**

**Technical Presentation. HT2016-7221**

**Jaeyun Moon, Austin Minnich**, California Institute of Technology, Pasadena, CA, United States

## TUESDAY, JULY, 12

### FUNDAMENTALS OF CONVECTION IN POROUS MEDIA 4-1 FUNDAMENTALS OF CONVECTION IN POROUS MEDIA-I

**Grand Teton** **8:30am - 10:10am**

Session Chair: Jose Lage, Southern Methodist University, Dallas, TX, United States

Session Co-Chair: Andrey Kuznestov, North Carolina State University, Raleigh, NC, United States

8:30am **Pore-Scale Modeling of Natural Convection in Reconstructed Porous Media**

**Technical Paper Publication. HT2016-7377**

**Zhenyu Liu, Huiying Wu**, Shanghai Jiao Tong University, Shanghai, China

8:50am **Numerical Simulation of the Convection in a Non-Homogenous Lid-Driven Square Cavity Subjected to a Gravitational Stable Condition**

**Technical Paper Publication. HT2016-7405**

**Vinicius G. Poletto, Fernando C. De Lai, Silvio L.M. Junqueira**, UTFPR, Curitiba, Parana, Brazil, **Admilson T. Franco**, Federal University of Technology - Paraná, Curitiba-Pr, Parana, Brazil

9:10am **Periodic Natural Convection Inside a Fluid Saturated Porous Medium Made of Disconnected Solid Obstacles: A Continuum Approach**

**Technical Paper Publication. HT2016-7294**

**S. Moussa Mirehei, Jose Lage**, Southern Methodist University, Dallas, TX, United States

9:30am **Analysis of the Momentum Transport Boundary Conditions at a Fluid-porous Interface**

**Technical Paper Publication. HT2016-7395**

**Hao Chen, Jiabing Wang, Kun Yang**, Huazhong University of Science and Technology, Wuhan, Hubei, China

### FUNDAMENTALS OF CONVECTION IN POROUS MEDIA 4-2 FUNDAMENTALS OF CONVECTION IN POROUS MEDIA-II

**Grand Teton** **10:30am - 12:10pm**

Session Chair: Jose Lage, Southern Methodist University, Dallas, TX, United States

Session Co-Chair: Andrey Kuznestov, North Carolina State University, Raleigh, NC, United States

10:30am **Exploring Augmentation of Thermal-Fluid Transport in Fractal Architectures**

**Technical Paper Publication. HT2016-7492**

**Surupa Shaw, Debjyoti Banerjee**, Texas A&M University, College Station, TX, United States

# Technical Sessions Heat Transfer

10:50am **Experimental and Numerical Investigation on Mixed Convection in Horizontal Channels Partially Filled with Aluminium Foam and Heated from Below**

**Technical Paper Publication. HT2016-7256**

**Bernardo Buonomo, Luca Cirillo, Oronzio Manca, Sergio Nardini,** Seconda Università degli Studi di Napoli, Aversa, Caserta, Italy

11:10am **Experimental and numerical investigation on natural convection in horizontal channels partially filled with aluminium foam and heated from below**

**Technical Paper Publication. HT2016-7257**

**Bernardo Buonomo,** Seconda Università degli Studi di Napoli, Aversa, Caserta, Italy, **Alessandra Diana,** Università degli Studi di Genova, Genova, Italy, **Oronzio Manca,** Seconda Università degli Studi di Napoli, Aversa (CE), Italy, **Sergio Nardini,** Seconda Università degli Studi di Napoli, Aversa, Caserta, Italy

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## FUNDAMENTALS OF BOILING AND CONDENSATION 5-1 FUNDAMENTALS OF BOILING HEAT TRANSFER

**Bryce** **4:00pm - 5:40pm**

Session Chair: Mirza Shah, Engineering Research Associates, Connecticut, CT, United States

Session Co-Chair: Ming-Chang Lu, National Chiao Tung University, Hsinchu, Taiwan

4:00pm **New Mechanism of CHF Enhancement in Pool Boiling**

**Technical Presentation. HT2016-7196**

**An Zou, Dharendra P. Singh, Shalabh Maroo,** Syracuse University, Syracuse, NY, United States

4:25pm **Effect of Subcooling on Bubble Growth Rate in Pool Boiling**

**Technical Presentation. HT2016-7200**

**Dharendra P. Singh, Ryan M. Olson, An Zou, Shalabh Maroo,** Syracuse University, Syracuse, NY, United States

4:50pm **Numerical Investigation on Heat Transfer Characteristics of High Pressure Boiling Water in Vertical Internally-Ribbed Tubes**

**Technical Paper Publication. HT2016-7296**

**Kaikai Guo, Huixiong Li, Qing Zhang, Weiqiang Zhang, Yuan Feng,** Xi'an Jiaotong University, Xi'an, China

5:15pm **Experimental and Modeling Results for Flow-Boilers (and Flow Condensers) that Operate in Annular Regimes and in High Heat-Flux Modes**

**Technical Presentation. HT2016-7464**

**Amitabh Narain, Ranjeeth Naik, Patcharapol Gorgitrattanakul, Sharayu Bhasme, Hrisikesh R. Prasad,** Michigan Technological University, Houghton, MI, United States, **Michael Kivisalu,** Michigan Technological University, Croton ON Hudson, NY, United States

## WEDNESDAY, JULY, 13

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### FUNDAMENTALS OF BOILING AND CONDENSATION 5-2 FUNDAMENTALS OF CONDENSATION HEAT TRANSFER

**Bryce** **10:30am - 12:10pm**

Session Chair: Sushant Anand, University of Illinois at Chicago, Chicago, IL, United States

Session Co-Chair: Ming-Chang Lu, National Chiao Tung University, Hsinchu, Taiwan

10:30am **Heat Transfer through a Condensate Droplet**

**Technical Presentation. HT2016-7049**

**Shreyas Chavan, Nitish Singla, Yip Fun Yeung, Dong Hoon Kang, Yujin Chang, Nenad Miljkovic,** University of Illinois at Urbana Champaign, Urbana, IL, United States, **Kashif Nawaz,** University of Oklahoma, Norman, OK, United States

10:55am **Internal and External Forced-Convection Jumping-Droplet Condensation on Superhydrophobic Surfaces**

**Technical Presentation. HT2016-7051**

**Patrick Birbarah, Nenad Miljkovic,** University of Illinois, Urbana, IL, United States

11:20am **Simulation of Dropwise Condensation with a Hybrid Volume-of-Fluid and Eulerian Sub-Grid Scale Approach**

**Technical Presentation. HT2016-7275**

**Sanjay Adhikari, Alexander Rattner,** The Pennsylvania State University, University Park, PA, United States



11:45am **The Study on the Effects of Steam Condensation on the Pressure Variations in the Hybrid SIT**

Technical Presentation. HT2016-7525

**Sung Uk Ryu, Woo-Jin Jeon, Sung-Jae Yi**, KAERI, Daejeon, OO, Korea (Republic), **Hyun-Sik Park**, Korea Atomic Energy Res. Inst., Daejeon, Korea (Republic)

## MONDAY, JULY, 11

### TRACK 4 NANOSCALE THERMAL TRANSPORT (K9)

MEASUREMENT TECHNIQUES FOR NANOSCALE HEAT CONDUCTION

#### 1-1 SURFACES AND INTERFACES

##### Regency D

8:30am - 10:10am

Session Chair: Austin Minnich, California Institute of Technology, Pasadena, CA, United States

Session Co-Chair: Patrick Hopkins, University of Virginia, Charlottesville, VA, United States

8:30am **Thermal Transport across Calcium Titanate - Strontium Titanate Interfaces**

Technical Presentation. HT2016-7174

**Ramez Cheaito, Patrick Hopkins**, University of Virginia, Charlottesville, VA, United States, **Jon F. Ihlefeld**, Sandia National Laboratories, Albuquerque, NM, United States

8:50am **Thermal Impact of Point Defect Migration and Buildup at TiO<sub>2</sub>-Electrode Boundaries**

Technical Presentation. HT2016-7178

**Brian Donovan, Patrick Hopkins**, University of Virginia, Charlottesville, VA, United States, **Daniel Long, Ali Moballeggh, Elizabeth Dickey**, North Carolina State University, Raleigh, NC, United States

9:10am **Multi-Frequency 3 Omega Measurements for Tracking Moving Phase Boundaries**

Technical Presentation. HT2016-7181

**Wyatt Hodges, Chris Dames**, University of California Berkeley, Berkeley, CA, United States

9:30am **Direct Measurement of Phonon Specularity Parameter in Silicon Membranes using Transient Grating Spectroscopy**

Technical Presentation. HT2016-7205

**Navaneetha Ravichandran, Hang Zhang, Austin Minnich**, California Institute of Technology, Pasadena, CA, United States

9:50am **Reinvestigating the Thickness-Dependent Thermal Conductivity of Silicon Thin Films using Electrothermal Metrology**

Technical Presentation. HT2016-7390

**Amy Marconnet, Yuqiang Zeng**, Purdue University, West Lafayette, IN, United States

FUNCTIONAL NANOMATERIALS

#### 5-1 FUNCTIONAL NANOMATERIALS

##### Everglades

8:30am - 10:10am

Session Chair: Zhiting Tian, Virginia Polytechnic Institute and State University, Blacksburg, VA, United States

Session Co-Chair: Patrick Hopkins, University of Virginia, Charlottesville, VA, United States

8:30am **High Thermal Rectification Diode using phase change material**

Technical Presentation. HT2016-7124

**Alok Ghanekar, Yi Zheng**, University of Rhode Island, Kingston, RI, United States

8:55am **Thermoelectric properties of nanostructured PbS**

Technical Presentation. HT2016-7147

**Sajad Yazdani, Raana Kashfi, Nasser Khakpash, George A. Rossetti, Jr., L. Suib, Michael Pettes**, The University of Connecticut, Storrs, CT, United States

9:20am **Experimental Investigation of Corrosivity of Molten Salt Nanomaterials for Applications in Concentrated Solar Power as Thermal Energy Storage (TES) and Heat Transfer Fluids (HTF)**

Technical Presentation. HT2016-7307

**Binjian Ma, Harsh Tamakuwala, Farzam Mortazavi, Debjyoti Banerjee**, Texas A&M University, College Station, TX, United States

# Technical Sessions Heat Transfer

9:45am **Thermal Properties of Entropy-Stabilized Oxides**

**Technical Presentation. HT2016-7259**

**Jeffrey Braun, Brian Donovan, Patrick Hopkins**, University of Virginia, Charlottesville, VA, United States, **Christina M. Rost, Jon-Paul Maria**, North Carolina State University, Raleigh, NC, United States

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MEASUREMENT TECHNIQUES FOR NANOSCALE HEAT CONDUCTION

**1-2 MEAN FREE PATH ACCUMULATION AND QUASI-BALLISTIC BEHAVIOR**

**Regency D** **2:00pm - 3:40pm**

Session Chair: Yee Kan Koh, National University of Singapore, Singapore, Singapore

Session Co-Chair: Amy Marconnet, Purdue University, West Lafayette, IN, United States

2:00pm **Fourier-transform Time-domain Thermoreflectance (FT-TDTR) for Studying Non-diffusive Heat Conduction in Semiconductors and Dielectrics**

**Technical Presentation. HT2016-7163**

**Yee Kan Koh, Puqing Jiang, Bin Huang**, National University of Singapore, Singapore, Singapore

2:20pm **Crystalline Coherence Length and Phonon-defect Scattering Effects on the Thermal Conductivity of MgO Thin Films**

**Technical Presentation. HT2016-7231**

**Kelsey Meyer, Ramez Cheaito, Patrick Hopkins**, University of Virginia, Charlottesville, VA, United States, **Elizabeth Paisley, Jon F. Ihlefeld**, Sandia National Laboratories, Albuquerque, NM, United States, **Christopher Shelton, Jon-Paul Maria**, North Carolina State University, Raleigh, NC, United States

2:40pm **Mapping and Controlling Thermal Spectra at the Nanoscale**

**Technical Presentation. HT2016-7363**

**Joon Sang Kang, Ming Ke, Yongjie Hu**, University of California, Los Angeles, Los Angeles, CA, United States

3:00pm **Exploring Quasiballistic Heat Transfer with Nanolines and TDTR**

**Technical Presentation. HT2016-7398**

**Xiangwen Chen, Austin Minnich, Chengyun Hua, Navaneetha Ravichandran, Hang Zhang**, California Institute of Technology, Pasadena, CA, United States

3:20pm **Using Coherent Extreme Ultraviolet Light to Access the Differential Thermal Conductivity Phonon MFP Spectrum of Silicon Below 100nm**

**Technical Presentation. HT2016-7533**

**Travis Frazer, Joshua Knobloch, Jorge Hernandez, Margaret Murnane, Henry Kapteyn, JILA**, University of Colorado Boulder, Boulder, CO, United States

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HARD-SOFT MATERIAL INTERFACES AND THERMAL INTERFACE MATERIALS

**4-1 HARD-SOFT MATERIAL INTERFACES AND THERMAL INTERFACE MATERIALS I**

**Lexington** **2:00pm - 3:40pm**

Session Chair: Pramod Sangi Reddy, University of Michigan, Ann Arbor, MI, United States

Session Co-Chair: Xiaojia Wang, Department of Mechanical Engineering, University of Minnesota, Twin Cities, Minneapolis, MN, United States

2:00pm **Thermal and Mechanical Properties Enhancement in Ultra drawn Polyethylene Nanofibers**

**Technical Presentation. HT2016-7127**

**Ramesh Shrestha, Pengfei Li, Maarten De Boer, Sheng Shen**, Carnegie Mellon University, Pittsburgh, PA, United States

2:16pm **Mixed Molecular Layers Create Unique Methods of Thermal Transport in Organic-Inorganic Heterojunctions**

**Technical Presentation. HT2016-7261**

**Shubhaditya Majumdar, Alan J.H. McGaughey, Jonathan Malen**, Carnegie Mellon University, Pittsburgh, PA, United States

2:32pm **Heat-transport Mechanisms in Molecular Building Blocks of Inorganic/organic Multilayers**

**Technical Presentation. HT2016-7320**

**Ashutosh Giri**, University of Virginia, Charlottesville, VA, United States,  
**Niemelä Janne-Petteri**, Aalto University, Aalto, Finland

2:48pm **Thermal Conductivity of Bottlebrush Polymers by Molecular Dynamics Simulations**

**Technical Presentation. HT2016-7364**

**Hao Ma, Zhiting Tian**, Virginia Polytechnic Institute and State University, Blacksburg, VA, United States

3:04pm **Effect of Particle Size and Aggregation on Thermal Conductivity of Metal-Polymer Nanocomposite**

**Technical Paper Publication. HT2016-7413**

**Xiangyu Li, Wonjun Park, Yong P Chen, Xiulin Ruan**, Purdue University, West Lafayette, IN, United States

3:20pm **Effect of Pressure on Thermal Contact Resistance van der Waals Interfaces**

**Technical Presentation. HT2016-7509**

**Ravi Prasher**, Lawrence Berkeley National Lab, Berkeley, CA, United States

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**MICRO/NANO-STRUCTURED SURFACES FOR PHASE-CHANGE HEAT TRANSFER**

**6-1 BOILING AND THIN FILM EVAPORATION ON NANOENGINEERED SURFACES**

**Bryce** **2:00pm - 3:40pm**

Session Chair: Peter Wang, University of South Carolina, Columbia, SC, United States

Session Co-Chair: Simon Dai, University of Texas at Dallas, University Park, PA, United States

2:00pm **Determination of Mass and Thermal Accommodation Coefficients of an Au-Ar System by Molecular Dynamics Simulations**

**Poster Paper Presentation. HT2016-7077**

**Steven Easter, Pamela Norris**, University of Virginia, Charlottesville, VA, United States

2:25pm **Passive Flow and Negative Liquid Pressures using Molecular Simulations**

**Technical Presentation. HT2016-7114**

**Sumith YD, Shalabh Maroo**, Syracuse University, Syracuse, NY, United States

2:50pm **Patterned Graded Copper Inverse Opals for Phase-Change Heat Transfer**

**Poster Paper Presentation. HT2016-7537**

**Quang Pham, Pranav Dubey, Kuan-Wei Chen, Kimia Montazeri, Yoonjin Won**, University of California, Irvine, Irvine, CA, United States

3:15pm **Bubble Dynamics in Electrowetting-modulated Nucleate Boiling**

**Technical Presentation. HT2016-7332**

**Yi Lu, Carmen Pascente, Paul Ruchhoeft, Dong Liu**, University of Houston, Houston, TX, United States, **Aritra Sur**, Halliburton Inc., Houston, TX, United States

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**THERMAL AND THERMOELECTRIC PROPERTIES OF 2D MATERIALS 7-1 GRAPHENE AND RELATED MATERIALS**

**Everglades** **2:00pm - 3:40pm**

Session Chair: Jun Liu, North Carolina State University, Raleigh, NC, United States

Session Co-Chair: Michael Pettes, University of Connecticut, Storrs, CT, United States

2:00pm **Electronic Control of Phonon Heat Flow across Graphene Interfaces**

**Technical Presentation. HT2016-7138**

**Yee Kan Koh**, National University of Singapore, Singapore, Singapore,  
**Austin Lyons, David Cahill**, University of Illinois at Urbana-Champaign, Urbana, IL, United States, **Eric Pop**, Stanford University, Stanford, CA, United States

2:25pm **Pressure Effects on In-plane and Cross-plane Thermal Transport within Graphene Heterostructures**

**Technical Presentation. HT2016-7251**

**Ali Yousefzadi Nobakht, Seungha Shin**, University of Tennessee, Knoxville, Knoxville, TN, United States

# Technical Sessions Heat Transfer

2:50pm **Thermal Conductance of Interfaces of As-grown and Transferred CVD Graphene with Different Degrees of Conformity**

Technical Presentation. HT2016-7289

**Bin Huang, Yee Kan Koh**, National University of Singapore, Singapore, Singapore, Singapore

3:15pm **Thermal Conductivity of Giant Graphene Supported on Organic Substrate**

Technical Presentation. HT2016-7371

**Jing Liu, Xinwei Wang**, Iowa State University, Ames, IA, United States

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MEASUREMENT TECHNIQUES FOR NANOSCALE HEAT CONDUCTION

**1-3 ADVANCES IN OPTICAL, OPTO-MAGNETIC, AND ELECTROTHERMAL TECHNIQUES**

**Regency D** **4:00pm - 5:40pm**

Session Chair: Renkun Chen, University of California, San Diego, La Jolla, CA, United States

Session Co-Chair: Yongjie Hu, University of California, Los Angeles, Los Angeles, CA, United States

4:00pm **Superb Signal-to-Noise Ratio of Ultrafast Thermal Characterization Using Ferrimagnetic Rare-Earth Transition Metal Transducers**

Technical Presentation. HT2016-7184

**Jun-Yang Chen, Jie Zhu, De-Lin Zhang, Mo Li, Jian-Ping Wang, Xiaojia Wang**, University of Minnesota, Twin Cities, Minneapolis, MN, United States

4:25pm **Direct Thermal Conductivity Measurements of Semiconductors via Frequency-domain Thermoreflectance without using a Metal Temperature Transducer**

Technical Presentation. HT2016-7190

**Lei Wang, Ramez Cheaito, John Gaskins, Patrick Hopkins**, University of Virginia, Charlottesville, VA, United States

4:50pm **Towards Temperature Mapping Using a Scanning Electron Microscope**

Technical Presentation. HT2016-7224

**Md. Imran Khan, Sean Lubner, Chris Dames**, University of California at Berkeley, Berkeley, CA, United States, **David Frank Ogletree, Ed Wong, Molecular Foundry**, Materials Science Division (Lawrence Berkeley National Lab), Berkeley, CA, United States,

5:15pm **Specific Heat Measurements of Individual Polymer Nanofibers**

Technical Presentation. HT2016-7439

**Jianlin Zheng, Matthew Wingert, Renkun Chen**, University of California, San Diego, La Jolla, CA, United States

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MICRO/NANO-STRUCTURED SURFACES FOR PHASE-CHANGE HEAT TRANSFER

**6-3 CONDENSATION AND FREEZING ON MICRO/NANOENGINEERED SURFACES**

**Bryce** **4:00pm - 5:40pm**

Session Chair: Simon Dai, University of Texas at Dallas, University Park, PA, United States

Session Co-Chair: Peter Wang, University of South Carolina, Columbia, SC, United States

4:00pm **Delayed Water Droplet Freezing on Superhydrophobic Surfaces**

Technical Presentation. HT2016-7052

**Shreyas Chavan, Nitish Singla, Nenad Miljkovic**, University of Illinois at Urbana Champaign, Urbana, IL, United States

4:25pm **Trajectory Analysis during Jumping-Droplet Condensation for Heat Flux, Droplet Charge, and Surface Charge Sensing**

Technical Presentation. HT2016-7064

**Patrick Birbarah, Zhaoer Li, Nenad Miljkovic**, University of Illinois at Urbana Champaign, Urbana, IL, United States

4:50pm **Coalescence-Induced Water Nanodroplet Jumping on Superhydrophobic Surfaces**

Technical Presentation. HT2016-7179

**Hyeongyun Cha, Chenyu Xu, Jae Min Chun, Michael Y. Ye, Nenad Miljkovic**, University of Illinois at Urbana Champaign, Urbana, IL, United States

5:15pm **Engineering Surfaces for Enhanced Nucleation and Droplet Removal during Dropwise Condensation**

**Technical Presentation. HT2016-7478**

**Navid Saneie, Sameera Khan, Sushant Anand**, University of Illinois at Chicago, Chicago, IL, United States

**THERMAL AND THERMOELECTRIC PROPERTIES OF 2D MATERIALS 7-2 BEYOND-GRAPHENE 2D MATERIALS**

**Everglades 4:00pm - 5:40pm**

Session Chair: Michael Pettes, University of Connecticut, Storrs, CT, United States

Session Co-Chair: Jun Liu, North Carolina State University, Raleigh, NC, United States

4:00pm **Anisotropic thermal conductivity of black phosphorus**

**Technical Presentation. HT2016-7161**

**Bo Sun, Yee Kan Koh**, National University of Singapore, Singapore, Singapore, Singapore

4:25pm **Tuning Thermal Conductivity in Molybdenum Disulfide by Electrochemical Intercalation**

**Technical Presentation. HT2016-7170**

**Jun Liu**, North Carolina State University, Raleigh, NC, United States, **Gaohua Zhu, Ruigang Zhang, Debasish Banerjee**, Toyota Research Institute of North America, Ann Arbor, MI, United States, **Qiyue Zheng, Dongyao Li, David Cahill**, University of Illinois at Urbana-Champaign, Urbana, IL, United States

4:50pm **Interfacial Energy Coupling between MoS<sub>2</sub> and c-Si**

**Technical Presentation. HT2016-7370**

**Pengyu Yuan, Xinwei Wang**, Iowa State University, Ames, IA, United States

5:15pm **Phonon Mean Free Path Calculations for Few layer h-BN and h-BN/Graphene Composite Structures**

**Technical Presentation. HT2016-7422**

**Hamed Gholivand, Fatma Nazli Donmezler**, Middle East Technical University, Ankara, Turkey

**TUESDAY, JULY, 12**

**ADVANCES IN MODELING AND SIMULATION OF NANOSCALE HEAT CONDUCTION**

**3-1 PHONON MODAL ANALYSIS**

**Regency D**

**8:30am - 10:10am**

Session Chair: Asegun Henry, Georgia Institute of Technology, Atlanta, GA, United States

Session Co-Chair: Xiulin Ruan, Purdue University, West Lafayette, IN, United States

8:30am **Mode-Resolved Continuum Mechanics Model of Phonon Scattering from Embedded Cylinders**

**Technical Paper Publication. HT2016-7219**

**Joseph P. Feser, Vineet Unni**, University of Delaware, Newark, DE, United States

8:50am **Investigating the Modal Contributions to the Heat Transfer across Crystalline and Amorphous Si/Ge Interfaces**

**Technical Presentation. HT2016-7274**

**Kiarash Gordiz, Asegun Henry**, Georgia Institute of Technology, Atlanta, GA, United States

9:10am **Green-Kubo Modal Analysis (GKMA)**

**Technical Presentation. HT2016-7295**

**Asegun Henry**, Georgia Institute of Technology, Atlanta, GA, United States

9:30am **Interface Conductance Modal Analysis (ICMA)**

**Technical Presentation. HT2016-7297**

**Asegun Henry**, Georgia Institute of Technology, Atlanta, GA, United States

9:50am **Thermal Transport across Superlattices: A Landauer Approach**

**Technical Presentation. HT2016-7530**

**Carlos Polanco, Jingjie Zhang, Ramez Cheaito, Patrick Hopkins, Avik W. Ghosh**, University of Virginia, Charlottesville, VA, United States

# Technical Sessions Heat Transfer

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## HARD-SOFT MATERIAL INTERFACES AND THERMAL INTERFACE MATERIALS

### 4-2 HARD-SOFT MATERIAL INTERFACES AND THERMAL INTERFACE MATERIALS II

**Lexington**

**8:30am - 10:10am**

Session Chair: Xiaojia Wang, University of Minnesota, Twin Cities, Minneapolis, MN, United States

Session Co-Chair: Shannon Yee, Georgia Institute of Technology, Atlanta, GA, United States

8:30am **Study of the Thermal Conductance of the Silicides/Silicon Interface**

**Technical Presentation. HT2016-7209**

**Ning Ye, Joseph P. Feser**, University of Delaware, Newark, DE, United States

8:46am **Effect of Anharmonicity on Thermal Conductance at Solid/Solid Interfaces with a Thin Intermediate Layer**

**Technical Presentation. HT2016-7214**

**Rouzbeh Rastgarkafshgarkolaei, Carlos Polanco, Nam Q. Le, Jingjie Zhang, Avik W. Ghosh, Pamela Norris**, University of Virginia, Charlottesville, VA, United States

9:02am **Thermal Boundary Conductance Across Roughened Interfaces.**

**Technical Presentation. HT2016-7239**

**Rohit Kakodkar, Joseph P. Feser**, University of Delaware, Newark, DE, United States

9:18am **Controlling Thermal Interface Conductance with an Intermediate Matching Layer**

**Technical Presentation. HT2016-7399**

**Carlos Polanco, Rouzbeh Rastgarkafshgarkolaei, Jingjie Zhang, Nam Q. Le, Pamela Norris, Avik W. Ghosh**, University of Virginia, Charlottesville, VA, United States

9:34am **Thermal Interfacial Resistance Reduction Between Metal And Dielectric Materials By Inserting Intermediate Metal Layer**

**Technical Paper Publication. HT2016-7414**

**Xiangyu Li, Wonjun Park, Yong P Chen, Xiulin Ruan**, Purdue University, West Lafayette, IN, United States

9:50am **Thermal Boundary Conductance Accumulation at Solid/Liquid Interfaces**

**Technical Presentation. HT2016-7244**

**Chester Szwejkowski, Brian Donovan, Ashutosh Giri, John Gaskins, Patrick Hopkins**, University of Virginia, Charlottesville, VA, United States

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## MICRO/NANO-STRUCTURED SURFACES FOR PHASE-CHANGE HEAT TRANSFER

### 6-4 DROPLET PHASE CHANGE HEAT TRANSFER AND DYNAMICS ON MICRO/NANOENGINEERED SURFACES

**Bryce**

**8:30am - 10:10am**

Session Chair: Aritra Sur, Halliburton Inc., Houston, TX, United States

Session Co-Chair: Simon Dai, University of Texas at Dallas, University Park, PA, United States

8:30am **Droplet Impact on Flexible Substrates for Advanced Thermal Management**

**Technical Presentation. HT2016-7035**

**Patricia Weisensee, Junjiao Tian, Nenad Miljkovic, William King**, University of Illinois at Urbana-Champaign, Urbana, IL, United States

8:50am **Water Freezing Dynamics on Superhydrophobic Surfaces**

**Technical Presentation. HT2016-7054**

**Shreyas Chavan, Nenad Miljkovic**, University of Illinois at Urbana-Champaign, Urbana, IL, United States, **Maneesh Nallapaneni**, National Institute of Technology, Warangal, India, Warangal, Telangana, India

9:10am **Focal Plane Shift Imaging for the Analysis of Jumping-Droplet Condensation**

**Technical Presentation. HT2016-7183**

**Hyeongyun Cha, Jae Min Chun, Nenad Miljkovic**, University of Illinois at Urbana-Champaign, Urbana, IL, United States

9:30am **Dynamics of Droplet Motion Induced by Electrowetting**

**Technical Paper Publication. HT2016-7331**

**Dong Liu, Yi Lu, Paul Ruchhoeft, Carmen Pascente**, University of Houston, Houston, TX, United States, **Aritra Sur**, Halliburton Inc., Houston, TX, United States

9:50am **Wetting Characteristics of Nanograss-Coated Copper Inverse Opals**

**Technical Presentation. HT2016-7535**

**Quang Pham, Pranav Dubey, Kuan-Wei Chen, Kimia Montazeri, Yoonjin Won**, University of California, Irvine, Irvine, CA, United States

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**ADVANCES IN MODELING AND SIMULATION OF NANOSCALE HEAT CONDUCTION**

**3-2 BOLTZMANN TRANSPORT EQUATION SIMULATIONS**

**Regency D** **10:30am - 12:10pm**

Session Chair: Xiulin Ruan, Purdue University, West Lafayette, IN, United States

Session Co-Chair: Yanbao Ma, University of California, Merced, Merced, CA, United States

10:30am **Volume Averaged Phonon Boltzmann Transport Equation for Heat Transport in Nanoporous Composites**

**Technical Presentation. HT2016-7063**

**Columbia Mishra, James Loy, Jayathi Murthy**, The University of Texas at Austin, Austin, TX, United States, **Sanjay Mathur**, Amoeba Technologies, Austin, TX, United States

10:55am **Simulation of Time-Domain Thermoreflectance Experiments Using the Multi-Dimensional Frequency-Dependent Phonon Boltzmann Transport Equation**

**Technical Presentation. HT2016-7078**

**Syed A Ali, Sandip Mazumder**, Ohio State University, Columbus, OH, United States

11:20am **Nondiffusive Thermal Transport Increases Temperature Rise in RRAM Filaments**

**Technical Presentation. HT2016-7266**

**Keith Regner, Jonathan Malen**, Carnegie Mellon University, Pittsburgh, PA, United States

11:45am **Effects of Field Plate on Maximum Temperature and Temperature Distribution for GaN HEMT Devices**

**Technical Paper Publication. HT2016-7367**

**Dogacan Kara, Nazli Donmezer**, Middle East Technical University, Ankara, Turkey, **Talha Furkan Canan, Ozlem Sen**, NANOTAM Research Center, Ankara, Turkey, **Ekmel Ozbay**, Bilkent University, Ankara, Turkey

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**HARD-SOFT MATERIAL INTERFACES AND THERMAL INTERFACE MATERIALS**

**4-3 HARD-SOFT MATERIAL INTERFACES AND THERMAL INTERFACE MATERIALS III**

**Lexington** **10:30am - 12:10pm**

Session Chair: Shannon Yee, Georgia Institute of Technology, Atlanta, GA, United States

Session Co-Chair: Xiaojia Wang, University of Minnesota, Twin Cities, Minneapolis, MN, United States

10:30am **Fabrication and Characterization of Copper Nanowire Arrays as Thermal Interface Materials**

**Technical Presentation. HT2016-7107**

**Wei Gong, Pengfei Li, Sheng Shen**, Carnegie Mellon University, Pittsburgh, PA, United States

10:50am **Thermal Conductivity of Single and Double Silicon Nanoribbons**

**Technical Presentation. HT2016-7245**

**Lin Yang, Yang Yang, Qian Zhang, Matthew D. Gerboth, Greg Walker, Deyu Li**, Vanderbilt University, NASHVILLE, TN, United States

11:10am **Ultralow Thermal Conductivity of Multifunctional Nanotrusses**

**Technical Presentation. HT2016-7293**

**Nicholas Dou, Austin Minnich**, California Institute of Technology, Pasadena, CA, United States

11:30am **Thickness and Density Effects in the Thermal Conductivity of Amorphous Alumina Thin Films Grown via Atomic Layer Deposition**

**Poster Paper Presentation. HT2016-7233**

**Kelsey Meyer, Mallory DeCoster, John Gaskins, Patrick Hopkins**, University of Virginia, Charlottesville, VA, United States, **Brandon Piercy, Mark Losego**, Georgia Institute of Technology, Atlanta, GA, United States

# Technical Sessions Heat Transfer

11:50am **Highly Conductive Thermal Paste of Liquid Metal Alloy Dispersed with Copper Particles**

**Technical Paper Publication. HT2016-7374**

**Gen Li, Yulong Ji, Mengke Wu**, Dalian Maritime University, Dalian, Liaoning, China, **Hongbin Ma**, University Of Missouri, Columbia, MO, United States

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## NANOBUBBLES, NANODROPLETS, AND NANOFLUIDS 8-1 FUNDAMENTAL STUDY OF NANOFLUIDS

**Everglades** **10:30am - 12:10pm**

Session Chair: Calvin Hong Li, Villanova University, Villanova, PA, United States

Session Co-Chair: Debjyoti Banerjee, Texas A&M University, College Station, TX, United States

10:30am **Heat Transfer Enhancement in Ferrofluids Flow In Micro And Macro Parallel Plate Channels: A Comparative Numerical Study**

**Technical Paper Publication. HT2016-7352**

**Aditi Sengupta**, University of Cambridge, Cambridge, England, United Kingdom, **P.S. Ghoshdastidar**, Indian Institute of Technology Kanpur, Kanpur 208016, Uttar Pradesh, India

11:03am **Liquid Layering and the Enhanced Thermal Conductivity of Ar-Cu Nanofluids: A Molecular Dynamics Study**

**Technical Paper Publication. HT2016-7385**

**Jithu Paul, A K Madhu, U B Jayadeep, Choondal B Sobhan**, National Institute of Technology Calicut, Kozhikode, India

11:36am **Addressing the High Temperature Nanofluid Stability Challenge**

**Technical Presentation. HT2016-7495**

**Sara Mesgari, Natasha Hjerrild, Robert Taylor**, UNSW, SYDNEY, NSW, Australia

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## NANOBUBBLES, NANODROPLETS, AND NANOFLUIDS 8-2 APPLICATIONS OF NANOFLUIDS

**Everglades** **4:00pm - 5:40pm**

Session Chair: Debjyoti Banerjee, Texas A&M University, College Station, TX, United States

Session Co-Chair: Calvin Hong Li, Villanova University, Villanova, PA, United States

4:00pm **Study of molten salt nanomaterials for enhanced Thermal Energy Storage (TES) and Heat Transfer Fluid (HTF) Applications**

**Technical Presentation. HT2016-7308**

**Binjian Ma, Debjyoti Banerjee**, Texas A&M University, College Station, TX, United States

4:33pm **Experimental Investigation of Oscillation Controlled Thermal Transport in Water-Based Nanofluids**

**Technical Paper Publication. HT2016-7343**

**Oguz Guven, Murat K. Aktas**, TOBB University of Economics & Technology, Ankara, Turkey, **Yildiz Bayazitoglu**, Rice University, Houston, TX, United States

5:06pm **Enhanced Thermal and Optical Performance of Solar Concentrator Fluids**

**Technical Presentation. HT2016-7498**

**Harjit Singh, Benjamin Rose, Prabesh KHANAL, Nita Verma**, Brunel University London, Uxbridge, United Kingdom, **S Suresh**, National Institute of Technology, Tiruchirappalli, Tamilnadu, India

## WEDNESDAY, JULY, 13

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### NANOSCALE THERMAL RADIATION 2-1 NANOSCALE THERMAL RADIATION 1

**Regency D** **10:30am - 12:10pm**

Session Chair: Sheng Shen, Carnegie Mellon University, Pittsburgh, PA, United States

Session Co-Chair: Yi Zheng, University of Rhode Island, Kingston, RI, United States



10:30am **Theory and Experiment of Thermal-optical Antenna Radiation**

**Technical Presentation. HT2016-7080**

**Baoan Liu, Pengfei Li, Wei Gong, Bowen Yu, Sheng Shen**, Carnegie Mellon University, Pittsburgh, PA, United States

11:03am **Tailoring Germanium-Dielectric Photonic Crystals For Spectrally Selective Absorber**

**Technical Presentation. HT2016-7314**

**Junlong Kou, Austin Minnich**, California Institute of Technology, Pasadena, CA, United States

11:36am **Near-Field Thermal Energy Analysis on Non-Uniform Distributed Nanoparticles**

**Technical Presentation. HT2016-7401**

**Anil Yuksel, Michael Cullinan, Jayathi Murthy**, University of Texas-at Austin, Austin, TX, United States

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## NANOSCALE THERMAL RADIATION 2-2 NANOSCALE THERMAL RADIATION 2

**Regency D** **2:00pm - 3:40pm**

Session Chair: Yi Zheng, University of Rhode Island, Kingston, RI, United States

Session Co-Chair: Sheng Shen, Carnegie Mellon University, Pittsburgh, PA, United States

2:00pm **Nanostructured Materials for Efficient Thermophotovoltaic Power Generation**

**Technical Presentation. HT2016-7528**

**Andrej Lenert**, University of Michigan, Ann Arbor, MI, United States

2:25pm **Nanoscale Radiative Heat Transfer Measured Between Parallel Planar Surfaces**

**Technical Presentation. HT2016-7529**

**Anthony Fiorino**, University of Michigan, Ann Arbor, MI, United States,  
**Bai Song**, University of Michigan, Ann Arbor, MI, United States,  
**Dakotah Thompson, Yashar Ganjeh, Pramod Sangi Reddy, Edgar Meyhofer**, University of Michigan, Ann Arbor, MI, United States

2:50pm **Nanoscale Dielectric Films Enhance Near-Field Radiative Heat Transport**

**Technical Presentation. HT2016-7531**

**Bai Song, Yashar Ganjeh, Seid Sadat, Dakotah Thompson, Anthony Fiorino, Edgar Meyhofer, Pramod Sangi Reddy**, University of Michigan, Ann Arbor, Ann Arbor, MI, United States

3:15pm **Prediction of Reflection and Absorption by Particle Deposit**

**Poster Paper Presentation. HT2016-7518**

**Bahareh Ramezan pour, Daniel W. Mackowski**, Auburn University, Auburn, AL, United States

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## 4-9 TUTORIAL ON PHONON TRANSPORT MODELING: FORMULATION, IMPLEMENTATION, AND APPLICATIONS 4-9-1 TUTORIAL ON PHONON TRANSPORT MODELING-I

**Concord** **2:00pm - 3:40pm**

Session Chair: Xiulin Ruan, Purdue University, West Lafayette, IN, United States

Session Co-Chair: Alan McGaughey, Carnegie Mellon University, Pittsburgh, PA, United States

2:00pm **Tutorial on Phonon Transport Modeling-Part I**

**Invited Presentation. HT2016-7546**

**Alan McGaughey**, Carnegie Mellon University, Pittsburgh, PA, United States

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## ADVANCES IN MODELING AND SIMULATION OF NANOSCALE HEAT CONDUCTION 3-3 THERMAL TRANSPORT SIMULATIONS IN MATERIALS AND NANOSTRUCTURES

**Regency D** **4:00pm - 5:40pm**

Session Chair: Asegun Henry, Georgia Institute of Technology, Atlanta, GA, United States

Session Co-Chair: Yanbao Ma, University of California, Merced, Merced, CA, United States

# Technical Sessions Heat Transfer

4:00pm **Modeling Thermal Conductivity of Aligned CNT-matrix Composites with Increasing Volume Fraction.**

**Technical Paper Publication. HT2016-7145**

**Diana Grandio, Drazen Fabris**, Santa Clara University, Santa Clara, CA, United States

4:20pm **Thermal Transport in Monocrystalline and Polycrystalline Graphene Oxide**

**Technical Presentation. HT2016-7146**

**Xin Mu, David Go, Tengfei Luo**, University of Notre Dame, Notre Dame, IN, United States

4:40pm **Comparative Modeling of Thermal Conductivity in High Aspect Ratio Nanoribbons**

**Technical Presentation. HT2016-7185**

**Matthew D. Gerboth, Lin Yang, Qian Zhang, Deyu Li, Greg Walker**, Vanderbilt University, Nashville, TN, United States

5:00pm **Anharmonicity Rise the Thermal Conductivity in Amorphous Silicon**

**Technical Presentation. HT2016-7227**

**Wei Lv, Asegun Henry**, Georgia Institute of Technology, Atlanta, GA, United States

5:20pm **Wettability and its Relationship with the Thermal Transport and Hydrodynamic Boundary Condition in Nanoconfined Liquids**

**Technical Presentation. HT2016-7506**

**Satish Kumar, George Peterson, Bladimir Ramos-Alvarado**, Georgia Institute of Technology, Atlanta, GA, United States

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**4-9 TUTORIAL ON PHONON TRANSPORT MODELING: FORMULATION, IMPLEMENTATION, AND APPLICATIONS**

**4-9-2 TUTORIAL ON PHONON TRANSPORT MODELING-II**

**Concord** **4:00pm - 5:40pm**

Session Chair: Xiulin Ruan, Purdue University, West Lafayette, IN, United States

Session Co-Chair: Alan McGaughey, Carnegie Mellon University, Pittsburgh, PA, United States

4:00pm **Tutorial on Phonon Transport Modeling-Part II**

**Invited Presentation. HT2016-7547**

**Xiulin Ruan**, Purdue University, West Lafayette, IN, United States

## TUESDAY, JULY, 12

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### TRACK 5 HEAT TRANSFER IN EQUIPMENT (K10)

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ADVANCES IN ENHANCED HEAT TRANSFER

**1-3 INVITED PANEL ON INNOVATIONS IN HEAT EXCHANGER TECHNOLOGY**

**Thornton B**

**8:30am - 10:10am**

Session Chair: Sumanta Acharya, University of Memphis, Memphis, TN, United States

Session Co-Chair: Tiruvadi Ravigururajan, Wichita State University, Wichita, KS, United States

8:30am **Comparison of Various Methods for Fast Optimization of Finned Heat Exchangers**

**Invited Presentation. HT2016-7555**

**Foluso Ladeinde**, TTC Technologies, Stony Brook, NY, United States

8:55am **Next Generation Heat Transfer Devices using Innovative Materials and Manufacturing Processes**

**Invited Presentation. HT2016-7556**

**Arun Muley**, Boeing, Huntington Beach, CA, United States

9:20am **Advanced Enhanced Compact Heat Exchangers – From Miniature to Large-scale Cores**

**Invited Presentation. HT2016-7557**

**Raj M Manglik**, University of Cincinnati, Cincinnati, OH, United States

9:45am **Additive Manufacturing for Single Phase and Phase Change Heat Transfer Augmentation in Heat Exchangers**

**Invited Presentation. HT2016-7559**

**Michael Ohadi**, University of Maryland, College Park, MD, United States

**WEDNESDAY, JULY, 13****ADVANCES IN ENHANCED HEAT TRANSFER****1-1 ADVANCES IN ENHANCED HEAT TRANSFER - I****Yellowstone****10:30am - 12:10pm**

Session Chair: Larry Swanson, GE Power, Irvine, CA, United States

Session Co-Chair: Mark Kedzierski, National Institute of Standards and Technology, Gaithersburg, MD, United States

10:30am **Numerical Investigation of Louver Fin Aluminum Microchannel Heat Exchangers at Low Reynolds Numbers****Technical Paper Publication. HT2016-7329****Pradeep Shinde, Cheng-xian Lin**, Florida International University, Miami, FL, United States, **Mirko Schäfer**, Rud. Otto Meyer Ltd. & Co. KG, Hamburg, Hamburg, Germany10:45am **A CFD-study of the Thermo-hydraulic Characteristics of Pillow-plate Heat Exchangers****Technical Paper Publication. HT2016-7176****Mark Piper, Julian M. Tran, Eugeny Y. Kenig**, University of Paderborn, Paderborn, Germany11:00am **Nusselt Numbers for Fully-Developed Flow between Parallel Plates with One Plate Textured with Isothermal Parallel Ridges****Technical Paper Publication. HT2016-7262****Georgios Karamanis, Marc Hodes**, Tufts University, Medford, MA, United States, **Toby Kirk, Demetrios Papageorgiou**, Imperial College London, London, United Kingdom11:15am **Cooling Performances of Perforated-Finned Heat Sinks****Technical Paper Publication. HT2016-7284****Mohammad Reza Shaeri, Bradley Richard, Richard Bonner**, Advanced Cooling Technologies, Inc., Lancaster, PA, United States11:30am **Thermal-hydraulic performance of open-cell metal foam heat exchangers under dry and wet operating conditions****Technical Paper Publication. HT2016-7322****Kashif Nawaz**, University of Oklahoma, Norman, OK, United States, **Anthony Jacobi**, University of Illinois at Urbana Champaign, Urbana, IL, United States**ADVANCES IN ENHANCED HEAT TRANSFER****1-2 ADVANCES IN ENHANCED HEAT TRANSFER - II****Yellowstone****2:00pm - 3:40pm**

Session Chair: Tiruvadi Ravigururajan, Wichita State University, Wichita, KS, United States

Session Co-Chair: Mark Kedzierski, National Institute of Standards and Technology, Gaithersburg, MD, United States

2:00pm **Heat Transfer Enhancement in Split and Recombine Flow Configurations: A Numerical and Experimental Study****Technical Paper Publication. HT2016-7119****Mojtaba Jarrahi, LIMSI/CNRS**, Univ. Paris-Sud, Université Paris-Saclay, Orsay, France, **Jean-Pierre Thermeau**, IN2P3 -CNRS, Orsay, France, **Hassan Peerhossaini**, Université Paris Diderot, Paris, France2:20pm **Local Heat Transfer Coefficients Measurement under Micro Jet Impinging using Nitrogen gas (N<sub>2</sub>)****Technical Paper Publication. HT2016-7215****Jeong-Heon Shin, Yingying Wang, Yoav Peles**, University of Central Florida, Orlando, FL, United States, **Tomer Rozenfeld, Gennady Ziskind**, Ben-Gurion University of the Negev, Beer-Sheva, Israel, **Ashwin Kumar Vutha**, Rensselaer Polytechnic Institute, Troy, NY, United States,2:40pm **Turbulent Natural Convection in a Composite Enclosure Using the Thermal Non-Equilibrium Model****Technical Paper Publication. HT2016-7327****Marcelo De Lemos**, LCFT-IEME-ITA, Sao Jose dos Campos, Brazil, **Caio Masciarelli**, ITA, Sao Jose dos Campos, Brazil3:00pm **First-order Model of Free-Jet Hydrodynamic Evolution for Heat Transfer Prediction, Including Nozzle and Flow Rate Effects****Technical Paper Publication. HT2016-7388****Ron S. Harnik, Herman Haustein**, Tel Aviv University, Tel Aviv, Israel3:20pm **Optimal Control of Iron Pellet Production****Technical Paper Publication. HT2016-7458****Junxiao Feng, Yanmei Chen, Zhou Jingzhi**, University of Science and Technology Beijing, Beijing, China

## HEAT TRANSFER IN ENERGY-WATER CONSERVATION

### 2-1 HEAT TRANSFER IN ENERGY-WATER CONSERVATION

**Yellowstone**

**4:00pm - 5:40pm**

Session Chair: Tiruvadi Ravigururajan, Wichita State University, Wichita, KS, United States

Session Co-Chair: Yaroslav Chudnovsky, Gas Technology Institute, Des Plaines, IL, United States

4:00pm **Modeling of Heat Transfer and Energy Efficiency Performance of Transient Cold Storage in Phase Change Thermal Storage Components**

Technical Paper Publication. HT2016-7237

**Andrea Helmns, Van Carey**, University of California, Berkeley, CA, United States

4:25pm **Numerical Modeling of Chevron Plate Heat Exchangers for Thermal Management Applications**

Technical Paper Publication. HT2016-7312

**Harsh Tamakuwala, Ryan Von Ness, Debjyoti Banerjee**, Texas A&M University, College Station, TX, United States

4:50pm **Effect of Porous Insert on Heat Transfer in a Backward-Facing Step Flow**

Technical Paper Publication. HT2016-7328

**Marcelo De Lemos**, LCFT-IEME-ITA, Sao Jose dos Campos, Brazil,  
**Wagner Galuppo**, ITA, Sao Jose dos Campos, Brazil

5:15pm **Experimental Study on Flow Patterns for Water Boiling Inside Horizontal Heated Straight Tubes**

Technical Paper Publication. HT2016-7454

**Shaowu Yin, Lige Tong, Chuanping Liu, Li Wang**, School of Mechanical Engineering, University of Science and Technology Beijing, Beijing, China,  
**Ping Wu**, School of Mathematics and Physics, University of Science and Technology Beijing, Beijing, China

## WEDNESDAY, JULY, 13

### TRACK 6 HEAT TRANSFER IN FIRE AND COMBUSTION (K11)

## HEAT TRANSFER IN FIRE AND COMBUSTION

### 1-1 COMBUSTION & FIRE FUNDAMENTALS

**Grand Teton**

**10:30am - 12:10pm**

Session Chair: W.K. Chow, The Hong Kong Polytechnic University, Hong Kong, China

Session Co-Chair: Qiuju Ma, Tsinghua University, Beijing, China

10:30am **Experimental Study on Flame Behavior in Under-Ventilated Train Car**

Technical Paper Publication. HT2016-7334

**K.L. Wong, W.K. Chow, Y.W. Ng**, The Hong Kong Polytechnic University, Hong Kong, China

10:55am **The Mass Burning Rate of n-Heptane Pool Fire Under Dynamic Pressure**

Technical Paper Publication. HT2016-7448

**Qiuju Ma, Quanyi Liu, Runhe Tian, Junjian Ye, Rui Yang, Hui Zhang**, Tsinghua University, Beijing, China

11:20am **Burning of Algae-derived Renewable Jet Fuel, Jet-A, and their Mixtures**

Technical Presentation. HT2016-7265

**Yuhao Xu, Ivan Keresztes, Anthony M. Condo, Jr., Perrine Pepiot, C. Thomas Avedisian**, Cornell University, Ithaca, NY, United States, **Dan Phillips**, Solazyme, Inc., San Francisco, CA, United States

11:45am **Schlieren 3D-CT Reconstruction of Instantaneous Density Distributions of Spark-Ignited Flame Kernels of Fuel-Rich Propane-Air Premixture**

Technical Paper Publication. HT2016-7423

**Yojiro Ishino, Naoki Hayashi, Yuta Ishiko, Ahmad Zaid Nazari, Kimihiro Nagase, Kazuma Kakimoto, Yu Saiki**, Nagoya Institute of Technology, Nagoya, Japan

## HEAT TRANSFER IN FIRE AND COMBUSTION

**1-2 HEAT AND MASS TRANSFER IN COMBUSTION FURNACE SYSTEMS****Grand Teton****2:00pm - 3:40pm**

Session Chair: Bengt Sunden, Lund University, Lund, Sweden

Session Co-Chair: Chenn Zhou, Purdue University Calumet, Hammond, IN, United States

2:00pm **A Numerical Study of Radiative Heat Transfer in a Cylindrical Furnace by Using Finite Volume Method****Technical Paper Publication. HT2016-7095****Bengt Sunden, Zhenhua Wang, Lei Wang**, Lund University, Lund, Sweden, **Shikui Dong, Zhihong He**, Harbin Institute of Technology, Harbin, China, **Weihua Yang**, Nanjing University of Aeronautics and Astronautics, Nanjing, China2:25pm **The Combustion Characteristics of Fuel Oil Emulsified with Glycerol/Water or Crude Glycerol in an Industrial-scale Boiler****Technical Presentation. HT2016-7152****Chih-Chieh Li, Ying-Chi Hsu, Jiunn-Haur Shaw**, Industrial Technology Research Institute, Nantou, Taiwan2:50pm **Numerical Simulation and Optimization of a Carbon Monoxide Boiler****Technical Paper Publication. HT2016-7281****Guangwu Tang, Bin Wu, Chenn Zhou**, Purdue University Calumet, Hammond, IN, United States3:15pm **Investigation of Heat Transfer Phenomena in Blast Furnace Tuyere/Blowpipe Region****Technical Presentation. HT2016-7285****Tyamo Okosun, Guangwu Tang, Bin Wu, Chenn Zhou**, Purdue University Calumet, Hammond, IN, United States

## HEAT TRANSFER IN FIRE AND COMBUSTION

**1-4 EXPERIMENTAL AND COMPUTATIONAL COMBUSTION CHARACTERIZATION****Grand Teton****4:00pm - 5:40pm**

Session Chair: Howard Pearlman, Advanced Cooling Technologies, Inc., Lancaster, PA, United States

Session Co-Chair: Chien-Hua Chen, ACT Inc., Lancaster, PA, United States

4:00pm **Progress on the Development of a "Swiss-Roll" Fuel Reformer for Syngas Production****Technical Paper Publication. HT2016-7277****Chien-Hua Chen, Bradley Richard, Ying Zheng, Howard Pearlman**, Advanced Cooling Technologies, Inc., Lancaster, PA, United States, **Shrey Trivedi, Srushti Koli, Andrew Lawson, Paul Ronney**, University of Southern California, Los Angeles, CA, United States4:33pm **Finite Element Projection Method for Turbulent Reactive flow with Conjugate Heat Transfer****Technical Presentation. HT2016-7369****David Carrington, Jiajia Waters**, Los Alamos National Laboratory, Los Alamos, NM, United States, **Darrell Pepper**, University of Nevada, Las Vegas, Las Vegas, NV, United States5:06pm **Investigation Of Emission Characteristics Of Ethanol And Methanol Blended With Mahua Oil, Rape Seed Oil And Mango Seed Oil As Substitute Fuels In CI Engine****Technical Presentation. HT2016-7490****Dr. Hiregoudar Yerrennagoudaru, Rao Bahadur.Y. Mahabaleswarappa** Engineering College, Bellary-583104; Karnataka-State, India, INDIA, India**MONDAY, JULY, 11****TRACK 8 HEAT TRANSFER IN MULTIPHASE SYSTEMS (K13)**

## 8-1 HEAT TRANSFER IN MULTIPHASE SYSTEMS I

**1-1 HEAT TRANSFER IN MULTIPHASE SYSTEMS IA****Yellowstone****8:30am - 10:10am**

Session Chair: Jungho Kim, University Of Maryland, College Park, College Park, MD, United States

Session Co-Chair: Corey Wilson, Dalian Maritime University, Dalian, Liaoning, China

# Technical Sessions Heat Transfer

8:30am **Heat Transfer Analysis of Phase Change Microcapsules with Thin Film Evaporation**

**Technical Paper Publication. HT2016-7038**

**Yang Guo, Benwei Fu, Yulong Ji, Fengmin Su, Corey Wilson**, Dalian Maritime University, Dalian, Liaoning, China, **Hongbin Ma**, University Of Missouri, Columbia, MO, United States

8:55am **Turbulent Double-Diffusive Free Convection in a Porous Square Cavity Simulated with the Two Temperature**

**Technical Paper Publication. HT2016-7085**

**Marcelo De Lemos**, LCFT-IEME-ITA, Sao Jose dos Campos, Brazil, **Paulo Carvalho**, ITA, Sao Jose dos Campos, Brazil

9:20am **Experimental Investigation on Cryogenic Line Chill-Down Process by Using Liquid Nitrogen**

**Poster Paper Publication. HT2016-7159**

**Lingxue Jin, Changgi Park, Cheonkyu Lee, Sangkwon Jeong**, Korea Advanced Institute of Science and Technology, Daejeon, Korea (Republic), **Mansu Seo, Hyokjin Cho**, Korea Aerospace Research Institute, Daejeon, Korea (Republic)

9:45am **A Combined Heat Pipe Solution for Long Distance Thermal Management**

**Technical Paper Publication. HT2016-7342**

**Steve Cai, Avijit Bhunia**, Teledyne Scientific Company, Thousand Oaks, CA, United States, **Julie Asfia**, Independent Author, Huntington Beach, CA, United States

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## 8-1 HEAT TRANSFER IN MULTIPHASE SYSTEMS I 1-2 HEAT TRANSFER IN MULTIPHASE SYSTEMS IB

**Yellowstone** **2:00pm - 3:40pm**

Session Chair: Corey Wilson, Dalian Maritime University, Dalian, Liaoning, China

Session Co-Chair: Jungho Kim, University Of Maryland, College Park, College Park, MD, United States

2:00pm **Experimental and Numerical Characterization of Droplet-Induced Spreading-Splashing Transition in Surface Cooling**

**Technical Paper Publication. HT2016-7226**

**Taolue Zhang, Jayaveera Muthusamy, Jorge Alvarado**, Texas A&M University, College Station, TX, United States, **Anoop Kanjirakat, Reza Sadr**, Texas A&M University-Qatar, Doha, Qatar

2:25pm **Heat Transfer through Evaporating Thin Film Region**

**Technical Presentation. HT2016-7462**

**Benwei Fu, Nannan Zhao**, Dalian Maritime University, Dalian, China, **Hongbin Ma**, University Of Missouri, Columbia, MO, United States

2:50pm **Experimental and Numerical Study of Jet Impingement Boiling Heat Transfer on Hot Tube Array**

**Technical Paper Publication. HT2016-7351**

**Lu Qiu, Swapnil Dubey, Fook Hoong Choo, Fei Duan**, Nanyang Technological University, Singapore, Singapore

3:15pm **Toward Modular Prediction of Free-Surface Jet Array Cooling: The Hydraulic Jump Location and Non-Monotonous Heat Transfer**

**Technical Paper Publication. HT2016-7400**

**Herman Haustein**, Tel Aviv University, Tel Aviv, Israel

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## 8-2 BOILING HEAT TRANSFER 8-2-1 BOILING HEAT TRANSFER

**Yellowstone** **4:00pm - 5:40pm**

Session Chair: Mirza Shah, Engineering Research Associates, Connecticut, CT, United States

Session Co-Chair: Xuehu Ma, Dalian University of Technology, Dalian, Liaoning Province, Liaoning, China

4:00pm **Effect of Entrainment on Liquid Film Dryout in Vertical Upward Annular Flow**

**Technical Paper Publication. HT2016-7042**

**Zan Wu, Bengt Sundén**, Lund University, Lund, OO, Sweden, **Vishwas Wadekar**, PS2E Institute, Jouy-en-Josas, France

4:20pm **Experimental Study of Nanofin Effect (NFE) in Nucleate Boiling Bubble Dynamics using AAO Nanofins**

**Technical Presentation. HT2016-7309**

**Hongjoo Yang, Navin Kumar, Ronita Roy, Binjian Ma, Yi Wang, Debjyoti Banerjee**, Texas A&M University, College Station, TX, United States

4:40pm **An Experimental Study of Boiling Heat Transfer During Quenching of Nanofluids With Carbon Nanotubes of Various Sizes**

**Technical Paper Publication. HT2016-7319**

**Jiaqi Li, Liwu Fan, Liang Zhang, Zitao Yu**, Zhejiang University, Hangzhou, Zhejiang, China

5:00pm **Flow Patterns During Boiling Instabilities in Silicon-Based Pin-Fin Microchannels**

**Technical Paper Publication. HT2016-7387**

**Fayao Xu, Huiying Wu, Zhenyu Liu**, Shanghai Jiao Tong University, Shanghai, China

5:20pm **Bubble Behavior at an Uneven Wall**

**Technical Paper Publication. HT2016-7393**

**Havatzetlet Shmueli, Gennady Ziskind, Ruth Letan**, Ben-Gurion University of the Negev, Beer-Sheva, Israel

## TUESDAY, JULY, 12

8-3 HEAT TRANSFER IN MULTIPHASE SYSTEMS II

**8-3-1 HEAT TRANSFER IN MULTIPHASE SYSTEMS IIA**

**Yellowstone 10:30am - 12:10pm**

Session Chair: Matthew McCarthy, Drexel University, Philadelphia, PA, United States

Session Co-Chair: Chen Li, University of South Carolina, Columbia, SC, United States

10:30am **Numerical Modeling of Natural Convection Driven Melting for an Inclined/Finned Rectangular Enclosure**

**Technical Paper Publication. HT2016-7068**

**Moe Kabbara, Ali C. Kheirabadi, Dominic Groulx**, Dalhousie University, Halifax, NS, Canada

10:55am **Quantum Dot Temperature Sensor AB INITIO TEST: Droplet Vaporization Heat Transfer**

**Technical Paper Publication. HT2016-7164**

**Jungho Kim, Husain Al Hashimi**, University of Maryland, College Park, College Park, MD, United States

11:20am **Multi-Scale Modeling of Heat Transfer Characteristics of PCM Slurry Flows**

**Technical Presentation. HT2016-7218**

**Hamidreza Shabgard, Han Hu, Matthew McCarthy, Ying Sun**, Drexel University, Philadelphia, PA, United States

11:45am **Experimental Characterization of Melting and Freezing Dynamics within Millimeter Diameter Tubes under Convective Boundary Conditions**

**Technical Presentation. HT2016-7228**

**Deborah Kapilow**, Drexel University, Berkeley Heights, NJ, United States, **Ben Xu, Grace Hsuan, Ying Sun, Matthew McCarthy**, Drexel University, Philadelphia, PA, United States

8-5 CONDENSATION HEAT TRANSFER

**8-5-1 CONDENSATION HEAT TRANSFER**

**Bryce 10:30am - 12:10pm**

Session Chair: Joshua Gess, Oregon State University, Corvallis, OR, United States

Session Co-Chair: Allison Mahvi, Georgia Institute of Technology, Atlanta, GA, United States

10:30am **Heat Transfer and Pressure Drop Characteristics of Condensation for R410A in a 3.78mm Circular Tube Under Normal and Micro Gravity**

**Technical Paper Publication. HT2016-7045**

**Jingzhi Zhang, Wei Li**, Zhejiang University, Hang-Zhou City, China, **Yonghai Zhang**, Xi'an Jiaotong University, Xi'an, China, **Tom Shih**, Purdue University, West Lafayette, IN, United States, **Yanping Shi**, Shanxi FTEC Engineering Co., Ltd., Taiyuan, China, **Yuzhen Niu**, Hangzhou Fortune Group Co., Ltd., Hangzhou, China

# Technical Sessions Heat Transfer

10:55am **The Effect of Surface Tension on Wavy-Laminar Falling-Film Condensation Heat Transfer**

**Technical Presentation. HT2016-7143**

**Mahdi Nabil, Alexander Rattner**, The Pennsylvania State University, University Park, PA, United States

11:20am **Simulation of Droplet Motion on Solid Surfaces under External Force by Lattice Boltzmann Method**

**Technical Presentation. HT2016-7441**

**Benli Peng, Jiaxuan Ma, Chen Li**, University of South Carolina, Columbia, SC, United States, **Zhong Lan, Wei Xu, Rongfu Wen, Xuehu Ma**, Dalian University of Technology, Dalian, Liaoning Province, Liaoning, China

11:45am **Condensation Heat Transfer Enhancement using Circles Hybrid Surface**

**Technical Presentation. HT2016-7442**

**Karim Egab, Benli Peng, Mohammad Alwazzan, Chen Li**, University of South Carolina, Columbia, SC, United States

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## 8-7 THIN FILM EVAPORATION 8-7-1 THIN FILM EVAPORATION

**Regency D** **4:00pm - 5:40pm**

Session Chair: Scott Thompson, Mississippi State University, Mississippi State, MS, United States

Session Co-Chair: Pengtao Wang, University of South Carolina, Columbia, SC, United States

4:00pm **Effect of Nanostructures on Heat Transfer Coefficient of an Evaporating Meniscus in Nucleate Boiling**

**Technical Presentation. HT2016-7128**

**Han Hu, Arif A. Rokoni, Ying Sun**, Drexel University, Philadelphia, PA, United States

4:20pm **Metrics for Quantifying Surface Wetting Effects on Vaporization Processes at Nanostructured Hydrophilic Surfaces**

**Technical Paper Publication. HT2016-7203**

**Claire Kunkle, Van Carey**, University of California, Berkeley, CA, United States

4:40pm **Modeling the Performance of Bi-textured Micro Pillar Array as a Wicked Evaporator**

**Technical Paper Publication. HT2016-7366**

**Hassan Azarkish, Luc G. Frechette**, Universite de Sherbrooke, Sherbrooke, QC, Canada, **Amin Behzadmehr**, University of Sistan and Baluchestan, Zahedan, Iran

5:00pm **A Computational Study of Thin Film Dynamics on Micro-Structured Surfaces**

**Technical Paper Publication. HT2016-7382**

**Linyu Lin, Nam Dinh**, North Carolina State University, Raleigh, NC, United States, **Ram Sampath**, Centroid Lab, Santa Monica, CA, United States, **Nadir Akinci**, Centroid LAB Inc., Ankara, Ankara, Turkey

5:20pm **Sweating-boosted air cooling with water dripping**

**Technical Paper Publication. HT2016-7435**

**Pengtao Wang, Raikan Dawas, Mohammad Alwazzan, Morgan Stefik, Jamil Khan, Chen Li**, University of South Carolina, Columbia, SC, United States

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## WEDNESDAY, JULY, 13

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### 8-3 HEAT TRANSFER IN MULTIPHASE SYSTEMS II 8-3-2 HEAT TRANSFER IN MULTIPHASE SYSTEMS IIB

**Everglades** **10:30am - 12:10pm**

Session Chair: Chen Li, University of South Carolina, Columbia, SC, United States

Session Co-Chair: Matthew McCarthy, Drexel University, Philadelphia, PA, United States

10:30am **Effect of Heat Source Geometry on the Transient Heat Transfer during Melting Process of a PCM**

**Technical Paper Publication. HT2016-7232**

**Mohammad Bashar, Kamran Siddiqui**, University of Western Ontario, London, ON, Canada



10:55am **An Experimental Study of Inward Solidification of Nano-Enhanced Phase Change Materials (NePCM) Inside a Spherical Capsule**

**Technical Paper Publication. HT2016-7317**

**Minjie Liu, Ziqin Zhu, Liwu Fan, Zitao Yu**, Zhejiang University, Hangzhou, Zhejiang, China

11:20am **Melting of a Phase Change Material Filled in a Metal Foam: A Visualized Study at the Pore-Scale Using Infrared Imaging**

**Technical Paper Publication. HT2016-7338**

**Hongqing Jin, Liwu Fan**, Zhejiang University, Hangzhou, Zhejiang, China

11:45am **Numerical Investigation of the Freezing of a Phase Change Material in a Thermal Storage Device with an Embedded Evaporator**

**Technical Paper Publication. HT2016-7409**

**H. Ezzat Khalifa**, Syracuse University, Manlius, NY, United States, **Mustafa Koz**, Syracuse University, Canandaigua, NY, United States

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## 8-4 HEAT TRANSFER IN MULTIPHASE SYSTEMS III 8-4-1 HEAT TRANSFER IN MULTIPHASE SYSTEMS III

**Everglades** **2:00pm - 3:40pm**

Session Chair: Mirza Shah, Engineering Research Associates, Connecticut, CT, United States

Session Co-Chair: Yulong Ji, DaLian Maritime University, DaLian, Liaoning, China

2:00pm **Experimental investigation of two-phase flow heat transfer inside horizontal tubes**

**Technical Paper Publication. HT2016-7156**

**Xu Chen, Wei Li**, Zhejiang University, Hang-Zhou City, China, **Pengfei Mi, Peter Childs**, Imperial College London, London, United Kingdom, **Ekaterina Sokolova**, Peter the Great Saint Petersburg Polytechnic University, St. Petersburg, Russia, **Yuying Yan**, University of Nottingham, Nottingham, United Kingdom

2:20pm **Non-Boiling Heat Transfer of Air/Water Mist Flow in a Square Duct with Orthogonal Ribs**

**Technical Paper Publication. HT2016-7158**

**Yi-Hsuan Huang, Chiao-Hsin Chen**, Yao-Hsien Liu, National Chiao-Tung University, Hsinchu, Taiwan, Taiwan

2:40pm **Visualization of Ice Formation Modes and Flow Blockage during Freezing of Water Flowing in a Microchannel**

**Technical Paper Publication. HT2016-7243**

**Aakriti Jain, Yonghua Huang, Justin A. Weibel, Suresh V Garimella**, Purdue University, West Lafayette, IN, United States

3:00pm **Numerical Investigation of the Melting of a Phase Change Material in a Thermal Storage Device with Embedded Air Flow Channels**

**Technical Paper Publication. HT2016-7412**

**Mustafa Koz**, Syracuse University, Canandaigua, NY, United States, **Hamza S. Erden**, Syracuse University, Syracuse, NY, United States, **H. Ezzat Khalifa**, Syracuse University, Manlius, NY, United States

3:20pm **Transient Analysis of a Cylindrical Heat Pipe Considering Different Wick Structures**

**Technical Paper Publication. HT2016-7469**

**Mehdi Famouri**, University of South Carolina, Cayce, SC, United States, **M. Mahdi Abdollahzadeh**, University of Porto, Porto, Portugal, **Ahmed Abdulshaheed, GuangHan Huang, Chen Li**, University of South Carolina, Columbia, SC, United States, **Gerardo Carbajal**, University of Turabo, Caguas, PR, United States

## WEDNESDAY, JULY, 13

### TRACK 9 GAS TURBINE HEAT TRANSFER (K14)

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#### GAS TURBINE HEAT TRANSFER 1-1 GAS TURBINE HEAT TRANSFER

**Bryce** **4:00pm - 5:40pm**

Session Chair: Srinath Ekkad, Virginia Polytechnic Institute and State University, Blacksburg, VA, United States

Session Co-Chair: Anil Tolpadi, General Electric, Liberty Township, OH, United States

4:00pm **LES Simulations of High Reynolds Number, Rotation and Centrifugal Buoyancy for U-Bend Geometry with Staggered Ribs**

**Technical Paper Publication. HT2016-7348**

**Cody Dowd, Danesh Tafti**, Virginia Polytechnic Institute and State University, Blacksburg, VA, United States

# Technical Sessions Heat Transfer

4:25pm **Steady States Liquid Crystal Thermography for Heat Transfer Measurement in a Rotating Pin Fin Channel**

**Technical Presentation. HT2016-7521**

**Szu Chi Huang, Yao-Hsien Liu**, National Chiao-Tung University, Hsinchu, Taiwan, Taiwan

4:50pm **Experimental Study on the Heat Transfer Characteristics of High Blockage Ribs Channel**

**Technical Presentation. HT2016-7553**

**Weihua Yang**, Nanjing University of Aeronautics and Astronautics, Nanjing, China

5:15pm **Experimental Investigation on Film Cooling Characteristics of Ellipse-shaped Tab**

**Technical Presentation. HT2016-7554**

**Weihua Yang**, Nanjing University of Aeronautics and Astronautics, Nanjing, China

## WEDNESDAY, JULY, 13

### TRACK 10 MANUFACTURING & MATERIALS PROCESSING (K15)

TRANSPORT PHENOMENA IN MANUFACTURING AND MATERIALS PROCESSING

**1-1 TRANSPORT PHENOMENA IN MANUFACTURING AND MATERIALS PROCESSING**

**Sequoia** **10:30am - 12:10pm**

Session Chair: Patrick Mensah, Southern University, Baton Rouge, LA, United States

Session Co-Chair: Stephen Akwaboa, Southern University and A&M College, Baton Rouge, LA, United States

10:30am **USING MICROCT TO VISUALIZE NANOFLUID DROPLET SORPTION PROFILES IN UNSATURATED POROUS MEDIA**

**Technical Paper Publication. HT2016-7325**

**Timothy Munuhe, Ronghui Ma, Liang Zhu**, Alexander Lebrun, University of Maryland, Baltimore County, Baltimore, MD, United States

11:03am **Modelling of Heat Transfer in Welding of Polymeric Materials**

**Technical Presentation. HT2016-7336**

**Jun Zhou, Liyong Sun**, Pennsylvania State University, The Behrend College, Erie, PA, United States

11:36am **In-situ Observation of Growth Process of Silicon Nitride Nano-belts and Their Microstructure**

**Poster Paper Presentation. HT2016-7457**

**Jinguang Yang, Ping Wu, Dan Yan, Shiping Zhang**, School of Mathematics and Physics, University of Science and Technology Beijing, Beijing, China

TRANSPORT PHENOMENA IN MANUFACTURING AND MATERIALS PROCESSING

**1-2 TRANSPORT PHENOMENA IN MATERIALS PROCESSING WITH LASERS AND PLASMAS**

**Sequoia** **2:00pm - 3:40pm**

Session Chair: Yi Zheng, University of Rhode Island, Kingston, RI, United States

Session Co-Chair: Milind Jog, University of Cincinnati, Cincinnati, OH, United States

2:00pm **Effects of Beam Size and Pulse Duration on the Laser Drilling Process**

**Technical Paper Publication. HT2016-7339**

**Nazia Afrin, Pengfei Ji, Jinn-Kuen Chen, Yuwen Zhang**, University Of Missouri, Columbia, MO, United States

2:33pm **Three-Dimensional Numerical Simulations off Nitrogen Gas Jet Impinging Onto A Laser Cut Kerf: Ejected Mass Flow And Overall Heat Transfer Rates Estimations**

**Technical Presentation. HT2016-7136**

**Omar Melhem, LIU**, Tripoli, Lebanon

3:06pm **Thermomechanical and Nanoscale Thermal Transport Dissipation Mechanisms during Pulsed Laser Ablation of Metal Films**

**Poster Paper Presentation. HT2016-7539**

**John Tomko, Brian Donovan, Patrick Hopkins**, University of Virginia, Charlottesville, VA, United States, **Daniel Bubb, Sean O'Malley**, Rutgers University, Camden, NJ, United States

**MONDAY, JULY, 11****TRACK 11 HEAT TRANSFER IN ELECTRONIC EQUIPMENT (K16)****HEAT TRANSFER IN ELECTRONIC EQUIPMENT  
(MOBILE DEVICES, LEDS, PHOTONICS ETC)****1-2 ACTIVE HEAT-SINKS****Thornton Lounge****8:30am - 10:10am**

Session Chair: Vivek Sahu, Qualcomm, San Diego, CA, United States

Session Co-Chair: Yoon Jo Kim, Washington State University Vancouver, Vancouver, WA, United States

8:30am **A Comparison of Numerical Strategies for Optimal Liquid Cooled Heat Sink Design****Technical Paper Publication. HT2016-7076****Ali C. Kheirabadi, Dominic Groulx**, Dalhousie University, Halifax, NS, Canada8:55am **Novel Jet Impingement Array Geometries through 3D Printed Manifolds****Technical Presentation. HT2016-7216****Evan M. Glanzer, Gregory J. Michna**, South Dakota State University, Brookings, SD, United States9:20am **Fluid Dynamics, Heat Transfer and Manufacturing Limits of a Liquid cooled Micro-feature Heat Sink****Technical Presentation. HT2016-7538****Noris Gallandat**, Technical Consultant, Atlanta, Vaud, Switzerland, **Rhett Mayor**, DHX Machines, Hoschton, GA, United States**HEAT TRANSFER IN ELECTRONIC EQUIPMENT  
(MOBILE DEVICES, LEDS, PHOTONICS ETC)****1-3 THERMAL MANAGEMENT OF POWER ELECTRONICS****Thornton Lounge****2:00pm - 3:40pm**

Session Chair: Joshua Gess, Oregon State University, Corvallis, OR, United States

Session Co-Chair: Banafsheh Barabadi, MIT, Cambridge, MA, United States

2:00pm **A Roadmap for Building Thermal Models for AlGaIn/GaN HEMTs: Simplifications and Beyond****Technical Paper Publication. HT2016-7383****Mohammad Azarifar, Nazli Donmezer**, Middle East Technical University, Ankara, Turkey2:20pm **High Resolution Temperature Measurement of GaN-based Transistors under Different Bias Conditions****Technical Presentation. HT2016-7406****Banafsheh Barabadi, Kevin Bagnall, Daniel Piedra, Tomas Palacios, Evelyn Wang**, Massachusetts Institute of Technology, Cambridge, MA, United States, **David McCloskey**, Trinity College Dublin, Dublin, Ireland2:40pm **Power Packaging Thermal Model for Parametric Analyses****Technical Presentation. HT2016-7436****Lauren M. Boteler**, U.S. Army Research Laboratory, Adelphi, MD, United States3:00pm **Experimental Investigation of Thermal Management of Tablet Computers using Phase Change Materials (PCMs)****Technical Paper Publication. HT2016-7067****Tousif Ahmed, Maha Bhourri, Samer Kahwaji, Dominic Groulx, Mary Anne White**, Dalhousie University, Halifax, NS, Canada3:20pm **Numerical Evaluation of Multiple Phase Change Materials for Pulsed Electronics Applications****Technical Paper Publication. HT2016-7223****David Gonzalez-Nino, Pedro O. Quintero**, Universidad de Puerto Rico, Mayagüez, PR, United States, **Lauren M. Boteler, Dimeji Ibitayo, Nicholas R. Jankowski**, U.S. Army Research Laboratory, Adelphi, MD, United States**HEAT TRANSFER IN ELECTRONIC EQUIPMENT  
(MOBILE DEVICES, LEDS, PHOTONICS ETC)****1-4 THERMAL MANAGEMENT GENERAL****Thornton Lounge****4:00pm - 5:40pm**

Session Chair: Gregory J. Michna, South Dakota State University, Brookings, SD, United States

Session Co-Chair: Dominic Groulx, Dalhousie University, Halifax, NS, Canada

4:00pm **Analysis of gas diffusion-induced Cassie to Wenzel state transition on a structured surface**

# Technical Sessions Heat Transfer

## Technical Paper Publication. HT2016-7278

**Jonah Kadoko, Marc Hodes, Georgios Karamanis**, Tufts University, Medford, MA, United States, **Toby Kirk**, Imperial College London, London, United Kingdom

4:20pm **Laser Induced Implantation Doping of Glass Substrates**

## Technical Paper Publication. HT2016-7402

**Sepehr Sadeh, Kunal Mitra**, Florida Institute of Technology, Melbourne, FL, United States

4:40pm **Low Cost Thermal Transient Anemometer for Challenging Gas Flow Rate Measurements**

## Technical Presentation. HT2016-7428

**Khoudor Keniar, Srinivas Garimella**, Georgia Institute of Technology, Atlanta, GA, United States, **Alexander Rattner**, The Pennsylvania State University, University Park, PA, United States

5:00pm **Recent Advances in Fast Modeling of Airflow and Heat Transfer in Data Centers**

## Technical Presentation. HT2016-7499

**Cheng-xian Lin, Long Phan**, Florida International University, Miami, FL, United States

5:20pm **Elmore Delay as an Estimator of Convective Coupling in Pulsed Electronic Packages**

## Technical Presentation. HT2016-7523

**Nicholas R. Jankowski**, U.S. Army Research Laboratory, Adelphi, MD, United States, **F. Patrick McCluskey**, University of Maryland, College Park, MD, United States

## TUESDAY, JULY, 12

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HEAT TRANSFER IN ELECTRONIC EQUIPMENT  
(MOBILE DEVICES, LEDS, PHOTONICS ETC)  
**1-5 PANEL ON THERMAL MODEL VALIDATION IN POWER SYSTEMS**

**Thornton Lounge** **8:30am - 10:10am**

Session Chair: Mark Spector, Office of Naval Research, Arlington, VA, United States

8:30am **Panel on Thermal Model Validation**

Invited Presentation. HT2016-7220

**Mark Spector**, Office of Naval Research, Arlington, VA, United States

8:46am **Thermal Validation in Power Systems- Design and Initial Data**

## Invited Presentation. HT2016-7548

**Yogendra Joshi**, Georgia Institute of Technology, Atlanta, GA, United States

9:02am **Thermal Validation in Power Systems- Data Comparison**

## Invited Presentation. HT2016-7549

**Martin Cerza**, US Naval Academy, Annapolis, MD, United States

9:18am **Thermal Validation in Power Systems- Interaction between Modelling, Design of Testbed, Testing and Model Validation**

## Invited Presentation. HT2016-7550

**Bart Eussen**, NLR, Amsterdam, Netherlands

9:34am **Thermal Validation in Power Systems- Dynamic Model of a Water Chiller System**

## Invited Presentation. HT2016-7551

**Kevin McCarthy**, PC Krause and Associates, West Lafayette, IN, United States

9:50am **Thermal Validation in Power Systems - Simulations, Experiments and Uncertainty Propagation**

## Invited Presentation. HT2016-7552

**John Doty**, Doty Consulting Services, Dayton, OH, United States

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HEAT TRANSFER IN ENERGY CONVERSION TECHNOLOGIES  
(PV, TE, AND OTHER RENEWABLE TECHNOLOGIES)

## 2-1 HEAT TRANSFER IN ENERGY CONVERSION TECHNOLOGIES

**Thornton Lounge** **10:30am - 12:10pm**

Session Chair: Amir Shooshtari, Researcher, College Park, MD, United States

10:30am **Design of a Magnetic Cooling Device using Gadolinium Alloy and Permanent Magnets**

## Technical Paper Publication. HT2016-7202

**Amanie Abdelmessih, Paul Bartholomae, Matthew L. Casillas, Rocky E. De Lyon, Joshua F Flaherty, Bradley D. Goolsby, Moriah Langley**,

**Lindsey A. Livoni, Trevor W. Logan, Nicolas J. Perhach, Jonathan J. Repogle, Daniel R. Swann, Garrett M. Williams**, California Baptist University, Riverside, CA, United States

10:55am **Numerical investigation of heat transfer characteristics of a novel wavy-tapered microchannel heat sink**

**Technical Paper Publication. HT2016-7432**

**Ahmed Eltaweel, Abdulla Baobeid, Brian Tompkins, Ibrahim Hassan**, Texas A&M University at Qatar, Dohar, Qatar

11:20am **Phosphor-Based Luminescent Solar Concentrators**

**Technical Presentation. HT2016-7426**

**Michael Hughes, Diana-Andra Borca-Tasciuc, Deborah Kaminski**, Rensselaer Polytechnic Institute, Troy, NY, United States

11:45am **Flow and Heat Transfer Study of an Impinging Piezoelectric Fan over a Vertical Surface**

**Technical Paper Publication. HT2016-7097**

**Shadi Habibi Parsa, Omidreza Ghaffari, Mehmet Arik**, Ozyegin University, Istanbul, Istanbul, Turkey, **Stephen. A. Solovitz**, Washington State University-Vancouver, Vancouver, WA, United States

## TUESDAY, JULY, 12

### TRACK 12 HEAT AND MASS TRANSFER IN BIOTECHNOLOGY (K17)

BIOTRANSPORT AT THE NANO- AND MICRO- SCALE  
1-1 BIO TRANSPORT AT THE NANO AND MICRO SCALE

**Thornton Lounge** **4:00pm - 5:40pm**

Session Chair: Rupak Banerjee, University of Cincinnati, Cincinnati, OH, United States

Session Co-Chair: Nichole Marissa Rylander, University of Texas at Austin, Austin, TX, United States

4:00pm **Enhanced Localized Hyperthermia Using Magnetic Nanoparticles During High Intensity Focused Ultrasound (HIFU) Procedures**

**Technical Presentation. HT2016-7280**

**Surendra Devarakonda, Seyed Ahmad Reza Dibaji, Rupak Banerjee**, University of Cincinnati, Cincinnati, OH, United States, **Prasanna Hariharan**, FDA, Silver Spring, MD, United States, **Matthew Myers**, U. S.

Food and Drug Administration, Potomac, MD, United States

4:25pm **High Resolution Calorimetry for Biological Application**

**Technical Presentation. HT2016-7431**

**Sahngki Hong, Edward Dechaumphai, Renkun Chen**, University of California, San Diego, La Jolla, CA, United States

4:50pm **Investigation of the Characteristics and Distribution of Internal Moisture in Wheat Kernal during Drying using Infrared Spectrum and Nuclear Magnetic Resonance**

**Technical Paper Publication. HT2016-7460**

**Mengzhuo Li, Ping Wu, Dan Yan, Shiping Zhang, Xianglong Li, Bing Ji**, School of Mathematics and Physics, University of Science and Technology Beijing, Beijing, China, **Li Wang**, School of Mechanical Engineering, University of Science and Technology Beijing, Beijing, China

5:15pm **Using Thermoelectric Cooling With Tourniquets for Nerve Preservation**

**Technical Paper Publication. HT2016-7236**

**Mark Trupiano, Shahram Aarabi, Ashley Emery**, University of Washington, Seattle, WA, United States

## TUESDAY, JULY, 12

### TRACK 13 HEAT TRANSFER UNDER EXTREME CONDITIONS (K18)

HEAT TRANSFER UNDER EXTREME CONDITIONS  
1-1 HEAT TRANSFER UNDER EXTREME CONDITIONS

**Grand Teton** **4:00pm - 5:40pm**

Session Chair: Zhixiong Guo, Rutgers University, Piscataway, NJ, United States

Session Co-Chair: Qiuwang Wang, Xi'an Jiaotong University, Xi'an, Shaanxi, China, Xuehu Ma, Dalian University of Technology, Dalian, Liaoning Province, Liaoning, China

4:00pm **Heat Transfer Characteristics of Aviation Kerosene in Vertical Upward High Flux Tubes at Supercritical Pressure**

**Technical Paper Publication. HT2016-7110**

**Jingxiang Chen, Yachao Song, Wei Li**, Zhejiang University, Hangzhou, China, **Guoqiang Xu, Jie Wen, Haiwang Li, Zhi Tao**, Beihang University, Beijing, China

4:20pm **Molecular Dynamics Simulation on Diffusion Welding between Cu and Al under Different Pressures and Roughnesses**

Technical Paper Publication. HT2016-7380

**Xionghui Li, Wenxiao Chu, Ting Ma, Qiuwang Wang**, Xi'an Jiaotong University, Xi'an, Shaanxi, China

4:40pm **Condensation Heat Transfer Enhancement of Steam-Air Mixture Vapor on the Finned Tubes with Different Surface Wettabilities**

Technical Paper Publication. HT2016-7381

**Xuehu Ma, Zhong Lan, Rui Jiang, Meng Lin, Kun Jin**, Dalian University of Technology, Dalian, Liaoning Province, Liaoning, China

5:00pm **A Numerical Study on 2-D Flow and Heat Transfer in a Natural Gas Heater**

Technical Paper Publication. HT2016-7061

**Yun Guo**, Shanghai University of Engineering Science, Shanghai, China, **Zhixiong Guo**, Rutgers University, Piscataway, NJ, United States

5:20pm **Cryogenic Temperature Monitoring via Optical PDMS Sensors**

Technical Paper Publication. HT2016-7188

**Matthew Frenkel, Zhixiong Guo**, Rutgers University, Piscataway, NJ, United States

## MONDAY, JULY, 11

### TRACK 15 COMPUTATIONAL HEAT TRANSFER (K20)

MESOSCALE AND NANOSCALE MODELING AND SIMULATION OF FLUID AND HEAT TRANSFER

**1-1 K-20 COMPUTATIONAL HEAT TRANSFER & K-8 THEORY AND FUNDAMENTAL RESEARCH: MESOSCALE AND NANOSCALE MODELING AND SIMULATION OF FLUID AND HEAT TRANSFER I**

**Thornton C**

**8:30am - 10:10am**

Session Chair: Yanbao Ma, University of California, Merced, Merced, CA, United States

Session Co-Chair: Ruhul Amin, Montana State University, Bozeman, MT, United States, Ashley Emery, University of Washington, Seattle, WA, United States, Sumanta Acharya, University of Memphis, Memphis, TN, United States

8:30am **A Numerical Parametric Study of Flow and Heat Transfer in Circular and Zig-zag Square Microchannel Heat Sinks**

Technical Paper Publication. HT2016-7438

**Wenming Li, Tamanna Alam, Congcong Ren**, University of South Carolina, Columbia, SC, United States, **Fanghao Yang**, IBM, Yorktown Heights, NY, United States

8:55am **Sensitivity of Thermal Conductivity to Force Estimates in Molecular Dynamics Simulations**

Technical Presentation. HT2016-7199

**Casey Brock, Matthew D. Gerboth, Greg Walker**, Vanderbilt University, Nashville, TN, United States

9:20am **A New Outlet Boundary Condition Scheme for Phase-field Lattice Boltzmann Model**

Technical Presentation. HT2016-7160

**Long Li, Yongwen Liu, Ming Su**, Shanghai Jiao Tong University, Shanghai, Shanghai, China

9:45am **Characterization and Modification of a Mesoscale Temperature Gradient**

Technical Presentation. HT2016-7272

**Shayan Davani, Niel D. Crews**, Louisiana Tech University, Ruston, LA, United States

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## COMPUTATIONAL HEAT TRANSFER METHODS AND ALGORITHMS 2-1 K-20 COMPUTATIONAL HEAT TRANSFER: COMPUTATIONAL HEAT TRANSFER METHODS

**Thornton C**

**2:00pm - 3:40pm**

Session Chair: Samuel Subia, Sandia National Laboratories, Albuquerque, NM, United States

Session Co-Chair: Shima Hajimirza, Texas A&M University, College Station, TX, United States, **Keith Woodbury**, University of Alabama, Tuscaloosa, AL, United States

2:00pm **Hybrid Ballistic-Diffusive Solution of the Frequency-Dependent Phonon Boltzmann Transport Equation**

Technical Paper Publication. HT2016-7079

**Pareekshith Allu, Sandip Mazumder**, Ohio State University, Columbus, OH, United States

2:20pm **Reduced Order Modeling Applied to the Discrete Ordinates Method for Radiation Heat Transfer in Participating Media**

Technical Paper Publication. HT2016-7010

**John Tencer, Marvin Larsen, Roy Hogan**, Sandia National Laboratories, Albuquerque, NM, United States, **Kevin Carlberg**, Sandia National Laboratories, California, Livermore, CA, United States

2:40pm **Transient Two-Dimensional Heat Conduction Problem with Partial Heating near Corners**

Technical Paper Publication. HT2016-7103

**Robert McMasters**, Virginia Military Institute, Lexington, VA, United States, **Filippo de Monte**, University of L'Aquila, L'Aquila, Italy, **James Beck**, Michigan State University, East Lansing, MI, United States, **Donald Amos**, Sandia National Laboratories, Albuquerque, NM, United States

3:00pm **Topology Optimization for Fluid Flow Applications using an Unstructured Finite Volume Scheme**

Technical Presentation. HT2016-7324

**Ajay Vadakkepatt, Jayathi Murthy**, The University of Texas At Austin, Austin, TX, United States, **Sanjay Mathur**, Amoeba Technologies, Austin, TX, United States

3:20pm **Multi-fidelity Modeling in Predictive Heat Transfer: A New Framework for Combining Experimental Correlations and Numerical Simulations**

Technical Presentation. HT2016-7491

**Hessam Babae**, Massachusetts Institute of Technology, Cambridge, MA, United States, **Paris Perdikaris, Chryssostomos Chryssostomidis**, Massachusetts Institutes of Technology Sea Grant, Cambridge, MA, United States, **George Karniadakis**, Brown University, Providence, RI, United States

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## COMPUTATIONAL HEAT TRANSFER METHODS AND ALGORITHMS 2-3 K-20 COMPUTATIONAL HEAT TRANSFER: COMPUTATIONAL HEAT TRANSFER METHODS IN PHASE CHANGE AND POROUS FLOW

**Thornton C**

**4:00pm - 5:40pm**

Session Chair: Xiuling Wang, Purdue University Calumet, Hammond, IN, United States

Session Co-Chair: Samuel Subia, Sandia National Laboratories, Albuquerque, NM, United States

4:00pm **Lattice Boltzmann Method Simulation of 3-D Melting Using Double MRT Model with Interfacial Tracking Method**

Technical Paper Publication. HT2016-7407

**Zheng Li, Yuwen Zhang**, University of Missouri, Columbia, MO, United States, Mo Yang, USST, Shanghai, China

4:20pm **Water Droplet Evaporation by Substrate Heating in Molecular Dynamics**

Technical Presentation. HT2016-7111

**Sumith YD, Shalabh Maroo**, Syracuse University, Syracuse, NY, United States

4:40pm **Quantifying Nano-Enhancement in Organic Phase Change Materials**

Technical Presentation. HT2016-7249

**Aaron Wemhoff**, Villanova University, Villanova, PA, United States

# Technical Sessions Heat Transfer

5:00pm **InterThermalPhaseChangeFoam - an Open Source Platform for Liquid-Vapor Phase Change CFD**

**Technical Presentation. HT2016-7403**

**Alexander Rattner, Mahdi Nabil, Sanjay Adhikari**, The Pennsylvania State University, University Park, PA, United States

5:20pm **Conditions that Diminish Numerical Accuracy in Level Set Methods**

**Technical Presentation. HT2016-7408**

**Mario F Trujillo, Lakshman Anumolu, Doug Ryddner**, University of Wisconsin, Madison, WI, United States

## TUESDAY, JULY, 12

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COMPUTATIONAL HEAT TRANSFER INDUSTRIAL APPLICATIONS  
**3-1 K-20 COMPUTATIONAL HEAT TRANSFER: APPLICATIONS OF COUPLED HEAT AND FLUID FLOW**

**Thornton C**

**8:30am - 10:10am**

Session Chair: Gerard Jones, Villanova University, Villanova, PA, United States

Session Co-Chair: Jorge Alvarado, Texas A&M University, College Station, TX, United States, Kevin Dowding, Sandia National Labs, Albuquerque, NM, United States, Elia Merzari, Argonne National Laboratory, Lemont, IL, United States

8:30am **Heat Transfer in Non-Newtonian Laminar Impinging Jets**

**Technical Paper Publication. HT2016-7340**

**Ajay Chatterjee, Drazen Fabris**, Santa Clara University, Santa Clara, CA, United States

8:50am **The Heat Transfer Behavior of a Suddenly Expanding Viscoplastic Flow Field**

**Technical Paper Publication. HT2016-7365**

**Khaled J. Hammad**, Central Connecticut State University, Simsbury, CT, United States

9:10am **Application of Inverse Heat Conduction Method and Method of Lines in Spray Cooling of Heated Surface**

**Technical Paper Publication. HT2016-7477**

**Ramin Soujoudi**, University of Texas at San Antonio, San Antonio, TX, United States

9:30am **Experimental Analysis and Investigation for Thermal Performance of Ventilated Disc Brake Rotor Using CFD**

**Technical Paper Publication. HT2016-7020**

**Mahesh Chopade**, MIT College of Engineering, Maharashtra, India, **Avinash Valavade**, Bharati Vidyapeeth Pune, Pune, India

9:50am **Investigation for Thermal Performance of Ventilated Disc Brake Rotor Using CFD**

**Technical Presentation. HT2016-7489**

**Mahesh Chopade**, MIT College of Engineering, Maharashtra, India

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COMPUTATIONAL HEAT TRANSFER INDUSTRIAL APPLICATIONS  
**3-3 K-20 COMPUTATIONAL HEAT TRANSFER: APPLICATIONS OF CONVECTION HEAT TRANSFER**

**Thornton C**

**10:30am - 12:10pm**

Session Chair: Sandip Mazumder, Ohio State University, Columbus, OH, United States

Session Co-Chair: Abhijit Mukherjee, California State University Northridge, Northridge, CA, United States

10:30am **Numerical Simulation of Heat Transfer and Pressure Drop Characteristics of Microfin Tubes**

**Technical Paper Publication. HT2016-7047**

**Jingzhi Zhang, Jinpin Lin, Wei Li**, Zhejiang University, Hang-Zhou City, China

10:55am **Mixed Convection Heat Transfer in an Annulus with Rotating Inner Cylinder**

**Technical Paper Publication. HT2016-7148**

**Yadukrishnan Nair, Venkateshan Shakkottai, Bhamidi Prasad**, Indian Institute of Technology Madras, Chennai, Tamil Nadu, India



11:20am **Numerical Simulation of Rayleigh-Bénard Convection of Cold Water near Its Density Maximum in a Rectangular Cavity with Aspect Ratio 2**

**Technical Presentation. HT2016-7032**

**You-Rong Li, Yu-peng Hu, Chun-Mei Wu, Jia-Jia Yu**, Chongqing University, Chongqing, China

11:45am **Direct Numerical Simulations of Thermal-solutal Capillary-buoyancy Flow of Silicon-germanium Melt in an Annular Pool**

**Technical Presentation. HT2016-7041**

**Jia-Jia Yu, You-Rong Li, Chun-Mei Wu**, Chongqing University, Chongqing, China

## WEDNESDAY, JULY, 13

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### COMPUTATIONAL HEAT TRANSFER INDUSTRIAL APPLICATIONS 3-4 K-20 COMPUTATIONAL HEAT TRANSFER: ENERGY AND HEAT EXCHANGER APPLICATIONS

**Bunker Hill** **10:30am - 12:10pm**

Session Chair: Elia Merzari, Argonne National Laboratory, Lemont, IL, United States

Session Co-Chair: Jorge Alvarado, Texas A&M University, College Station, TX, United States

10:30am **Analysis on Impact of Turbulence Parameters and Swirl Angle Variation on Isothermal Gas Turbine Combustor Flows**

**Technical Paper Publication. HT2016-7134**

**Sandeep Kedukodi, David Gomez Ramirez, Srinath Ekkad**, Virginia Polytechnic Institute and State University, Blacksburg, VA, United States, **Hee Koo Moon, Yong W. Kim, Ram Srinivasan, Solar Turbines Inc.**, San Diego, CA, United States

10:50am **Numerical Simulation for Wind Turbine Wake and Effects from Different Atmospheric Boundary Conditions**

**Technical Paper Publication. HT2016-7303**

**Peng Zhou, Xiuling Wang**, Purdue University Calumet, Hammond, IN, United States

11:10am **Numerical and Experimental Study of Lead-Acid battery**

**Technical Paper Publication. HT2016-7475**

**Vicente D. Munoz-Carpio**, University of Guanajuato / West Virginia University, Morgantown, WV, United States, **Jerry Mason, Ismail Celik**, West Virginia University, Morgantown, WV, United States, **Francisco Elizalde Blancas**, Universidad De Guanajuato, Salamanca, Guanajuato, Mexico, **Alejandro Alatorre-Ordaz**, University of Guanajuato, Guanajuato, Guanajuato, Mexico

11:30am **Modeling of Steel Slab Reheating Process in a Walking Beam Reheating Furnace**

**Technical Paper Publication. HT2016-7282**

**Guangwu Tang, Arturo Saavedra, Bin Wu, Tyamo Okosun, Chenn Zhou**, Purdue University Calumet, Hammond, IN, United States, **Dengqi Bai, Yufeng Wang, Rick Bodnar**, SSAB Americas, Muscatine, IA, United States

11:50am **A Computational Model for Sodium Sulfur Battery in a Stack Setup**

**Technical Presentation. HT2016-7463**

**Hayri Sezer**, Worcester Polytechnic Institute, Worcester, MA, United States, **Mehmet Aygun, Ismail Celik**, West Virginia University, Morgantown, WV, United States

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### OPTIMIZATION AND NUMERICAL MODELING OF ENERGY SYSTEMS 5-1 K-20 COMPUTATIONAL HEAT TRANSFER AND K-6 HEAT TRANSFER IN ENERGY SYSTEMS: OPTIMIZATION AND NUMERICAL MODELING OF ENERGY SYSTEMS I

**Bunker Hill** **2:00pm - 3:40pm**

Session Chair: Bakhtier Farouk, Drexel University, Philadelphia, PA, United States

Session Co-Chair: Kyle Daun, University of Waterloo, Waterloo, ON, Canada, **Shima Hajimirza**, Texas A&M University, College Station, TX, United States, **John Tencer**, Sandia National Laboratories, Albuquerque, NM, United States

2:00pm **A Novel Machine-Learning Aided Optimization Technique for Material Design: Application in Thin Film Solar Cells**

**Technical Paper Publication. HT2016-7306**

**Shima Hajimirza**, Texas A&M University, College Station, TX, United States

# Technical Sessions Heat Transfer

2:25pm **Numerical Modeling of Thermo-cycling Characterization of Phase Change Materials (PCM)**

**Technical Presentation. HT2016-7311**

**Navin Kumar, Harsh Tamakuwala, Debjyoti Banerjee**, Texas A&M University, College Station, TX, United States

2:50pm **Simulation and Optimization of a Binary Refrigerant Refrigeration System**

**Technical Presentation. HT2016-7452**

**Bakhtier Farouk, Wangshu Wei, Samuel Beccaria**, Drexel University, Philadelphia, PA, United States

3:15pm **Solution of Inverse Problems in Thermal Systems**

**Technical Presentation. HT2016-7515**

**Yogesh Jaluria**, Rutgers University, Piscataway, NJ, United States

## TUESDAY, JULY, 12

### TRACK 17 HEAT TRANSFER VISUALIZATION (K22)

HEAT TRANSFER VISUALIZATION GALLERY

**1-1 HEAT & MASS TRANSFER PHOTOGALLERY I**

**Yellowstone**

**4:00pm - 5:40pm**

Session Chair: Justin A. Weibel, Purdue University, West Lafayette, IN, United States

Session Co-Chair: David Pratt, NASA, Miamisburg, OH, United States

4:00pm **Frost Wave Propagation on Hydrophilic, Hydrophobic and Superhydrophobic Surfaces**

**Poster Paper Presentation. HT2016-7081**

**Shreyas Chavan, Hanmash Gunnam, Nenad Miljkovic**, University of Illinois at Urbana Champaign, Urbana, IL, United States

4:20pm **3D Printing of Spark-Ignited Flame Kernels, Experimentally Captured by 3D-Computer Tomography and Multi-Directional Schlieren Photography**

**Technical Presentation. HT2016-7424**

**Yojiro Ishino, Naoki Hayashi, Yuta Ishiko, Ahmad Zaid Nazari, Kimihiro Nagase, Kazuma Kakimoto, Yu Saiki**, Nagoya Institute of Technology, Nagoya, Japan

4:40pm **Visualization of Microscale Transpiration Cooling for Gas Turbine Applications**

**Technical Presentation. HT2016-7445**

**Jungho Lee, Hyung-Soo Lim, Jeong-Min Seo, Je Sung Bang, Jeong Lak Sohn**, Korea Institute of Machinery and Materials, Deajeon, Korea (Republic), **Sang Gun Lee**, Seoul National University, Seoul, Korea (Republic)

5:00pm **Numerical Simulation of Evaporating Two-Phase Flow in a High-Aspect-Ratio Microchannel with Bends**

**Invited Presentation. HT2016-7505**

**Justin A. Weibel**, Purdue University, West Lafayette, IN, United States

5:20pm **ESEM Imaging of Condensation Process on a Hybrid Superhydrophobic and Superhydrophilic Surface**

**Invited Presentation. HT2016-7540**

**Hongbin Ma**, University of Missouri, Columbia, MO, United States

## WEDNESDAY, JULY, 13

HEAT TRANSFER VISUALIZATION GALLERY

**1-2 HEAT & MASS TRANSFER PHOTOGALLERY II**

**Lexington**

**10:30am - 12:10pm**

Session Chair: David Pratt, NASA, Miamisburg, OH, United States

Session Co-Chair: Chang Kyoung Choi, Michigan Technological University, Houghton, MI, United States

10:30am **Pancake Droplet Bouncing on Flexible Superhydrophobic Substrates**

**Poster Paper Presentation. HT2016-7036**

**Patricia Weisensee, Junjiao Tian, Nenad Miljkovic, William King**, University of Illinois at Urbana-Champaign, Urbana, IL, United States

10:50am **Multi-Droplet Coalescence-Induced Droplet-Jumping on Superhydrophobic Surfaces**

**Poster Paper Presentation. HT2016-7186**

**Hyeongyun Cha, Jae Min Chun, Yuehan Xu, Nenad Miljkovic**, University of Illinois at Urbana-Champaign, Urbana, IL, United States

11:10am **Photopolymerizing Monodisperse Nonspherical Oxidized Methacrylated Alginate Microgels using Microfluidics**

**Technical Presentation. HT2016-7353**

**Shuo Wang, Chang Kyoung Choi**, Michigan Technological University, Houghton, MI, United States

11:30am **Experimental and Numerical Visualization of Droplet-Induced Crown Splashing Dynamics**

**Poster Paper Presentation. HT2016-7429**

**Taolue Zhang, Jayaveera Muthusamy, Jorge Alvarado**, Texas A&M University, College Station, TX, United States, **Anoop Kanjirakat, Reza Sadr**, Texas A&M University-Qatar, Doha, Qatar

11:50am **Orientation Effects on Pool Boiling of Microporous Coating in Water**

**Invited Presentation. HT2016-7510**

**Seung M. You**, The University Of Texas At Dallas, Richardson, TX, United States

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## HEAT TRANSFER VISUALIZATION GALLERY

### 1-3 HEAT & MASS TRANSFER PHOTOGALLERY III

**Lexington**

**2:00pm - 3:40pm**

Session Chair: Matthew McCarthy, Drexel University, Philadelphia, PA, United States

Session Co-Chair: Justin A. Weibel, Purdue University, W Lafayette, IN, United States

2:00pm **Shock Trains Characteristic of Supersonic Air Ejector**

**Invited Presentation. HT2016-7496**

**Daotong Chong**, Xi'an Jiaotong University, Xi'an, China

2:20pm **Jumping Droplet Visualization for Heat Flux and Charge Sensing**

**Poster Paper Presentation. HT2016-7065**

**Patrick Birbarah, Zhaoer Li, Nenad Miljkovic**, University of Illinois at Urbana-Champaign, Urbana, IL, United States

2:40pm **Nanoparticle Deposition Patterns regarding Different Surface Wettability in the Contact Line Region of the Nanofluid Droplets**

**Technical Presentation. HT2016-7427**

**Chang Kyoung Choi, Dong Hwan Shin, Jeffrey Allen**, Michigan Technological University, Houghton, MI, United States, **Seong Hyuk Lee**, Chung-Ang University, Seoul, Korea (Republic), **Jungho Lee**, Korea Institute of Machinery and Materials, Deajeon, Korea (Republic)

3:00pm **Effect of Dual Frequency Ultrasound on the Bubble Formation in a Capillary Tube**

**Technical Paper Publication. HT2016-7453**

**Benwei Fu, Nannan Zhao, Guoyou Wang**, Dalian Maritime University, Dalian, China, **Hongbin Ma**, University Of Missouri, Columbia, MO, United States

3:20pm **Evaporation-induced Non-wetting Water Droplets on Hot Silicon Micropillars**

**Invited Presentation. HT2016-7501**

**Evelyn Wang**, Massachusetts Institute of Technology, Cambridge, MA, United States

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## HEAT TRANSFER VISUALIZATION GALLERY

### 1-4 HEAT & MASS TRANSFER PHOTOGALLERY IV

**Lexington**

**4:00pm - 5:40pm**

Session Chair: Chang Kyoung Choi, Michigan Technological University, Houghton, MI, United States

Session Co-Chair: Kenneth Kihm, University of Tennessee, Knoxville, TN, United States

4:00pm **Visual Onset of Nucleate Boiling in Water Spray Cooling on Hot Steel Plate**

**Technical Presentation. HT2016-7446**

**Jungho Lee**, Korea Institute of Machinery and Materials, Deajeon, Korea (Republic), **Sang Gun Lee**, Seoul National University, Seoul, Korea (Republic)

# Technical Sessions Heat Transfer

4:25pm **Temperature Controlled Formation of Layered APTES Self-assembly Films on Mica**

**Invited Presentation. HT2016-7500**

**Fei Long, Chang Kyoung Choi**, Michigan Technological University, Houghton, MI, United States

4:50pm **Thin Film Condensation supported on Ambiphilic Microstructures**

**Invited Presentation. HT2016-7503**

**Matthew McCarthy**, Drexel University, Philadelphia, PA, United States

5:15pm **Icing Characteristics of Supercooled Liquid Droplet Using SPR Imaging Method**

**Invited Presentation. HT2016-7516**

**Seong Hyuk Lee, Chan Ho Jeong, Chung-Ang** Univeristy, Seoul, Korea (Republic), **Dong Hwan Shin**, Korea Institute of Science and Technology(KIST), Seoul, Korea (Republic), **Vinaykumar Konduru, Jeffrey Allen, Chang Kyoung Choi**, Michigan Technological University, Houghton, MI, United States

## MONDAY, JULY, 11

### TRACK 19 PLENARY SPEAKERS

19-1 PLENARY SESSIONS

**19-1-1 PLENARY SESSION I**

**Regency BC** **10:30am - 12:10pm**

Session Chair: Sumanta Acharya, University of Memphis, Memphis, TN, United States

10:30am **How can Thermal Science and Engineering help Decarbonize the Global Energy System**

**Plenary Presentation. HT2016-7517**

**Arun Majumdar**, Stanford University, Stanford, CA, United States

## TUESDAY, JULY, 12

19-1 PLENARY SESSIONS

**19-1-2 PLENARY SESSION II**

**Regency BC** **2:00pm - 3:40pm**

Session Chair: Raj M Manglik, University of Cincinnati, Cincinnati, OH, United States

2:00pm **Nucleate Pool Boiling Heat Transfer at Different Levels of Gravity**

**Plenary Presentation. HT2016-7346**

**Vijay Dhir**, University of California, Los Angeles, Los Angeles, CA, United States

## WEDNESDAY, JULY, 13

19-1 PLENARY SESSIONS

**19-1-3 PLENARY SESSION III**

**Regency BC** **8:30am - 10:10am**

Session Chair: Yogesh Jaluria, Rutgers University, Piscataway, NJ, United States

8:30am **Combustion of Bio and Surrogate Fuels: A Hot Subject with Cool Flames**

**Plenary Presentation. HT2016-7345**

**C. Thomas Avedisian**, Cornell University, Ithaca, NY, United States

## MONDAY, JULY, 11

### TRACK 20 GENERAL PAPERS

20-1 GENERAL PAPERS IN HEAT TRANSFER

**20-1-1 GENERAL PAPERS IN HEAT TRANSFER**

**Yosemite** **8:30am - 10:10am**

Session Chair: Chris Kobus, Oakland University, Rochester, MI, United States

Session Co-Chair: Michael Pate, Texas A&M University, College Station, TX, United States, Cheng-xian Lin, Florida International University, Miami, FL, United States

8:30am **Effects of the ISS Operations on the Thermal Control System of AMS**

Poster Paper Publication. HT2016-7069

**Zheng Cui, Feng Luo, Naihua Wang, Lin Cheng**, Shandong University, Jinan, Shandong, China, **Yu LIU**, Tsinghua University, Beijing, Beijing, China

8:55am **Energy Saving Effect of Different Wall Structures based on Intermittent Energy Use Characteristics in a Hot Summer and Cold Winter Zone**

Technical Paper Publication. HT2016-7108

**Yanyan Zhu**, Qingdao University of Science & Technology, Qingdao, China, **Wei Li, Bin Zhou**, Zhejiang University, Hang-Zhou City, China, **David Kukulka**, State University of New York/Buffalo, Buffalo, NY, United States

9:20am **Numerical Study on Natural Convection from a Row of Heated Pipes Embedded in an Air-Filled Cavity**

Technical Paper Publication. HT2016-7173

**Chean Chin Ngo**, California State University, Fullerton, Fullerton, CA, United States, **Baqer A. Alhabeeb**, University of Kerbala, Fraiha, Kerbala, Iraq

9:45am **The Thermodynamic and Dimensional Analysis of a Chinese Artifact Called pee-pee boy shows a Well-designed Heat Engine**

Technical Presentation. HT2016-7425

**Daniel Attinger**, Iowa State University, Ames, IA, United States, **Vincent Le**, Georgia Institute of Technology, Atlanta, GA, United States

**TUESDAY, JULY, 12**

**TRACK 21 FEDERAL FUNDING OPPORTUNITIES IN THE THERMAL-SCIENCES**

21-1 FEDERAL FUNDING OPPORTUNITIES IN THERMAL-SCIENCES  
21-1-1 FEDERAL FUNDING OPPORTUNITIES IN THERMAL-SCIENCES

**Regency BC**

**4:00pm - 5:40pm**

Session Chair: James Klausner, Michigan State University, East Lansing, MI, United States

4:00pm **Thermal Science Research Opportunities-National Science Foundation**

Invited Presentation. HT2016-7541

**Jose Lage**, Southern Methodist University, Dallas, TX, United States

4:20pm **Thermal Science Research Funding Opportunities - Office of Naval Research**

Invited Presentation. HT2016-7542

**Mark Spector**, Office of Naval Research, Arlington, VA, United States

4:40pm **Thermal Science Research Opportunities- Advanced Research Project Agency-Energy(ARPAE)**

Invited Presentation. HT2016-7543

**Addison Stark**, ARPA-E, Washington DC, United States

5:00pm **Thermal Science Research Opportunities-Department of Energy (Building Technologies)**

Invited Presentation. HT2016-7544

**Patrick Phelan**, U.S. Department of Energy, Washington, DC, United States

5:20pm **Thermal Science Research Opportunities - U.S Department of Energy (Concentrated Solar Power-Sun Shot Program)**

Invited Presentation. HT2016-7545

**Joseph Stekli**, U.S. Department of Energy, Washington, DC, United States

## MONDAY, JULY, 11

### TRACK 1 FORUM ON ADVANCES IN FLUIDS ENGINEERING EDUCATION

#### 1-1 FLUIDS ENGINEERING EDUCATION

##### Grand Teton 10:30am - 12:10pm

Session Organizer: Ray Taghavi, University of Kansas, Lawrence, KS, United States

Session Co-Organizer: Ganesh Raman, Illinois Institute of Technology, Chicago, IL, United States

10:30am **Learning by Doing on Computational Fluid Dynamics**

Technical Publication. FEDSM2016-7504

**Teresa Parra-Santos, Mariano Cacho Perez, J. Ruben Perez**, University of Valladolid, Valladolid, Spain, **Jose Miguel Molina Jorda**, University of Alicante, Alicante, Spain, **Gabriel Luna Sandoval**, Universidad Estatal de Sonora, San Luis, Mexico,

10:50am **An Educational Laboratory with a Remote Controlled Centrifugal Pump Test Rig**

Technical Publication. FEDSM2016-7557

**Bastian Dolle, Friedrich-karl Benra, Dieter Brillert, Hans Josef Dohmen**, University of Duisburg-Essen, Duisburg, Germany

11:10am **Application Building in Undergraduate Courses with a Simulation Component**

Technical Publication. FEDSM2016-7844

**Ivana Milanovic, Tom Eppes**, University of Hartford, Simsbury, CT, United States,

11:30am **Effectiveness of Demonstration and Visualization based Teaching Resources to Enhance Students' Learning**

Technical Presentation Only. FEDSM2016-7987

**Yogendra Panta**, West Virginia University Institute of Technology, Montgomery, WV, United States

11:50am **Integration of Hands-on Computational Fluid Dynamics (CFD) and Particle Image Velocimetry (PIV) in Undergraduate Curriculum**

Technical Presentation Only. FEDSM2016-7988

**Yogendra Panta**, West Virginia University Institute of Technology, Montgomery, WV, United States

## MONDAY, JULY, 11

### TRACK 2, 17TH SYMPOSIUM ON TURBOMACHINERY FLOW SIMULATION AND OPTIMIZATION

#### 2-4 TURBO IV - DESIGN

##### Congressional D 10:30am - 12:10pm

Session Organizer: Yu-Tai Lee, Naval Surface Warfare Center, West Bethesda, MD, United States

Session Co-Organizer: Chunill Hah, NASA Glenn Research Center, Cleveland, OH, United States

10:30am **Aerodynamic Performance Analysis of Radial-Inflow Turbine Using CFD Simulation in Comparison with Mean-Line Method**

Technical Publication. FEDSM2016-7556

**Amir Karimi Noughabi**, AmirKabir University of Technology, Tehran, Iran, **Mehran Tadjfar**, Amirkabir University of Technology (Tehran polytechnic), Tehran, Iran

10:50am **Effects of blade inlet width on performance of centrifugal pump as turbine with special impeller using in turbine mode**

Technical Publication. FEDSM2016-7667

**Tao Wang**, Xiaobing Liu, Xide Lai, Qiuqin Gou, Xihua University, Chengdu, China

11:10am **Research on Unsteady Flow in Centrifugal Pumps Considering the Interaction of Each Component in Pump Unit**

Technical Publication. FEDSM2016-7654

**Hui Sun, Yin Luo, Shouqi Yuan, Yihang Guo**, Jiangsu University, Zhenjiang, China

11:30am **Centrifugal Compressor Impeller Blade Rake Angle Numerical Study**

**Technical Publication. FEDSM2016-7540**

**Aleksandr Drozdov, Yuri Galerkin**, Peter the Great St. Petersburg Polytechnic University, St. Petersburg, Russia

11:50am **Loading Factor Performance of a Centrifugal Compressor Impeller. Specific Features and Way of Modeling**

**Technical Presentation Only. FEDSM2016-7952**

**Kristina Soldatova, Yury Galerkin**, Peter the Great St. Petersburg Polytechnic University, St. Petersburg, Russia

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## 2-1 TURBO I - SIMULATION

**Congressional D** **2:00pm - 3:40pm**

Session Organizer: Chunill Hah, NASA Glenn Research Center, Cleveland, OH, United States

Session Co-Organizer: Hiroyoshi Watanabe, Ebara Corporation, Futtsu-shi, Chiba, Japan

2:00pm **Modeling Transition on Smooth and Rough Blades**

**Technical Publication. FEDSM2016-7563**

**Liang Wei, Jacob George**, MetroLaser Inc., Laguna Hills, CA, United States, **Xuan Ge**, University of Memphis, Memphis, TN, United States, **Paul Durbin**, Iowa State University, Ames, IA, United States

2:20pm **Numerical Analysis of SDBD-Plasma Based Separation Control on the Blades of a Rotating Impeller**

**Technical Publication. FEDSM2016-7538**

**Shawn Aram, Yu-Tai Lee, Hua Shan**, Naval Surface Warfare Center, Carderock Division, West Bethesda, MD, United States,

2:40pm **CFD Study of Flow in Shroud Cavity of Centrifugal Compressor Impeller**

**Technical Publication. FEDSM2016-7523**

**Kristina Soldatova**, Peter the Great St. Petersburg Polytechnic University, St. Petersburg, Russia

3:00pm **CFD Analysis of Performance of Five-Stage High-Pressure Volute Pump**

**Technical Publication. FEDSM2016-7799**

**Takayuki Suzuki, Takashi Takemura**, Ebara Corporation, Futtsu-shi, Japan,

3:20pm **Calculation Analysis of an Axial Compressor Supersonic Stage Impeller**

**Technical Publication. FEDSM2016-7528**

**Kristina Soldatova, Aleksey Rekstin**, Peter the Great St. Petersburg Polytechnic University, St. Petersburg, Russia

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## 2-2 TURBO II - COMPONENT ANALYSIS

**Congressional D** **4:00pm - 5:40pm**

Session Organizer: Hiroyoshi Watanabe, Ebara Corporation, Futtsu-shi, Chiba, Japan

Session Co-Organizer: Chunill Hah, NASA Glenn Research Center, Cleveland, OH, United States

4:00pm **Flow Analysis and Design Improvement of a Heat Sink of an Integrated Starter Generator**

**Technical Publication. FEDSM2016-7875**

**Sangwoo Song, Nahmkeon Hur**, Sogang University, Seoul, Korea (Republic), **Jeongki Kwon, Hyundai Mobis, Yongin, Gyeonggi-Do**, Korea (Republic)

4:20pm **A Study of Rotordynamic Characteristics of Swirl Brakes for Three Types of Seals**

**Technical Publication. FEDSM2016-7519**

**Wanjun Xu, Jiangang Yang**, Southeast University, Nanjing, China

4:40pm **Comparison of Grooved Rotors with Grooved Stators for Labyrinth and Helical Groove Seals**

**Technical Presentation Only. FEDSM2016-7733**

**Cori Watson, Houston G. Wood**, University of Virginia, Charlottesville, VA, United States, **Alexandrina Untaroiu**, Virginia Polytechnic Institute and State University, Blacksburg, VA, United States

# Technical Sessions Fluids Engineering

5:00pm **Unsteady Simulation for Francis Turbine During Load Rejection Events**

Technical Publication. FEDSM2016-7535

**Hossein Hosseinimanesh, Christophe Devals, Marcelo Reggio, Francois Guibault**, École Polytechnique de Montréal, Montreal, QC, Canada, **Bernd Nennemann**, Andritz Hydro Canada Inc., Pointe Claire, QC, Canada

5:20pm **Effect of Kinematic Viscosity of Barrier Fluids on the Performance of a Bi-Directional Integrated Pumping Ring for Dual Mechanical Seals**

Technical Publication. FEDSM2016-7763

**H. A. Warda, I. G. Adam, A. B. Rashad, M. W. Gamal Aldin**, Alexandria University, Alexandria, Egypt

## TUESDAY, JULY, 12

### 2-3 TURBO III - OPTIMIZATION

**Congressional D**

**8:30am - 10:10am**

Session Organizer: Yu-Tai Lee, Naval Surface Warfare Center, West Bethesda, MD, United States

Session Co-Organizer: Hiroyoshi Watanabe, Ebara Corporation, Futtsu-shi, Chiba, Japan

8:30am **Optimizing Fluid Engineering Systems under Interval Uncertainty: An Application in Turbomachinery**

Technical Presentation Only. FEDSM2016-7664

**Shapour Azarm**, University Of Maryland, College Park, MD, United States, **Yu-Tai Lee**, Naval Surface Warfare Center, West Bethesda, MD, United States

8:50am **Design Optimization of Flow Passages of a High Pressure Pump Based on Adjoint Method and CFD**

Technical Publication. FEDSM2016-7831

**Yumiko Sekino, Hiroyoshi Watanabe**, EBARA CORPORATION, Futtsu-shi, Chiba, Japan, **Faidon Christakopoulos**, Advanced Design Technology Ltd, London, United Kingdom, **Mehrdad Zangeneh**, University College London, London, United Kingdom

9:10am **Multi-objective and Multidisciplinary Optimization of a Double-Channel Pump's Volute**

Technical Presentation Only. FEDSM2016-7944

**Binjuan Zhao, Youfei Zhao, Chenghu Zhang, Huilong Chen**, Jiangsu University, Zhenjiang, China

9:30am **Numerical analysis of Fluid Flow through an Electrical Submersible Pump Handling Viscous Liquid**

Technical Publication. FEDSM2016-7589

**M.H. Siddique, Sanoop Manayilthodiyil, Abdus Samad**, IIT Madras, Chennai, India, **Afzal Husain**, Sultan Qaboos University, Muscat, Oman, **Frank Kenyery**, University of Simon Bolivar, Caracas 1080a, Venezuela

9:50am **Neural Network Application for Centrifugal Compressor Performance Curves Modeling**

Technical Publication. FEDSM2016-7537

**Kristina Soldatova**, Peter the Great St. Petersburg Polytechnic University, St. Petersburg, Russia, **Alexandr Nikiforov**, Daria Popova, Smolensk State Agricultural Academy, Smolensk, Russia

## MONDAY, JULY, 11

### TRACK 3 SYMPOSIUM ON APPLICATIONS IN CFD

#### 3-1 SYMPOSIUM ON APPLICATIONS IN CFD-I

**Thornton A**

**2:00pm - 3:40pm**

Session Organizer: Elia Merzari, Argonne National Laboratory, Lemont, IL, United States

Session Co-Organizer: Yassin Hassan, Texas A&M University, College Station, TX, United States, Richard Schultz, Idaho State University, Pocatello, ID, United States

2:00pm **Simulation of Forward Osmosis Flow in a Two-Dimensional Asymmetric Membrane Channel with Draw Channel Circular Baffle Implementation**

Technical Publication. FEDSM2016-7615

**James Koch, Ramesh Agarwal**, Washington University in St. Louis, St. Louis, MO, United States



2:20pm **Small and Full Scale Modeling for the Application of Wall Solar Chimneys**

**Technical Publication. FEDSM2016-7639**

**David Park, Francine Battaglia**, Virginia Polytechnic Institute and State University, Blacksburg, VA, United States

2:40pm **Numerical and Experimental Study of Wave Over Coastal Levee Structures**

**Technical Publication. FEDSM2016-7581**

**Yuyi Pei, Ning Zhang, Dimitrios Dermisis**, McNeese State University, Lake Charles, LA, United States

3:00pm **Large Eddy Simulation of Turbine Internal Cooling Passages**

**Technical Presentation Only. FEDSM2016-7932**

**Chaitanya Ghodke, Sourabh Apte**, Oregon State University, Corvallis, OR, United States, **Gustavo Ledezma, Jonathon Slepski**, General Electric Global Research Center, Niskayuna, NY, United States, **Gregory Laskowski**, GE Aviation, Lynn, MA, United States

3:20pm **CFD Modeling to Analyze Flammable Cloud Distribution at Flare Systems**

**Technical Presentation Only. FEDSM2016-7973**

**Mohan Rampure**, Ramsey Bunama, SABIC, Riyadh, Saudi Arabia

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### 3-2 SYMPOSIUM ON APPLICATIONS IN CFD-II

**Thornton A**

**4:00pm - 5:40pm**

Session Organizer: Zhongquan Zheng, University of Kansas, Lawrence, KS, United States

Session Co-Organizer: Ning Zhang, McNeese State University, Lake Charles, LA, United States

4:00pm **Dynamic Performance of Spring-loaded Pressure Relief Valve for High Temperature and High Pressure Steam**

**Technical Publication. FEDSM2016-7609**

**Liu Yang, Chao Wang, Jian Zhang, Ronghua Lu, Xinhai Yu**, East China University Of Science And Technology, Shanghai, Shanghai, China

4:20pm **CFD Simulation of a Supersonic Steam Ejector for Refrigeration Application**

**Technical Publication. FEDSM2016-7614**

**Liju Su, Ramesh Agarwal**, Washington University in St. Louis, St. Louis, MO, United States,

4:40pm **Numerical Analysis for Oil and Air Two-phase Flow of Transaxle using Overset Mesh Method.**

**Technical Presentation Only. FEDSM2016-7830**

**Jaeyeol Cho, Nahmkeon Hur**, Sogang University, Seoul, Korea (Republic), **Jongrak Choi**, LS Mtron, Gunpo, Korea (Republic)

5:00pm **Practical Learning on Computational Fluid Dynamics at undergraduate level**

**Technical Publication. FEDSM2016-7542**

**Teresa Parra-Santos, J. Ruben Perez, Mariano Cacho Perez**, University of Valladolid, Valladolid, Spain, **Jose Miguel Molina Jorda**, University of Alicante, Alicante, Spain, **Gabriel Luna Sandoval**, Universidad Estatal de Sonora, San Luis, Mexico,

5:20pm **Computational Fluid Dynamics in Undergraduate Engineering Education: A Short Introductory Tutorial to OpenFOAM**

**Technical Publication. FEDSM2016-7747**

**Ivaylo Nedyalkov**, University of New Hampshire, Durham, NH, United States, **Martin Wosnik**, University of New Hampshire, Newmarket, NH, United States

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## TUESDAY, JULY, 12

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### 3-3 SYMPOSIUM ON APPLICATIONS IN CFD-III

**Thornton A**

**8:30am - 10:10am**

Session Organizer: Ramesh Agarwal, Washington University, Saint Louis, MO, United States

Session Co-Organizer: Ning Zhang, McNeese State University, Lake Charles, LA, United States

8:30am **Elliptical Shape Hole-Pattern Seals Performance Evaluation Using Design of Experiments Technique**

**Technical Publication. FEDSM2016-7687**

**Hanxiang Jin, Alexandrina Untaroiu**, Virginia Polytechnic Institute and State University, Blacksburg, VA, United States

# Technical Sessions Fluids Engineering

8:50am **Quantifying the Fluid Modeling Capability of SPH and CLE through the Study of the Lid-Driven Cavity Problem**

Technical Publication. FEDSM2016-7808

**Brandon Horton, Javid Bayandor**, Virginia Polytechnic Institute and State University, Blacksburg, VA, United States

9:10am **Numerical Simulation of Insulin Depot Formation in Subcutaneous Tissue**

Technical Publication. FEDSM2016-7719

**Michael Zedelmaier, Abhijit Mukherjee**, California State University Northridge, Northridge, CA, United States

9:30am **Use of the Adjoint Method to Assess the Error in Simulations**

Technical Publication. FEDSM2016-7934

**Alexandre Carrier, Claire Deschenes**, Laval University, Québec, QC, Canada, **Jonathan Nicolle**, IREQ, Varennes, QC, Canada,

9:50am **Predicting Solid Particle Erosion of Fine Particles Utilizing Computational Fluid Dynamics**

Technical Presentation Only. FEDSM2016-7760

**Soroor Karimi, Marzieh Mahdavi, Siamack Shirazi, Brenton McLaury**, University of Tulsa, Tulsa, OK, United States,

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## 3-4 SYMPOSIUM ON APPLICATIONS IN CFD-IV

**Thornton A**

**2:00pm - 3:40pm**

Session Organizer: Zhongquan Zheng, University of Kansas, Lawrence, KS, United States

Session Co-Organizer: Charlotte Barbier, Oak Ridge National Laboratory, Oak Ridge, TN, United States

2:00pm **Numerical Study of the Flow Structure and Transport in a Two-Dimensional Channel with Oscillating Periodic Cavities and a Bounding Top Wall**

Technical Publication. FEDSM2016-7637

**Srivathsan Ragunathan, Cummins Inc.**, Columbus, IN, United States

2:20pm **Numerical Simulation of Turbulent Flow over a Forward Facing Step**

Technical Publication. FEDSM2016-7676

**Ali Nematollahi, M.F Tachie**, University of Manitoba, Winnipeg, MB, Canada

2:40pm **Assessment of CFD Predictions of a Planar Tubulent Offset Jet**

Technical Publication. FEDSM2016-7694

**Ali Nematollahi, M.F Tachie, Scott J. Ormiston**, University of Manitoba, Winnipeg, MB, Canada

3:00pm **Numerical Analysis of Turbulent Flow over a Wavy Wall in a Channel**

Technical Publication. FEDSM2016-7712

**Vinicius Martins Segunda, Scott J. Ormiston, M.F Tachie**, University of Manitoba, Winnipeg, MB, Canada

3:20pm **Numerical Simulation of the Flow Field of a Confined, Submerged Slot Jet Impinging on an Oscillating Surface: A Parametric Study**

Technical Publication. FEDSM2016-7743

**Srivathsan Ragunathan**, Cummins Inc., Columbus, IN, United States

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## 3-5 SYMPOSIUM ON APPLICATIONS IN CFD-V

**Thornton A**

**4:00pm - 5:40pm**

Session Organizer: Elia Merzari, Argonne National Laboratory, Lemont, IL, United States

4:00pm **Coupled 3-D CFD-DDPM Numerical Simulation of Turbulent Swirling Gas-Particle Flow within Cyclone Suspension Preheater of Cement Kilns**

Technical Publication. FEDSM2016-7596

**Eugen-Dan Cristea, Independent Author**, Bergamo(BG), OO, Italy, **PierAngelo Conti**, Università degli Studi di Bergamo-Facoltà di Ingegneria, Bergamo (BG), Italy

4:20pm **CFD Simulations of Aerosol Particles Deposition In A Venturi Meter Used In Smoke Sampling Devices**

**Technical Publication. FEDSM2016-7657**

**Omar Melhem**, Lebanese International University, Tripoli, Lebanon

4:40pm **Estimation of Uncertain Parameters for Thermal and Fluid Analysis in Engine Room of Construction Machinery Using Data Assimilation**

**Technical Publication. FEDSM2016-7898**

**Kazuya Kusano, Hitachi, Ltd., Ibaraki, Japan, Hironobu Yamakawa, Hitachi, Ltd, Hitachinaka, Japan, Kunihiro Ikeda, Hitachi Construction Machinery Co., Ltd., Ibaraki, Japan**

5:00pm **RANS Computations of Quasi-axial Flows in an In-line Tube Bundle - Preliminary Results**

**Technical Presentation Only. FEDSM2016-7910**

**Sofiane Benhamadouche, Benjamin Claudet**, EDF R&D, Chatou, France

5:20pm **Flow and Heat Transfer Analysis of Variable Diameter Circular Pillar Disc Brake Rotor Using CFD**

**Technical Presentation Only. FEDSM2016-7951**

**Mahesh Chopade**, MIT College of Engineering, Maharashtra, India, **Avinash Valavade**, Bharati Vidyapeeth, Pune, India

## WEDNESDAY, JULY, 13

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### 3-6 SYMPOSIUM ON APPLICATIONS IN CFD-VI

**Thornton A**

**8:30am - 10:10am**

Session Organizer: Ning Zhang, McNeese State University, Lake Charles, LA, United States

8:30am **Improving CFD simulations for the SNS jet-flow target**

**Technical Publication. FEDSM2016-7671**

**Charlotte Barbier, Elvis E. Dominguez-Ontiveros**, Oak Ridge National Laboratory, Oak Ridge, TN, United States

8:50am **Optimization of Ventricular Catheter Design Using High-Performance Computing**

**Technical Publication. FEDSM2016-7675**

**Sofy Weisenberg, Stephanie TerMaath**, University of Tennessee, Knoxville, Knoxville, TN, United States

9:10am **A High-Fidelity Approach for the Simulation of Flow Induced Vibration**

**Technical Publication. FEDSM2016-7857**

**Elia Merzari, Paul Fischer**, Argonne National Laboratory, Lemont, IL, United States, **Jerome Solberg**, Lawrence Livermore National Laboratory, Berkeley, CA, United States, **Robert Ferencz**, Lawrence Livermore National Laboratory, Livermore, CA, United States,

9:30am **CO2 Capture and Storage in Deep Salt Caverns with Applications in the Pre-salt Reservoir**

**Technical Presentation Only. FEDSM2016-7770**

**Marcelo De Lemos**, LCFT-IEME-ITA, Sao Jose dos Campos SP12228900, Brazil

9:50am **Computational Study Comparing Reduced Chemical Mechanisms with the PDF Method in Non-Premixed Flames**

**Technical Publication. FEDSM2016-7543**

**Lu Chen, Francine Battaglia**, Virginia Polytechnic Institute and State University, Blacksburg, VA, United States

## TUESDAY, JULY, 12

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### TRACK 4, 7TH SYMPOSIUM ON BIO-INSPIRED AND BIO-MEDICAL FLUID MECHANICS

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#### 4-1 BIOMEDICAL STUDIES

**Congressional C**

**2:00pm - 3:40pm**

Session Organizer: Michael Plesniak, George Washington University, Washington, DC, United States

Session Co-Organizer: D. Keith Walters, Mississippi State University, Mississippi State, MS, United States

# Technical Sessions Fluids Engineering

2:00pm **Computational Fluid Dynamic Analysis of a Blood Pump: An FDA Critical Path Initiative**

Technical Publication. FEDSM2016-7611

**Christopher Nassau, Timothy Wray, Ramesh Agarwal**, Washington University in St. Louis, St. Louis, MO, United States,

2:20pm **Optimization of Anastomotic Geometry for Vascular Access Fistula**

Technical Publication. FEDSM2016-7612

**Guangyu Bao, Xiaomin Chen, Ramesh Agarwal**, Washington University in St. Louis, St. Louis, MO, United States,

2:40pm **Validation of a Time Dependent Physio-Chemical Model for Thrombus Formation and Growth**

Technical Publication. FEDSM2016-7803

**Hamid Hosseinzadegan, Danesh Tafti**, Virginia Polytechnic Institute and State University, Blacksburg, VA, United States

3:00pm **Computational Model of Human Capillary Hydrodynamics**

Technical Publication. FEDSM2016-7858

**Peter Windes, Danesh Tafti, Bahareh Behkam**, Virginia Polytechnic Institute and State University, Blacksburg, VA, United States

3:20pm **Fluid Dynamics of Two-Dimensional Pollination In Ruppia (Widgeon Grass)**

Technical Publication. FEDSM2016-7891

**Naga Aditya Musunuri, Pushendra Singh, Daniel Bunker, Ian Fischer**, New Jersey Institute of Technology, Newark, NJ, United States, **Susan Pell**, Brooklyn Botanic Garden, Brooklyn, NY, United States

4:00pm **Bio-inspired Robotic Undulating Stingray**

Technical Publication. FEDSM2016-7682

**Emily Studebaker, William Ermlick, Joseph Baillargeon, Nathan Roberson, Brandon Hart, Aanand Pandey, Rickey Warner, Jianyu An, Luke Sienkiewicz, Heather Smith, Brittany Gater, Jeffrey Feaster, Javid Bayandor, Sunghwan Jung**, Virginia Polytechnic Institute and State University, Blacksburg, VA, United States

4:20pm **Computational Analysis of 3D Fin-fin Interaction in Fish's Steady Swimming**

Technical Publication. FEDSM2016-7699

**Pan Han, Geng Liu, Haibo Dong, Yan Ren**, University of Virginia, Charlottesville, VA, United States

4:40pm **Flying Fish Sculls to Taxi and Perturbs Wing Lift with Travelling Waves to Land**

Technical Publication. FEDSM2016-7507

**Promode Bandyopadhyay**, Naval Undersea Warfare Center, Newport, RI, United States

5:00pm **Numerical Study of Rigid and Flexible Wing Shapes In Hover**

Technical Publication. FEDSM2016-7565

**Aamer Shahzad, Fangbao Tian, John Young, Joseph.C.S Lai**, School of Engineering and Information Technology, Canberra, ACT, Australia

5:20pm **Dynamic Behaviors of Vortex Ring Rolled up by a Butterfly Wing and Its Dynamic Lift**

Technical Publication. FEDSM2016-7586

**Masaki Fuchiwaki, Kazuhiro Tanaka**, Kyushu Institute of Technology, Iizuka 820-85002, Japan

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## 4-2 BIOINSPIRED LOCOMOTION

Congressional C

4:00pm - 5:40pm

Session Organizer: Alexander Matta, Virginia Polytechnic Institute and State University, Blacksburg, VA, United States

Session Co-Organizer: Brandon Horton, Virginia Polytechnic Institute and State University, Blacksburg, VA, United States, Brittany Gater, Virginia Polytechnic Institute and State University, Blacksburg, VA, United States

## MONDAY, JULY, 11

### TRACK 5, 51ST CAVITATION AND MULTIPHASE FLOW FORUM

#### 5-1 Cavitation and Multiphase Flow Forum

**Bryce** **10:30am - 12:10pm**

Session Organizer: William Straka, Pennsylvania State University, State College, PA, United States

Session Co-Organizer: Mark Wendel, Oak Ridge National Laboratory, Knoxville, TN, United States, Ivaylo Nedyalkov, University of New Hampshire, Durham, NH, United States

10:30am **Wingtip Devices for Tidal Turbines: Performance Improvement and Cavitation Mitigation**

Technical Publication. FEDSM2016-7750

Ivaylo Nedyalkov, Ian Gagnon, Jesse Shull, John Brindley, University of New Hampshire, Durham, NH, United States, Martin Wosnik, University of New Hampshire, Newmarket, NH, United States

10:50am **Effect of Thickness of Polyurea Coating on Cavitation Erosion Protection**

Technical Presentation Only. FEDSM2016-7794

Anil Kapahi, Chao-tsung Hsiao, Jin Keun Choi, Georges L. Chahine, Dynaflo Inc., Jessup, MD, United States

11:10am **Development of an Efficient Phase Separator for Space and Ground Applications**

Technical Publication. FEDSM2016-7793

Xiongjun Wu, Greg Loraine, Chao-tsung Hsiao, Georges L. Chahine, Dynaflo Inc., Jessup, MD, United States

11:30am **Numerical Study of Gravity Effects on Phase Separation in a Swirl Chamber**

Technical Publication. FEDSM2016-7845

Chao-tsung Hsiao, Jingsen Ma, Georges Chahine, Dynaflo, Inc, Jessup, MD, United States

11:50am **Numerical Simulation of Unsteady Cavitation Flow in a Centrifugal Pump**

Technical Publication. FEDSM2016-7925

Weiguo Zhao, Rennian Li, Xiangdong Han, Lanzhou University of Technology, Lanzhou, Gansu, China

## WEDNESDAY, JULY, 13

### TRACK 6, 86TH SYMPOSIUM ON CFD VERIFICATION AND VALIDATION

#### 6-1 SYMPOSIUM ON CFD VERIFICATION AND VALIDATION

**Bryce** **8:30am - 10:10am**

Session Organizer: Elia Merzari, Argonne National Laboratory, Lemont, IL, United States

Session Co-Organizer: Yassin Hassan, Texas A&M University, College Station, TX, United States

8:30am **Interface Tracking Simulation of Phase-Change Phenomena: Boiling and Condensation Verification**

Technical Publication. FEDSM2016-7701

Mengnan Li, Igor A. Bolotnov, North Carolina State University, Raleigh, NC, United States

8:50am **Parametric Study of Erosion under High Concentrated Slurry: Experimental and Numerical Analyses**

Technical Publication. FEDSM2016-7718

Marzieh Mahdavi, University of Tulsa, Houston, TX, United States, Soroor Karimi, Siamack Shirazi, Brenton McLaury, University of Tulsa, Tulsa, OK, United States

9:10am **Parametric Analysis of Erosion in 90 Degree and Long Radius Bends**

Technical Publication. FEDSM2016-7735

Peyman Zahedi, Soroor Karimi, Marzieh Mahdavi, Brenton McLaury, Siamack Shirazi, University Of Tulsa, Tulsa, OK, United States

# Technical Sessions Fluids Engineering

9:30am **CFD Simulation of Round Impinging Jet and Comparison with Experimental Data**

Technical Publication. FEDSM2016-7889

**Hadi Arabnejad Khanouki, Amir Mansouri, Siamack Shirazi, Brenton McLaury**, University of Tulsa, Tulsa, OK, United States

9:50am **Discretization Error Estimation in Transient Flow Simulations**

Technical Publication. FEDSM2016-7919

**Ismail Celik, Zhiyuan Ma**, West Virginia University, Morgantown, WV, United States, **Sofiane Benyahia**, National Energy Technology Laboratory, Morgantown, WV, United States

## MONDAY, JULY, 11

### TRACK 7 SYMPOSIUM ON DEVELOPMENT AND APPLICATIONS OF IMMERSED BOUNDARY METHODS

#### 7-1 IMMERSED-BOUNDARY METHODS

**Yosemite** **10:30am - 12:10pm**

Session Organizer: Zhongquan Zheng, University of Kansas, Lawrence, KS, United States

Session Co-Organizer: Ning Zhang, McNeese State University, Lake Charles, LA, United States

10:30am **Energy Harvesting From Vortical Flows by a Passive Heaving Foil**

Keynote Paper Publication. FEDSM2016-7882

**Zhenglun Wei**, Georgia Institute of Technology, Atlanta, GA, United States, **Zhongquan Zheng**, University of Kansas, Lawrence, KS, United States

11:10am **Implementing a Complex Levee System on Regional Scale Hydrodynamic Simulations Using an Immersed Boundary Method**

Technical Presentation Only. FEDSM2016-7788

**Ning Zhang, Xiao Han**, McNeese State University, Lake Charles, LA, United States

11:30am **Numerical simulation of energy harvesting eel in a viscous flow using immersed boundary method**

Technical Presentation Only. FEDSM2016-7810

**Emad Uddin**, National University of Sciences and Technology (NUST), Islamabad, Pakistan, **Hyung Jin SUNG**, Korea Advanced Institute of Sciences and technology (KAIST), **Daejeon, Daejeon**, Korea (Republic)

## TUESDAY, JULY, 12

### TRACK 8, 11TH SYMPOSIUM ON DNS, LES AND HYBRID RANS/LES METHODS

#### 8-1 DNS, LES AND HYBRID RANS/LES METHODS-I

**Everglades**

**8:30am - 10:10am**

8:30am **Streamwise-Oriented Vortex-Surface Interactions with a Finite Aspect-Ratio Wing**

Keynote Presentation. FEDSM2016-7931

**Caleb Barnes**, Air Force Research Laboratory, Wright-Patterson AFB, OH, United States

8:55am **Direct Numerical Simulation of Nonlinear Secondary Instabilities on the Pressure Side of a Savonius Style Wind Turbine**

Technical Publication. FEDSM2016-7714

**Antoine Ducoin**, LHEEA Laboratory, Ecole Centrale de Nantes, Nantes, France, **Sukanta Roy**, IRPHE, Marseille, France, **Mostafa Safdari Shadloo**, CORIA Laboratory, Rouen, France

9:20am **Particle-resolved DNS to Study Spatio-temporal Correlations of Hydrodynamic Forces on Particle-bed in an Oscillatory Flow Environment**

Technical Publication. FEDSM2016-7761

**Chaitanya Ghodke, Sourabh Apte**, Oregon State University, Corvallis, OR, United States

9:45am **Direct Numerical Simulation of Turbulent Flow and Aeroacoustic Fields around an Airfoil Using Lattice Boltzmann Method**

Technical Publication. FEDSM2016-7585

**Kazuya Kusano**, HITACHI, LTD., Ibaraki, Japan, **Kazutoyo Yamada, Masato Furukawa, KIL-JU MOON**, Kyushu University, Fukuoka, Japan

## 8-2 DNS, LES AND HYBRID RANS/LES METHODS-II

Everglades

2:00pm - 3:40pm

2:00pm **Implicit LES Applied to Isothermal Swirling Coaxial Jets**

Technical Publication. FEDSM2016-7501

**Teresa Parra-Santos, J. Ruben Perez, Francisco Castro**, University of Valladolid, Valladolid, Spain, **R. Z. Szasz**, Lund University, Lund, Sweden, **Ville Vuorinen**, Aalto university, Espoo, Finland,

2:20pm **A Novel Fix To Reduce the Log-layer Mismatch in Wall-modeled Large-eddy Simulations of Turbulent Channel Flow**

Technical Publication. FEDSM2016-7698

**Rey DeLeon**, University of Idaho Boise, Boise, ID, United States, **Inanc Senocak**, Boise State University, Boise, ID, United States

2:40pm **Proper Orthogonal Decomposition and Dynamic Mode Decomposition of Transonic Open Cavity Flows with Self-Sustained Oscillations**

Technical Presentation Only. FEDSM2016-7677

**Kaushik Das, Debashis Basu**, Southwest Research Institute, San Antonio, TX, United States

3:00pm **Uncertainty Estimation for the Spatial and Temporal Resolution in Detached Eddy Simulations (DES) of Transonic Flow Over an Open Cavity**

Technical Publication. FEDSM2016-7678

**Debashis Basu, Kaushik Das**, Southwest Research Institute, San Antonio, TX, United States

3:20pm **Analysis of Turbulence Generation and Energy Transfer Mechanisms in Boundary Layer Transition Using Direct Numerical Simulation**

Technical Publication. FEDSM2016-7795

**Shanti Bhushan, Manish Borse**, Mississippi State University, Starkville, MS, United States, **D. Keith Walters**, Mississippi State University, Mississippi State, MS, United States, **Crystal Pasilio**, Eglin Air Force Base, Eglin, FL, United States

## MONDAY, JULY, 11

### TRACK 9, 28TH SYMPOSIUM ON FLUID MACHINERY

#### 9-1 PROFESSOR SHIN-HYOUNG KANG'S MEMORIAL SESSION

Bunker Hill

2:00pm - 3:40pm

Session Organizer: Kwang-yong Kim, Inha University, Incheon 402-751, Korea (Republic)

Session Co-Organizer: Seung Jin Song, Seoul National University, Seoul 151-744, Korea (Republic)

2:00pm **Development of a Centrifugal Blood Pump for ECMO AND LVAD Operations**

Technical Presentation Only. FEDSM2016-7938

**Nahmkeon Hur, Shinhwa Choi, Minwook Chang, Sung-Gil Kim, Sungmin Hong, Mohammad Moshfeghi, Wonjung Kim**, Seongwon Kang, Sogang University, Seoul, Korea (Republic), **Shin Hyoung Kang**, Seoul National University, Seoul, Seoul, Korea (Republic)

2:16pm **The Effect of the Thickness and Angle of the Inlet and Outlet Guide Vane on the Performance of Axial-Flow Pump**

Technical Publication. FEDSM2016-7939

**Sang-Won Kim, Youn J. Kim**, Sungkyunkwan University, Suwon, Korea (Republic),

2:32pm **Steady and Unsteady Characterisitcs of Tip Clearance Vortex Development and Break-down in Pumps and Compressors**

Technical Presentation Only. FEDSM2016-7941

**Chunill Hah**, NASA Glenn Research Center, Cleveland, OH, United States

2:48pm **New Design Considerations of Cryogenic Fuel Pumps for LNG Carriers Using Dual Fuel Propulsion System**

Technical Presentation Only. FEDSM2016-7942

**Jinkook Lee**, Eaton Aerospace, Cleveland, OH, United States

3:04pm **Cavitation Instabilities in Fluid Machinery**

Technical Presentation Only. FEDSM2016-7943

**Yoshinobu Tsujimoto**, Osaka University, Minoo, Japan

# Technical Sessions Fluids Engineering

3:20pm **A Turbo-compound System Approach to Engine Exhaust Heat Recovery**

**Technical Presentation Only. FEDSM2016-7948**

**Yangjun Zhang**, Tsinghua University, Beijing, China

## TUESDAY, JULY, 12

### 9-2 PUMPS 1

**Bunker Hill**

**8:30am - 10:10am**

Session Organizer: Hans Josef Dohmen, University of Duisburg-Essen, Duisburg, Germany

Session Co-Organizer: Shouqi Yuan, Jiangsu University, Zhenjiang, Jiangsu, China

8:30am **The Developments of Axial Flow Pump System Research in China**

**Technical Publication. FEDSM2016-7621**

**Chao Liu**, Yangzhou University, Yangzhou, China

8:50am **Study of a Bionic Anti-Erosion Blade in a Double Suction Centrifugal Pump**

**Technical Publication. FEDSM2016-7627**

**Zhongdong Qian, Jing Dong, Zhiwei Guo, Zhiyuan Wang, Fan Wang**, State Key Laboratory of Water Resources and Hydropower Engineering Science, Wuhan University, Wuhan City, Hubei Province, China

9:10am **Experimental Investigation on Influence of Relative Positions between Diffuser and Volute on Pressure Fluctuation at the Outlet of a Centrifugal Pump**

**Technical Publication. FEDSM2016-7740**

**Wenjie Wang, Shouqi Yuan, Ji Pei, Yandong Gu**, Jiangsu University, Zhenjiang, China, **Giorgio Pavesi**, Universita Degli Studi/padova, Padova, Italy

9:30am **Numerical Simulation and Test Research on the Wear of Back Blades in Slurry Pumps**

**Technical Publication. FEDSM2016-7587**

**Yi Tao, Shouqi Yuan, Jianrui Liu, Fan Zhang**, Jiangsu University, Zhenjiang, China, **Jianping Tao, Jiangsu Province Yixing Taoye** Nonmetallic Chemical Machinery Factory Co, Ltd., Wuxi, Jiangsu, China

9:50am **Numerical Simulation and Performance Prediction of Multistage Canned Motor Pump**

**Technical Publication. FEDSM2016-7644**

**Bin Xia**, Research Center of Fluid Machinery Engineering and Technology, Zhenjiang, China, **Fanyu Kong, Yuxing Bai, Xiaohui Duan**, Jiangsu University, Zhenjiang, China

### 9-4 PUMPS 2

**Bunker Hill**

**2:00pm - 3:40pm**

Session Organizer: Jinkook Lee, Eaton Aerospace, Cleveland, OH, United States

2:00pm **Hydraulic efficiency conversion from a model to prototype pump based on Effects of Reynolds number and Surface roughness**

**Technical Publication. FEDSM2016-7780**

**Hiroaki Yoda, Daichi Torii**, Hitachi, Ltd., Industrial Products Company, Tsuchiura, Ibaraki, Japan, **Kazuo Uranishi**, Hachinohe National College of Technology, Sendai, Aomori, Japan, **Masao Oshima**, Kanagawa Institute of Technology, Atsugi, Japan, Yokohama, Yokohama, Japan, **Takaki Sakurai**, Ebara Corporation, Chiba, Japan, Futttsu, Chiba, Japan, **Masahiro Miyabe**, Torishima Pump Mfg. Co., Osaka, Japan, Takatsuki, Osaka, Japan, **Kazuta Kobayashi**, Mitsubishi Heavy Industries, Ltd., Hyogo, Japan, Takasago, Hyogo, Japan, **Masashi Ikezawa**, DMW Corporation, Shizuoka, Japan, Mishima, Shizuoka, Japan

2:20pm **Flow Analysis of the Guide Vanes Region of Pump Turbine at the Slight Opening in the Pumping Startup Process**

**Technical Publication. FEDSM2016-7739**

**Honggang FAN, Haixia YANG**, Tsinghua University, Beijing, China, **Qingfeng JI, Weili LIAO**, Xi'an University of Technology, Xi'an, Shaanxi, China,

2:40pm **The Three-Dimensional Inverse Design Method of Centrifugal Pump Twisted Blade Based on Free-Form Deformation**

**Technical Publication. FEDSM2016-7892**

**Zhang Renhui**, Lanzhou University of Technology, Gansu Lanzhou, China, **Zhang Shuwei, Yang Junhu**, Lanzhou University of Technology, Lanzhou, GANSU, China



3:00pm **Analysis for cooling circuit of high speed rescue pump based on flow-heat coupling**

**Technical Publication. FEDSM2016-7643**

**Yuxing Bai, Fanyu Kong, Bin Xia, Yingying Liu**, Jiangsu University, Zhenjiang, China

3:20pm **Inference of Bulb Ratio on the Hydraulic Performance of Bulb Tubular Pumping System**

**Technical Presentation Only. FEDSM2016-7940**

**Yan Jin, Hongcheng Chen, Chao Liu, Li Cheng, Lijian Shi**, Yangzhou University, Yangzhou, China

5:00pm **Aerodynamic and Performance Behavior of a Radial Turbine at Design and Off-Design Conditions**

**Technical Publication. FEDSM2016-7816**

**Cheng Zhu, Jie Peng, Weilin Zhuge, Yangjun Zhang**, Tsinghua university, Beijing, China

5:20pm **Sensitivity Measurement of a Horizontal Hydrostatic Bearing System for a Bulb-type Model Turbine Test**

**Technical Presentation Only. FEDSM2016-7813**

**Yong Cho, Young-Jun Kim, Sung-Il Kwon, Gyo-Hyeon Lee**, K-Water, Daejeon, Daejeon, Korea (Republic)

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## 9-5 GAS TURBINES, COMPRESSORS AND FANS

**Bunker Hill**

**4:00pm - 5:40pm**

Session Organizer: Yangjun Zhang, Tsinghua University, Beijing, China

4:00pm **Numerical Analysis on Non-Equilibrium Steam Condensing Flow in Rotating Machinery**

**Technical Publication. FEDSM2016-7588**

**Changhyun Kim, JaeHyeon Park, Jehyun Baek**, POSTECH, Pohang, Kyungbuk, Korea (Republic), **DongIl Kim**, Doosan Heavy Industries & Construction, Yongin, Gyeonggi, Korea (Republic),

4:20pm **Improvement of Outlet Nozzle Shape for Pressure-Loss Reduction in Air Conditioner**

**Technical Publication. FEDSM2016-7622**

**Daiwa Sato, Taku Iwase**, Hitachi, Ltd., Research & Development Group, Hitachinaka-City, Ibaraki, Japan, **Hideshi Obara, Naoyuki Fushimi**, Hitachi-Johnson Controls Air Conditioning, Inc., Sizuoka, Japan

4:40pm **Design and Performance Assessments of a Partial Admission Axial Turbine using Supercritical Carbon Dioxide**

**Technical Publication. FEDSM2016-7734**

**Young-Seok Kang, Jae Sung Huh**, Korea Aerospace Research Institute, Daejeon, Korea (Republic), **Junhyun Cho, Hyunki Shin, YOUNG-JIN BAIK**, Korea Institute of Energy Research, Daejeon, Korea (Republic)

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## WEDNESDAY, JULY, 13

### 9-6 HYDRAULIC TURBINES

**Everglades**

**8:30am - 10:10am**

Session Organizer: Yoshinobu Tsujimoto, Osaka University, Minoo, Japan

8:30am **Calculation and Analysis of Axial Symmetry-swirling Flow in Pump as Turbine Draft Tube**

**Technical Publication. FEDSM2016-7928**

**Wang Xiaohui**, LanZhou University of Technology, Lanzhou, China

8:50am **The Same Initial Condition of the Optimum Method for All Specifications**

**Technical Publication. FEDSM2016-7518**

**Takuji Tsugawa**, Independent Consultant, Kobe, Japan

9:10am **Research on Hydrodynamic Buffering of the Fall Off Reactor Core with Dynamic Mesh**

**Technical Publication. FEDSM2016-7822**

**Y.H. Li, J. Jiang, X.H. Weng, Qiangqiang Sun**, Wuhan University, Wuhan, Hubei Province, China

# Technical Sessions Fluids Engineering

9:30am **Numerical Investigation on the Aerodynamic Performance of an Airfoil with Leading-Edge Protuberances**

Technical Publication. FEDSM2016-7949

**Chang Cai, Zhigang Zuo, Shuhong Liu**, Tsinghua University, Beijing, 100084, China

9:50am **Numerical Optimization of Micro Kaplan Hydro Turbine System**

Technical Publication. FEDSM2016-7575

**Ryoichi Amano, Yi Hsin Yen, Tarek Elgammal**, University of Wisconsin-Milwaukee, Glendale, WI, United States, **Joseph Millevolte, Randal Mueller**, Cadens, LLC, Milwaukee, WI, United States, **Bruno Lequesne**, E-Motors Consulting, LLC, Menomonee Falls, WI, United States,

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## 9-7 PUMPS 3

**Everglades**

**4:00pm - 5:40pm**

Session Organizer: Kwang-yong Kim, Inha Univ, Incheon 402-751, Korea (Republic)

4:00pm **Effect of impeller balance holes on performance and axial thrust of a low-specific-speed centrifugal pump**

Technical Presentation Only. FEDSM2016-7662

**Yandong Gu, Shouqi Yuan, Ji Pei, Wenjie Wang, haisi gao**, Jiangsu University, zhenjiang, China,

4:20pm **MOC-CFD Coupled Approach for the Transient Characteristics of a Pump System during Running down Process**

Technical Presentation Only. FEDSM2016-7789

**Peng Wu, Shuai Yang, Leqin Wang**, Zhejiang University, Hangzhou, China, **Dazhuan Wu**, Zhejiang University, Zhejiang, Zhejiang, China

4:40pm **Numerical Research on Design Method and Flow Field Properties in Water Jet Pump with Contra-rotating rotors**

Technical Presentation Only. FEDSM2016-7790

**Linlin Cao, Bangxiang Che, Leijun Hu, Dazhuan Wu**, Zhejiang University, Hangzhou, Zhejiang, China,

5:00pm **Steger-Warming Flux Vector Splitting Method for the Gas-liquid Two-phase Transient Flow in The Pump System**

Technical Presentation Only. FEDSM2016-7815

**Jin Jiang, You Fu, Lisheng Zhang, Y.H. Li**, Wuhan University, Wuhan, Hubei Province, China

5:20pm **Suppression of Cavitation in High-Speed Centrifugal Pump by Variable Pitch Inducer**

Technical Presentation Only. FEDSM2016-7821

**Qiangqiang Sun, Jin Jiang, You Fu, Y.H. Li, X.H. Weng**, Wuhan University, Wuhan, Hubei Province, China

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## MONDAY, JULY, 11

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### TRACK 10 FORUM ON FLUID MEASUREMENTS AND INSTRUMENTATION

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#### 10-1 FMI 1

**Sequoia**

**10:30am - 12:10pm**

Session Organizer: Judith A. Bamberger, Pacific Northwest National Laboratory, Richland, WA, United States

Session Co-Organizer: Joel Park, Naval Surface Warfare Center Carderock Division, West Bethesda, MD, United States

10:30am **AIRFLOW CHARACTERISTICS AND DEVICE UNDER TEST EFFECTS IN A CALIBRATION WIND TUNNEL-KEYNOTE PAPER**

Keynote Presentation. FEDSM2016-7576

**JIUNN-HAUR SHAW, JianYuan Chen**, Center for Measurement Standards/ITRI, Hsinchu, ROC, Taiwan

10:55am **Characterization of a Custom-Designed, High-Reynolds Number Water Tunnel**

Technical Publication. FEDSM2016-7866

**Yasaman Farsiani, Brian R. Elbing**, Oklahoma State University, Stillwater, OK, United States

11:20am **Uncertainty Quantification of Low Void Fraction Measurements using Wire-Mesh Sensors in Horizontal Air-Water Flows**

**Technical Publication. FEDSM2016-7843**

**Etienne Lessard, Sun-Kyu Yang, Robert Bowden**, Canadian Nuclear Laboratories, Chalk River, ON, Canada

11:45am **Experimental Evaluation of Dual-Opposed Jet Mixer Pump Performance for Slurry Mixing**

**Technical Publication. FEDSM2016-7749**

**Judith A. Bamberger, Carl W. Enderlin**, Pacific Northwest National Laboratory, Richland, WA, United States

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## 10-2 FMI 2

**Sequoia** **2:00pm - 3:40pm**

Session Organizer: Francisco Diez, Rutgers Univ, Piscataway, NJ, United States

Session Co-Organizer: Judith A. Bamberger, Pacific Northwest National Laboratory, Richland, WA, United States

2:00pm **Re-thinking of Data Acquisition Rates in the Era of Expensive Data**

**Technical Publication. FEDSM2016-7930**

**Barton Smith**, Utah State University, Logan, UT, United States, **Douglas R. Neal**, LaVision Inc, Ypsilanti, MI, United States

2:20pm **Correlated Bias Uncertainty in PIV Data Due To Interrogation Window Overlap**

**Technical Publication. FEDSM2016-7937**

**Rick Cressall, Barton Smith**, Utah State University, Logan, UT, United States,

2:40pm **PIV Uncertainty: Computational & Experimental Evaluation of the Peak Ratio Method**

**Technical Publication. FEDSM2016-7926**

**Stamatios Pothos, Aaron Boomsma, Dan Troolin**, TSI Incorporated, Shoreview, MN, United States, **Sayantana Bhattacharya, Pavlos Vlachos**, Purdue University, West Lafayette, IN, United States,

3:00pm **PIV Investigation of Turbulent Flow over a Wavy Wall in a Horizontal Channel**

**Technical Publication. FEDSM2016-7715**

**Vinicius Martins Segunda, M.F Tachie, Scott J. Ormiston**, University of Manitoba, Winnipeg, MB, Canada

3:20pm **Numeric Particle Image Velocimetry Laboratory**

**Technical Presentation Only. FEDSM2016-7984**

**Joseph Klamo**, Naval Postgraduate School, Monterey, CA, United States, **Paisan Atsavapranee**, Naval Surface Warfare Center - Carderock Div., West Bethesda, MD, United States, **Chetan Kumar**, Defence Science and Technology Group, Fishermans Bend, Victoria, Australia

## TUESDAY, JULY, 12

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### TRACK 11, 17TH INTERNATIONAL SYMPOSIUM ON FLUID-STRUCTURE INTERACTION AND FLOW-INDUCED NOISE IN INDUSTRIAL APPLICATIONS

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#### 11-1 FLUID STRUCTURE INTERACTION

**Glacier** **2:00pm - 3:40pm**

Session Organizer: Caleb Barnes, Air Force Research Laboratory, Wright-Patterson AFB, OH, United States

2:00pm **Study of a Fluid Structure Interaction Using Sharp Interface Immersed Boundary Method**

**Technical Publication. FEDSM2016-7861**

**Long He, Keyur Joshi, Danesh Tafti**, Virginia Polytechnic Institute and State University, Blacksburg, VA, United States

2:20pm **Finite Element Approximation of the Extended Fluid-Structure Interaction (eXFSI) Problem**

**Technical Publication. FEDSM2016-7506**

**Bhuiyan Shameem Mahmood Ebna Hai, Markus Bause**, Helmut Schmidt University-University of the Federal Armed Forces Hamburg, Hamburg, Hamburg, Germany, **Paul Allen Kuberry**, Center for Computing Research, Sandia National Laboratories, Albuquerque, NM, United States

# Technical Sessions Fluids Engineering

2:40pm **Efficiency of Diffuse and Sharp Interface Strongly Coupled Fluid Structure Interaction Methods in Fixed and Moving Boundaries**

Technical Publication. FEDSM2016-7668

Fazlolah Mohaghegh, H. S. Udaykumar, University of Iowa, Iowa City, IA, United States

3:00pm **High-Fidelity Fluid-Structure Coupled Analysis for Underwater Propulsion Using Flexible Biomimetic Fins**

Technical Presentation Only. FEDSM2016-7796

Howard Chung, Ashok Kancharala, Michael Philen, Kevin Wang, Virginia Polytechnic Institute and State University, Blacksburg, VA, United States

3:20pm **Characterization of a Pulsating Drill Bit Blaster**

Technical Publication. FEDSM2016-7868

Nicholas J. Thorp, Geir Hareland, Brian R. Elbing, Oklahoma State University, Stillwater, OK, United States, Runar Nygaard, Missouri University of Science and Technology, Stillwater, OK, United States

## MONDAY, JULY, 11

### TRACK 12, 10TH INTERNATIONAL SYMPOSIUM ON FLOW APPLICATIONS IN AEROSPACE

#### 12-1 COMPLEX FLOW AERODYNAMICS

Bunker Hill

4:00pm - 5:40pm

Session Organizer: Javid Bayandor, Virginia Polytechnic Institute and State University, Blacksburg, VA, United States

4:00pm **Adjoint-Based Aerodynamic Design of Complex Aerospace Configurations**

Keynote Paper Publication. FEDSM2016-7573

Eric Nielsen, NASA Langley Research Center, Hampton, VA, United States

4:25pm **Pressure Fields Around a Rotor Blade in Reverse Flow**

Technical Publication. FEDSM2016-7685

Nandeesh Hiremath, Dhwanil Shukla, Zujia Huang, Narayanan Komerath, Georgia Institute of Technology, Atlanta, GA, United States

4:50pm **Dielectric Barrier Discharge Actuators to Control Goertler Vortices on a Swept Wing**

Technical Publication. FEDSM2016-7688

Vaibhav Kumar, Nikolaus Thorell, Dhwanil Shukla, Narayanan Komerath, Georgia Institute of Technology, Atlanta, GA, United States

5:15pm **Fluid Field Simulation along Advanced High-bypass Propulsion System Subjected to Foreign Object Ingestion**

Technical Presentation Only. FEDSM2016-7784

Yangkun Song, Javid Bayandor, Virginia Polytechnic Institute and State University, Blacksburg, VA, United States

## TUESDAY, JULY, 12

### 12-2 ADVANCED ICE, DETONATION, AND AEROSPACE KINEMATICS MODELING

Yosemite

8:30am - 10:10am

Session Organizer: Stefan aus der Wiesche, University of Applied Sciences Muenster, Steinfurt, Germany

Session Co-Organizer: David Davis, NASA Glenn Research Center, Cleveland, OH, United States

8:30am **A Numerical Study of Droplet Impingement for In-flight Ice Accretion Prediction**

Technical Publication. FEDSM2016-7603

Hao Zhang, Chih-Yung Wen, The Hong Kong Polytechnic University, Kowloon, Hong Kong, Hong Kong, Jun-wei Su, Xian Jiaotong University, Xi'an, China

8:50am **Effects of Vibrational Non-Equilibrium On The Numerical Detonation Cell-Size Prediction**

Technical Presentation Only. FEDSM2016-7660

Lisong SHI, Hua SHEN, Chih-Yung Wen, The Hong Kong Polytechnic University, Kowloon, Hong Kong, Hong Kong

9:10am **An Analytical Study on the Effect of Active Wing Folding and Twist on the Aerodynamic Performance and Energy Consumption of a Bio-inspired Ornithopter**

**Technical Publication. FEDSM2016-7741**

**Alexander Matta, Javid Bayandor**, Virginia Polytechnic Institute and State University, Blacksburg, VA, United States

9:30am **Validation of an Adaptive Meshing Implementation of the Lattice-Boltzmann Method for Insect Flight**

**Technical Publication. FEDSM2016-7782**

**Jeffrey Feaster, Francine Battaglia, Javid Bayandor**, Virginia Polytechnic Institute and State University, Blacksburg, VA, United States, **Ralf Deiterding**, University of Southampton, Southampton, Southampton, United Kingdom

9:50am **Dynamics and Propulsive Efficiency of Bio-Inspired Undulatory Marine Locomotion**

**Technical Publication. FEDSM2016-7742**

**Brittany Gater, Jeffrey Feaster, Javid Bayandor**, Virginia Polytechnic Institute and State University, Blacksburg, VA, United States

## MONDAY, JULY, 11

### TRACK 13, 11TH SYMPOSIUM ON ACTIVE FLUID DYNAMICS AND FLOW CONTROL - THEORY, EXPERIMENTS AND IMPLEMENTATION

#### 13-1 ACTIVE FLOW CONTROL BY SYNTHETIC JETS (SPONSORED BY FMTC)

**Congressional C**

**10:30am - 12:10pm**

Session Organizer: Hassan Peerhossaini, Université Paris Diderot, Paris, France

Session Co-Organizer: Mihir Sen, University Of Notre Dame, Notre Dame, IN, United States, Bahram Khalighi, General Motors Research Labs, Warren, MI, United States, Upendra Rohatgi, Brookhaven National Laboratory, Upton, NY, United States

10:30am **PIV Study of Mildly Controlled Flow over a Wing Model Using a Synthetic Jet Array**

**Technical Publication. FEDSM2016-7628**

**Pramod Salunkhe, Pad. Dr. D.Y. Patil** Institute of Engineering, Management & Research, Pune, India, **Hui Tang**, The Hong Kong Polytechnic University, Kowloon, Hong Kong, **Yanhua Wu**, Nanyang Technological University, Singapore, Singapore

10:50am **Study on Flow around a Rectangular Cylinder with an Asymmetric Slot for Synthetic Jets**

**Technical Publication. FEDSM2016-7647**

**Nobuhiro Kobayashi, Kotaro Sato**, Kogakuin University, Tokyo, Japan, **Koichi Nishibe**, Tokyo City University, Tokyo, Japan, **Yusuke Watabe, Kazuhiko Yokota**, Aoyama Gakuin University, 5-10-1, Huchinobe Chuo-ku, Sagamihara-shi, Japan

11:10am **Influence of Tangential Synthetic Jet Location on Flow control**

**Technical Publication. FEDSM2016-7655**

**Afshin Abdi, AmirKabir** University of Technology, Tehran, Iran, **Mehran Tadjfar**, Amirkabir University of Technology (Tehran polytechnic), Tehran, Iran, **Morteza Bayati**, Azad University, Tehran, Iran

11:30am **Time- and Phase-Averaged Boundary Layer Measurements on a Controlled NACA 0025 Airfoil**

**Technical Publication. FEDSM2016-7847**

**Mark Feero, Philippe Lavoie, Pierre Sullivan**, University of Toronto, Toronto, ON, Canada,

11:50am **Active Flow Control Schemes for Bluff Body Drag Reduction**

**Technical Publication. FEDSM2016-7520**

**Jacob Whiteman**, The Ohio State University, Grove City, OH, United States, **Mei Zhuang**, The Ohio State University, Columbus, OH, United States

#### 13-2 ACTIVE FLUID DYNAMICS AND FLOW STABILITY (SPONSORED BY FMTC)

**Congressional C**

**2:00pm - 3:40pm**

Session Organizer: Hassan Peerhossaini, Université Paris Diderot, Paris, France

Session Co-Organizer: Mihir Sen, University Of Notre Dame, Notre Dame, IN, United States, Bahram Khalighi, General Motors Research Labs, Warren, MI, United States, Upendra Rohatgi, Brookhaven National Laboratory, Upton, NY, United States

# Technical Sessions Fluids Engineering

2:00pm **Motion of Active Fluids: Diffusion Dynamics of Cyanobacteria**

Technical Publication. FEDSM2016-7526

**Thomas VOURC'H**, Hassan Peerhossaini, Annick Mejean, Université Paris Diderot, Paris, France, **Julien Leopoldes**, Université Paris Est - Marne la Vallée, Marne la Vallée, France

2:20pm **EFFECTS OF SHEAR STRESS ON THE GROWTH RATE OF MICRO-ORGANISMS IN AGITATED REACTORS**

Technical Publication. FEDSM2016-7590

**Hadi Fadlallah**, Eric Herbert, Roselyne Ferrari, Annick Mejean, Hassan Peerhossaini, Université Paris Diderot, Paris, France, **Mojtaba Jarrahi**, Université Paris-Sud, Orsay, France,

2:40pm **Experimental Investigations of Couette-Taylor-Poiseuille Flows Using the Electro-Diffusional Technique**

Technical Publication. FEDSM2016-7918

**Emna Berrich**, University of Nantes, Nantes, France, **Fethi Aloui**, University of Valenciennes (UVHC), Valenciennes, France, **Jack Legrand**, University of Nantes, Saint-Nazaire, France

3:00pm **Numerical Analysis of Flow and Heat Transfer at a Backward-Facing Step with an Obstacle Based on Lattice Boltzmann Method**

Technical Publication. FEDSM2016-7915

**Insaf Mehrez**, Ramla Gheith, Sassi Ben Nasrallah, University of Monastir, Monastir, Tunisia, **Fethi Aloui**, University of Valenciennes (UVHC), Valenciennes, France,

3:20pm **Magnetic Field Effect on the Formation of Free-Surface Vortex in a Cylinder**

Technical Presentation Only. FEDSM2016-7975

**Jong Hyeon Son**, Il Seouk Park, Kyungpook National University, Daegu, Korea (Republic)

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## 13-3 ACTIVE FLOW CONTROL BY DIELECTRIC BARRIER DISCHARGE ACTUATORS AND JETS (SPONSORED BY FMTC)

Congressional C

4:00pm - 5:40pm

Session Organizer: Hassan Peerhossaini, Université Paris Diderot, Paris, France

Session Co-Organizer: Mihir Sen, University Of Notre Dame, Notre Dame, IN, United States, Mojtaba Jarrahi, Université Paris-Sud, Orsay, France

4:00pm **Leading Edge Vortex Control on a Delta Wing with Dielectric Barrier Discharge Actuators**

Technical Publication. FEDSM2016-7532

**Lu SHEN**, Chih-Yung Wen, The Hong Kong Polytechnic University, Kowloon, Hong Kong, Hong Kong

4:20pm **Numerical Simulation of Flow Induced by Multiple DBD Plasma Actuators**

Technical Publication. FEDSM2016-7583

**Hua Shan**, Shawn Aram, Yu-Tai Lee, Naval Surface Warfare Center, Carderock Div., West Bethesda, MD, United States

4:40pm **Aerodynamic Drag Reduction Investigation for a Simplified Road Vehicle Using Plasma Flow Control**

Technical Publication. FEDSM2016-7927

**Bahram Khalighi**, Taeyoung Han, General Motors Research Labs, Warren, MI, United States, **Joanna Ho**, **John Cooney**, **Brian Neiswander**, **Thomas Corke**, University of Notre Dame, Notre Dame, IN, United States

5:00pm **Active Flow Control of Dynamic Stall by Means of Jet Flow at a High Reynolds Number**

Technical Publication. FEDSM2016-7508

**Ehsan Asgari**, Mehran Tadjfar, Amirkabir University of Technology (Tehran polytechnic), Tehran, Iran

5:20pm **Stability and Transition over a Low-Reynolds Number Airfoil**

Technical Publication. FEDSM2016-7817

**Paul Ziade**, Pierre Sullivan, University Of Toronto, Toronto, ON, Canada

## TUESDAY, JULY, 12

### TRACK 14 ,19TH SYMPOSIUM ON FUNDAMENTAL ISSUES AND PERSPECTIVES IN FLUID MECHANICS

#### 14-1 BOUNDARY LAYER AND VORTEX DYNAMICS FLOWS

**Yellowstone** **8:30am - 10:10am**

Session Organizer: Francine Battaglia, Virginia Polytechnic Institute and State University, Blacksburg, VA, United States

Session Co-Organizer: Stefan aus der Wiesche, University of Applied Sciences Muenster, Steinfurt, Germany

8:30am **Experimental Investigation of the Laminar Boundary Layer Flow on a Rotating Wavy Disk**

Technical Publication. FEDSM2016-7579

**Christian Helcig, Stefan aus der Wiesche**, Muenster University of Applied Sciences, Steinfurt, Germany, **Christian Teigeler**, Fachhochschule Münster, Steinfurt, Germany, Germany,

8:50am **Exit Plane Velocity Profiles and Boundary Layer Similarity on a Forward-facing Cylinder Issuing a Jet into a Counterflow**

Technical Publication. FEDSM2016-7584

**John Vaccaro**, Hofstra University, Levittown, NY, United States, **David M. Rooney, Thomas Balestrieri, Yakov Mikhaylov**, Hofstra University, Hempstead, NY, United States, **Michael Lipani**, Hofstra University, Glendale, NY, United States

9:10am **On the Topology and Strength of Large-scale Vortical Structures Induced by Static Tabs: Effect of Geometrical Singularity**

Technical Presentation Only. FEDSM2016-7697

**Dolaana Khovalyg, Ali M. Hamed, Leonardo P. Chamorro**, University of Illinois Urbana-Champaign, Urbana, IL, United States

9:30am **Characterization of Vortex Dynamics in the Near Wake of an Oscillating Flexible Foil**

Technical Publication. FEDSM2016-7806

**Firas F. Siala, Alexander D. Totpal, James A. Liburdy**, Oregon State University, Corvallis, OR, United States,

9:50am **A Study of 3-Dimensional Reattachment On Rotor Blades After Dynamic Stall**

Technical Publication. FEDSM2016-7692

**Vrishank Raghav, Nandeesh Hiremath, Narayanan Komerath**, Georgia Institute of Technology, Atlanta, GA, United States

#### 14-2 NON-NEWTONIAN AND NON-ISOTHERMAL FLOWS

**Yellowstone** **2:00pm - 3:40pm**

Session Organizer: Khaled J. Hammad, Central Connecticut State University, Simsbury, CT, United States

Session Co-Organizer: Javid Bayandor, Virginia Polytechnic Institute and State University, Blacksburg, VA, United States

2:00pm **Laminar-Turbulent Transition Flows of Non-Newtonian Slurries: Models Assessment**

Technical Publication. FEDSM2016-7597

**Kofi Freeman Adane**, Alberta Innovates-Technology Futures, Devon, AB, Canada, **Martin Agelinchaab**, University of Ontario Institute of Technology, Oshawa, ON, Canada

2:20pm **Experimental Study on the Drag-reducing Characteristics in Two Oscillating Grid Turbulence with Polymer Additives**

Technical Publication. FEDSM2016-7616

**Yue Wang, Weihua Cai, Tongzhou Wei, Fengchen Li**, Harbin Institute of Technology, Harbin, China, **Liming Yao, Mengshi Zhao**, Institute of Advanced Technology of Heilongjiang Academy of Sciences, Harbin, China

2:40pm **STUDY ON THE CHARACTERISTICS OF RAYLEIGH-BENARD CONVECTION WITH VISCOELASTIC FLUIDS**

Technical Publication. FEDSM2016-7638

**Weihua Cai, Gin Ye, Jianping Chen, Hong-Na Zhang, Tongzhou Wei, Fengchen Li**, Harbin Institute of Technology, Harbin, OO, China,

3:00pm **Effects of Surfactant Additives on Flow Characteristics at Different Wall-normal Locations in Turbulent Channel Flow**

Technical Publication. FEDSM2016-7653

**Lu Wang, Zhi-Ying Zheng, Ping-An Liu, Yue Wang, Weihua Cai, Fengchen Li**, Harbin Institute of Technology, Harbin China

# Technical Sessions Fluids Engineering

3:20pm **Friction Factor of Silicon Dioxide-Water Colloidal Suspension Flow in Circular and Square Tubes**

Technical Publication. FEDSM2016-7716

**Md. Tanveer Sharif**, University of Pittsburgh, Pittsburgh, PA, United States, **Sarbottam Pant**, Meiden America, Inc., Northville, MI, United States, **Clement Tang**, University of North Dakota, Grand Forks, ND, United States

## WEDNESDAY, JULY, 13

### 14-3 CAVITY, JET, AND PIPE FLOWS

**Yellowstone** **8:30am - 10:10am**

Session Organizer: Ivana Milanovic, University of Hartford, Simsbury, CT, United States

Session Co-Organizer: David Davis, NASA Glenn Research Center, Cleveland, OH, United States

8:30am **Boundary Condition Effects on Supersonic Rectangular Cavities**

Technical Publication. FEDSM2016-7593

**Ryan Schmit, Rudy Johnson, James Grove**, Air Force Research Laboratory, Wright-Patterson AFB, OH, United States

8:50am **Self-Excited Vibration of A Flat Plate With A Hole For Water Flow**

Technical Publication. FEDSM2016-7645

**kosuke Takahashi, Fujio Hiroki, Kotaro Sato**, Kogakuin University, Tokyo, Japan, **Koichi Nishibe**, Tokyo City University, Tokyo, Japan

9:10am **Vector Control of Synthetic Jets using an Asymmetric Slot**

Technical Publication. FEDSM2016-7648

**Ryota Kobayashi, Yusuke Watabe, Kotaro Sato**, Kogakuin University, Tokyo, Japan, **Koichi Nishibe**, Tokyo City University, Tokyo, Japan, **Kazuhiko Yokota**, Aoyama Gakuin University, 5-10-1, Huchinobe Chuo-ku, Sagamihara-shi, Japan

9:30am **Flow over a Sudden Expansion in an Annular Pipe: Steady Axisymmetric Flow and its Stability**

Technical Publication. FEDSM2016-7896

**Behnaz Beladi, Hendrik Christoph Kuhlmann**, Technical University of Vienna, Vienna, Austria

9:50am **Research on the Threshold of Flow State of Viscous Fluids Based on Chaotic Dynamics**

Technical Publication. FEDSM2016-7775

**Chao-Feng Lan, Meng Zhang, Weihua Cai, Wen-Tao Su, Fengchen Li**, Harbin University of Science and Technology, Harbin, China

## TUESDAY, JULY, 12

### TRACK 15, 23RD SYMPOSIUM ON INDUSTRIAL AND ENVIRONMENTAL APPLICATIONS OF FLUID MECHANICS

#### 15-1 INDUSTRIAL FLOWS I

**Congressional D** **2:00pm - 3:40pm**

Session Organizer: George Chamoun, Eastman Chemical Company, Gray, TN, United States

Session Co-Organizer: Yogendra Panta, WVU, Institute of Technology, Montgomery, WV, United States

2:00pm **Modular Retrofitting of CFD Code for Advanced Simulation of Fragmenting and Coalescing Multiphase Flows**

Keynote Presentation. FEDSM2016-7726

**Petar Liovic**, CSIRO, Clayton, VIC, Australia

2:40pm **Spectral Analysis of Unsteady Turbulent Flow and Thermal Mixings in T-Junctions in the Coolant Loop of Pressurized Water Reactors**

Technical Publication. FEDSM2016-7708

**Kaushik Das, Mohammed Hasan, Debashis Basu**, Southwest Research Institute, San Antonio, TX, United States



3:00pm **Performance Improvement of Capacitive Deionization for Water Desalination Using a Multi-Step Buffered Approach**

**Technical Publication. FEDSM2016-7849**

**Yasamin Salamat, Carlos A. Rios Perez, Carlos Hidrovo**, Northeastern University, Boston, MA, United States

3:20pm **Flow-Induced Stresses In Self-Affined Rock Fractures: An Experimental Investigation**

**Technical Presentation Only. FEDSM2016-7873**

**David Cunningham, Shahab Shojaei-Zadeh, German Drazer**, Rutgers University New Brunswick, Piscataway, NJ, United States

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## 15-2 INDUSTRIAL FLOWS II

**Congressional D** **4:00pm - 5:40pm**

Session Organizer: George Chamoun, Eastman Chemical Company, Gray, TN, United States

Session Co-Organizer: Wayne Strasser, Eastman Chemical Co, Kingsport, TN, United States

4:00pm **Impacts of Industrial Fresh Water Withdrawals on Calcaiseu Lake Hydrodynamics and Salinity Concentration**

**Technical Publication. FEDSM2016-7902**

**Xiao Han, Ning Zhang**, McNeese State University, Lake Charles, LA, United States

4:20pm **Turbulent Flow in an Axisymmetric Channel with a Sinusoidal Contraction and a Layer of Porous Material**

**Technical Presentation Only. FEDSM2016-7766**

**Marcelo De Lemos**, LCFT-IEME-ITA, Sao Jose dos Campos SP12228900, Brazil

4:40pm **Employing Numerical Analysis to Study Air Flow Incident on a Commercial Building**

**Technical Presentation Only. FEDSM2016-7990**

**Ari Pignatelli, Kevin Shanley**, State University of New York at New Paltz, New Paltz, NY, United States, **Heejin Cho**, Mississippi State University, Mississippi State University, MS, United States

5:00pm **Aerodynamic Load Maps of Bluff-Body Combinations in Incompressible Flow**

**Technical Publication. FEDSM2016-7683**

**Nicholas Motahari, Nandeesh Hiremath, Narayanan Komerath**, Georgia Institute of Technology, Atlanta, GA, United States

5:20pm **Turbulence Induced Thermal Mixing Effects and Thermal Fatigue Analysis in T-Junction Configurations in Pressurized Water Reactors (PWR)**

**Technical Publication. FEDSM2016-7707**

**Debashis Basu, Mohammed Hasan, Kaushik Das**, Southwest Research Institute, San Antonio, TX, United States

## MONDAY, JULY, 11

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### TRACK 19, 4TH INTERNATIONAL SYMPOSIUM ON MULTISCALE METHODS FOR MULTIPHASE FLOW

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#### 19-1 MULTISCALE METHDS

**Everglades** **10:30am - 12:10pm**

Session Organizer: Jules Lindau, Pennsylvania State University - Applied Research Lab, State College, PA, United States

10:30am **Molecular Dynamic Simulation of Couette Flow of Liquid Argon in Nanochannel**

**Technical Publication. FEDSM2016-7917**

**Hamed Esmaeilzadeh, Junwei Su, Chefu Su, Hongwei Sun**, University of Massachusetts Lowell, Lowell, MA, United States,

10:50am **Analysis of Pressure Wave Propagation in the Two-phase Flow Based on the Two-fluid Model**

**Technical Presentation Only. FEDSM2016-7965**

**Moon-sun Chung**, Korea Institute Of Energy Research, Daejeon, Korea (Republic), **Jae-Seung Suh**, SENTECH Co., Ltd, Daejeon, Korea (Republic), **Sung-Jae Yi**, KAERI, Daejeon, Korea (Republic)

# Technical Sessions Fluids Engineering

11:10am **Influence of Inter-particle Collisions on Erosion of Pipe Bends**

**Technical Presentation Only. FEDSM2016-7773**

**Santiago Lain**, Universidad Autónoma de Occidente, Cali, Colombia,  
**Martin Sommerfeld**, Martin-Luther-Universität Halle-Wittenberg, Halle (saale), Sachsen-Anhalt, Germany

11:30am **Numerical Study of Effect of Inlet Conditions on Rope Formation in Gas-Solid Flows through a 90° Pipe Bend**

**Technical Presentation Only. FEDSM2016-7923**

**Venkata Subba Sai Satish Guda, Ismail Celik**, West Virginia University, MORGANTOWN, WV, United States,

11:50am **Brownian Diffusion of Nano Fibers and the Applications**

**Technical Presentation Only. FEDSM2016-7985**

**Lin Tian**, RMIT University, Bundoora, VIC, Australia, **Goodarz Ahmadi**, Clarkson University, Potsdam, NY, United States

## MONDAY, JULY, 11

### TRACK 20 SYMPOSIUM ON NONINVASIVE MEASUREMENTS IN SINGLE AND MULTIPHASE FLOWS

#### 20-1 MULTIPHASE FLOW MEASUREMENTS 1

**Sequoia** **4:00pm - 5:40pm**

Session Organizer: Judith A. Bamberger, Pacific Northwest National Laboratory, Richland, WA, United States

Session Co-Organizer: Joel Park, Naval Surface Warfare Center Carderock Division, West Bethesda, MD, United States

4:00pm **Experimental Study on the Wall Collision of Regular and Irregular Shaped Non-spherical Particles**

**Keynote Presentation. FEDSM2016-7776**

**Zeeshan Qadir, Martin Sommerfeld**, Martin-Luther-Universität Halle-Wittenberg, Halle (Saale), Germany

4:40pm **Comparison between the Boundaries of the Main Flow Regimes Identified by Ultrafast X-Ray Tomography in Different Parts from the Cross-Section of a Bubble Column**

**Technical Presentation Only. FEDSM2016-7980**

**Stoyan Nedeltchev, Markus Schubert**, Helmholtz-Zentrum Dresden-Rossendorf, Institute of Fluid Dynamics, Dresden, Sachsen, Germany

5:00pm **Examination of Cavitation Instabilities of Pump with Inducer and Inlet Guide Vane**

**Technical Presentation Only. FEDSM2016-7842**

**Dae-Jin Kim, Chang Ho Choi**, Korea Aerospace Research Institute, Daejeon, Korea (Republic)

5:20pm **A Combined Numerical and Experimental Assessment of Air and Dust Flow in a Low-Reynolds Number Valve Including Modifications to Prevent Valve Seal Contamination**

**Technical Publication. FEDSM2016-7669**

**Ravinder Gill, Jeff Defoe, Gary Rankin**, University of Windsor, Windsor, ON, Canada,

## TUESDAY, JULY, 12

#### 20-2 MULTIPHASE FLOW MEASUREMENTS 2

**Sequoia** **8:30am - 10:10am**

Session Organizer: Bahram Khalighi, General Motors Research Labs, Warren, MI, United States

Session Co-Organizer: Theodore Heindel, Iowa State University, Ames, IA, United States

8:30am **Effects of Reynolds Number on Turbulent Characteristics of Surface Jet**

**Technical Publication. FEDSM2016-7674**

**M.S. Rahman, M.F Tachie**, University of Manitoba, Winnipeg, MB, Canada

8:50am **Global and Local Measurements and Proper Orthogonal Decomposition of a Swirling Conical Liquid Sheet**

**Technical Publication. FEDSM2016-7860**

**Pretam K. Choudhury, Ashkan Davanlou, Ranganathan Kumar**, University of Central Florida, Orlando, FL, United States, **Eduardo Castillo Orozco**, University of Central Florida, Winter Park, FL, United States

9:10am **Adaptive-Time-Step High-Frame-Rate Particle Image Velocimetry**

Technical Publication. FEDSM2016-7748

Ivaylo Nedyalkov, University of New Hampshire, Durham, NH, United States, Martin Wosnik, University of New Hampshire, Newmarket, NH, United States

9:30am **Particle Tracking Velocimetry (PTV) Measurement of Abrasive Microparticle Impact Speed and Angle in both Air-sand and Slurry Erosion Testers**

Technical Publication. FEDSM2016-7768

Amir Mansouri, Hadi Arabnejad Khanouki, Siamack Shirazi, Brenton McLaury, University of Tulsa, Tulsa, OK, United States

9:50am **A New Insight into the Instability Problem in Swirling Flows**

Technical Presentation Only. FEDSM2016-7972

Jingjing Li, Junlian Yin, Wang Dezhong, Shanghai Jiao Tong University, Shanghai, China

## MONDAY, JULY, 11

### TRACK 21, 16TH INTERNATIONAL SYMPOSIUM ON NUMERICAL METHODS FOR MULTIPHASE FLOW

#### 21-1 NUMERICAL METHODS FOR MULTIPHASE FLOWS

**Yellowstone** **10:30am - 12:10pm**

Session Organizer: Francine Battaglia, Virginia Polytechnic Institute and State University, Blacksburg, VA, United States

Session Co-Organizer: Shankhadeep Das, The Dow Chemical Company, Freeport, TX, United States

10:30am **Analysis of Bloodstains Patterns at Sharp Impact Angles**

Technical Publication. FEDSM2016-7862

Mohammad Moshfeghi, Iman Rahimipetroudi, Nahmkeon Hur, Sogang University, Seoul, Seoul, Korea (Republic)

10:50am **Modeling of Multiphase Flows in Porous Media with Applications to Reservoir and Well Performance Analysis**

Technical Publication. FEDSM2016-7887

Huiying Li, ANSYS Inc, Lebanon, NH, United States, Sergio A. Vasquez, Mohammed Azhar, ANSYS Inc., Sheffield, United Kingdom

11:10am **Preconditioning the Enriched Conformal Decomposition Finite Element Method for Multiphase and Multimaterial Problems**

Technical Presentation Only. FEDSM2016-7974

David Noble, Sandia National Laboratories, Albuquerque, NM, United States

11:30am **Hydrodynamics Investigation of a Flat-Bottomed Gas-Solid Spout-Fluid Bed with Non-Porous Draft Tube**

Technical Presentation Only. FEDSM2016-7983

Arthur Ndri Konan, David Huckaby, Justin Weber, William Rogers, U.S. Dept. of Energy, National Energy Technology Laboratory, Morgantown, WV, United States,

11:50am **Quantification of Numerical and Modeling Errors in Simulation of Fluid Flow through a Fixed Particle Bed**

Technical Publication. FEDSM2016-7561

Annette Volk, Urmila Ghia, University of Cincinnati, Cincinnati, OH, United States, Christopher Stoltz, John Hecht, Jason Stamper, Procter and Gamble, West Chester, OH, United States

## TUESDAY, JULY, 12

### TRACK 22, 9TH SYMPOSIUM ON TRANSPORT PHENOMENA IN ENERGY CONVERSION FROM CLEAN AND SUSTAINABLE RESOURCES

#### 22-1 TRANSPORT PHENOMENA IN ENERGY CONVERSION FROM CLEAN AND SUSTAINABLE RESOURCES

**Grand Teton** **2:00pm - 3:40pm**

Session Organizer: Khaled J. Hammad, Central Connecticut State University, Simsbury, CT, United States

Session Co-Organizer: Fethi Aloui, University of Valenciennes (UVHC), Valenciennes, France

# Technical Sessions Fluids Engineering

2:00pm **Convective Flow and Heat Transfer Inside a Beta Type Stirling Engine Based on Control Volume Finite Element Method**

Technical Publication. FEDSM2016-7911

**Ramla Gheith, Houda Hachem, Nessrine Zahi**, University of Monastir, Monastir, Tunisia, **Sassi Ben Nasrallah, Fethi Aloui**, University of Valenciennes (UVHC), Valenciennes, OO, France

2:20pm **Experimental Study of the Operation Conditions of Stability on a Gamma Stirling Engine**

Technical Publication. FEDSM2016-7912

**Houda Hachem, Ramla Gheith, Sassi Ben Nasrallah**, University of Monastir, Monastir, Tunisia, **Fethi Aloui**, University of Valenciennes (UVHC), Valenciennes, OO, France

2:40pm **Modeling and Design of Thermoelectric Generator for Waste Heat Recovery**

Technical Publication. FEDSM2016-7833

**Dongxu Ji, Alessandro Romagnoli**, Nanyang Technological University, Singapore, Singapore

3:00pm **Measurement of Maize Root Alteration Under Drought Using Microfluidic Flow Sensor**

Technical Presentation Only. FEDSM2016-7870

**Talukder Jubery, Sisi Liu, Daniel Attinger, Thomas Lubberstedt, Baskar Ganapathysubramanian**, Iowa State University, Ames, IA, United States

3:20pm **Effect of Prandtl Number on Convective Heat Transfer in the Separated and Reattached Flow Region on a Blunt Flat Plate**

Technical Publication. FEDSM2016-7580

**Christian Helcig, Tim Reents, Marek Kapit, Stefan aus der Wiesche**, Muenster University of Applied Sciences, Steinfurt, Germany

**WEDNESDAY, JULY, 13**

**TRACK 24, 9TH SYMPOSIUM ON TRANSPORT PHENOMENA IN MIXING**

**24-1 TRANSPORT PHENOMENA IN MIXING I: JETS**

**Congressional C**

**8:30am - 10:10am**

Session Organizer: George Papadopoulos, Simvotech, Nesconset, NY, United States

Session Co-Organizer: Ivana Milanovic, University of Hartford, Simsbury, CT, United States

8:30am **Swirl Influence on Mixing and Reactive Flows**

Technical Publication. FEDSM2016-7502

**Teresa Parra-Santos, Miguel A. Rodriguez, J. Ruben Perez, Francisco Castro**, University of Valladolid, Valladolid, Spain, **Artur Gutkowski**, Technical University of Lodz, Lodz, Poland, **Victor Mendoza**, Universidad de Tarapaca, Arica, Chile, **R. Z. Szasz**, Lund University, Lund, Sweden,

8:55am **Characteristics of Twin Jets in the Vicinity of a Free Surface**

Technical Publication. FEDSM2016-7672

**M.S. Rahman, E.M. Nabess, M.F Tachie**, University of Manitoba, Winnipeg, MB, Canada

9:20am **Reynolds Number Effects on the Characteristics of Twin Jets Interacting With a Free Surface**

Technical Publication. FEDSM2016-7673

**M.S. Rahman, E.M. Nabess, M.F Tachie**, University of Manitoba, Winnipeg, MB, Canada

9:45am **A Simple Criterion to Estimate Performance of Pulse Jet Mixed Vessels**

Technical Publication. FEDSM2016-7751

**Judith A. Bamberger, Lenna Mahoney, S. Thomas Yokuda, Michael J. Minette, Leonard F Pease**, Pacific Northwest National Laboratory, Richland, WA, United States

## 24-2 TRANSPORT PHENOMENA IN MIXING II: MICRO, VORTEX, AND TURBULENT MIXERS

**Congressional C**

**4:00pm - 5:40pm**

Session Organizer: Khaled J. Hammad, Central Connecticut State University, Simsbury, CT, United States

Session Co-Organizer: Theodore Heindel, Iowa State Univ, Ames, IA, United States

4:00pm **An Experimental Investigation of the Flow over Static Tabs with Various Geometries Using Volumetric 3-component PIV in a Refractive-Index-Matching Flume**

**Technical Presentation Only. FEDSM2016-7703**

**Ali M. Hamed, Dolaana Khovalyg, Axy Pagan-Vazquez, Leonardo P. Chamorro**, University of Illinois Urbana-Champaign, Urbana, IL, United States

4:20pm **Characteristics of High Concentration Pulses in Turbulent Mass Diffusion**

**Technical Publication. FEDSM2016-7786**

**Mayasa Endo, QianQian Shao, Takahiro Tsukahara, Yasuo Kawaguchi**, Tokyo University of Science, Noda, Chiba, Japan

4:40pm **Variable Atwood number Rayleigh Taylor instability**

**Technical Presentation Only. FEDSM2016-7976**

**Jesse Canfield**, Los Alamos National Laboratory, Los Alamos, NM, United States

5:00pm **Comparison of Mixing Efficiency of Fluids in Microchannels**

**Technical Presentation Only. FEDSM2016-7986**

**Yogendra Panta**, West Virginia University Institute of Technology, Montgomery, WV, United States, **Sai Ram Atmuri**, CVS Health, New York, NY, United States

5:20pm **Performance of Three Dimensional Split and Recombine Micromixer with Mixing Chambers**

**Technical Presentation Only. FEDSM2016-7591**

**Afzal Husain, Noorul Huda**, Sultan Qaboos University, Muscat, Oman, **Mohammad Hamdan**, United Arab Emirates University, AlAin, Abu Dhabi, United Arab Emirates, **Mubashshir A. Ansari**, Aligarh Muslim University, Aligarh, India

## TUESDAY, JULY, 12

### TRACK 25, 7TH INTERNATIONAL SYMPOSIUM ON TURBULENT FLOWS - ISSUES AND PERSPECTIVES

#### 25-1 TURBULENT FLOWS-1

**Concord**

**8:30am - 10:10am**

Session Organizer: Stefan aus der Wiesche, University of Applied Sciences Muenster, Steinfurt, Germany

8:30am **The Effects of Nozzle Geometry on the Behavior of Free Jets at Low Reynolds Number**

**Technical Publication. FEDSM2016-7684**

**Seyed Sobhan Aleyasin, M.F Tachie**, University of Manitoba, Winnipeg, MB, Canada, **Mikhail Koupriyanov**, Price Industries Limited, Winnipeg, MB, Canada

8:50am **Reynolds Number Effects in the Near and Intermediate Fields of Triangular and Round Jets**

**Technical Publication. FEDSM2016-7689**

**Seyed Sobhan Aleyasin, M.F Tachie**, University of Manitoba, Winnipeg, MB, Canada, **Mikhail Koupriyanov**, Price Industries Limited, Winnipeg, MB, Canada

9:10am **A Turbulent Boundary Layer Flow Over an Open Shallow Cavity**

**Technical Publication. FEDSM2016-7765**

**Khaled J. Hammad**, Central Connecticut State University, Simsbury, CT, United States

9:30am **Investigation of Mean and Turbulent Flow Behaviour over an Escarpment**

**Technical Publication. FEDSM2016-7640**

**Ryan Kilpatrick, Dan Parvu, Horia Hangan, Kamran Siddiqui**, University of Western Ontario, London, ON, Canada

# Technical Sessions Fluids Engineering

9:50am **Turbulent Flow in a Channel with Porous Baffles Simulated with Linear and Non-linear Models**

**Technical Presentation Only. FEDSM2016-7767**

**Marcelo De Lemos**, LCFT-IEME-ITA, Sao Jose dos Campos, Brazil

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## 25-2 TURBULENT FLOWS-2

**Concord**

**2:00pm - 3:40pm**

Session Organizer: Kamran Siddiqui, University of Western Ontario, London, ON, Canada

2:00pm **A study on Heat Transport Phenomena in a Developed Thermal Bboundary Layer of Drag Reducing channel flow**

**Technical Publication. FEDSM2016-7680**

**Kana Watanabe, Yuichi Kaiho, Shumpei Hara, Takahiro Tsukahara, Yasuo Kawaguchi**, Tokyo University of Science, Noda, Chiba, Japan

2:20pm **Turbulence Measurements in Pipe Flow With Drag Reducing Polymer Additives**

**Technical Publication. FEDSM2016-7530**

**Lady Pumisacho**, Escuela Politécnica Nacional, Quito, Ecuador, **Luis Fernando Azevedo**, PUC-Rio, Rio de Janeiro, Brazil

2:40pm **Spectral Analysis and Discussion on the Velocity Fluctuation in Drag Reducing Channel Flow by Surfactant Additives**

**Technical Publication. FEDSM2016-7725**

**Yuichi Kaiho, Shumpei Hara, Takahiro Tsukahara, Yasuo Kawaguchi**, Tokyo University of Science, Noda, Chiba, Japan

3:00pm **Proposal and Verification of Estimation Method for Turbulent Frictional Drag of Irregularly Roughened Surface from the Roughness Curve Measurement.**

**Technical Publication. FEDSM2016-7728**

**Manami Gunji, Taiga Shoen, Yasuo Kawaguchi**, Tokyo University of Science, Noda City, Chiba, Japan, **Hirohisa Mieno, Chugoku Marine Paints, LTD.**, Otake-City, Hiroshima, Japan

3:20pm **Enhancement of Turbulent Shear Stress and Mass Transfer in Wall Turbulence Accompanied with Wall Blowing**

**Technical Publication. FEDSM2016-7746**

**Yushi Okamura, Hideaki Sugioka, Yasuo Kawaguchi**, Tokyo University of Science, Noda, Chiba, Japan

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## 25-3 TURBULENT FLOWS-3

**Concord**

**4:00pm - 5:40pm**

Session Organizer: Yasuo Kawaguchi, Tokyo University of Science, Noda, Chiba, Japan

Session Co-Organizer: Khaled J. Hammad, Central Connecticut State University, Simsbury, CT, United States

4:00pm **Profile and Mixing Losses of a Turbine Cascade under the Condition of Low Reynolds Number Flows**

**Technical Publication. FEDSM2016-7568**

**Jonas Rejek, Felix Reinker, Karsten Hasselmann, Maximilian Passmann, Stefan aus der Wiesche**, Muenster University of Applied Sciences, Steinfurt, Germany, **Lilach Mazor**, The Technion - Israel Institute of Technology, Haifa, Israel, **Reinhard Willinger**, Vienna University of Technology, Vienna, Austria

4:20pm **Experimental Study of Turbulent Flow through a Square Sectioned Elbow and Tee Junction Using Particle Image Velocimetry (PIV)**

**Technical Presentation Only. FEDSM2016-7982**

**Andrew Bluestein, Douglas Bohl, Goodarz Ahmadi, Brian Helenbrook**, Clarkson University, Potsdam, NY, United States

4:40pm **Numerical Simulations of Turbulent Flow through an Elbow and T-junction**

**Technical Presentation Only. FEDSM2016-7989**

**Ravon Venters, Andrew Bluestein, Brian Helenbrook, Goodarz Ahmadi, Douglas Bohl**, Clarkson University, Potsdam, NY, United States

5:00pm **Evaluation of Turbulence Models for the Numerical Study of Reciprocating-Mechanism Driven Heat Loop**

**Technical Publication. FEDSM2016-7771**

**Olubunmi Popoola, Ayobami Bamgbade, Yiding Cao**, Florida International University, Miami, FL, United States

5:20pm **Simulation of a 3D Axisymmetric Hill: Comparison of RANS and Hybrid RANS-LES Models**

**Technical Publication. FEDSM2016-7772**

**Tausif Jamal**, Mississippi State University, Starkville, MS, United States,  
**D. Keith Walters**, Mississippi State University, Mississippi State, MS,  
United States

## TUESDAY, JULY, 12

### TRACK 26 SYMPOSIUM ON ALGORITHMS AND APPLICATIONS FOR HIGH PERFORMANCE CFD COMPUTATION

#### 26-1 SYMPOSIUM ON ALGORITHMS AND APPLICATIONS FOR HIGH PERFORMANCE CFD COMPUTATION I

**Bryce** 2:00pm - 3:40pm

Session Organizer: Ning Zhang, McNeese State University, Lake Charles, LA, United States

Session Co-Organizer: Jingsen Ma, Dynaflo, Inc, Jessup, MD, United States

2:00pm **Accelerating the High-fidelity Simulation of Turbulence: Ensemble Averaging**

**Technical Publication. FEDSM2016-7853**

**Vakhtang Makarashvili, Elia Merzari, Aleksandr Obabko, Paul Fischer, Andrew Siegel**, Argonne National Laboratory, Argonne, IL, United States

2:20pm **Effects of Parallel Processing on Large Eddy Simulations in Ansys Fluent**

**Technical Publication. FEDSM2016-7884**

**Puxuan Li, Steve Eckels, Garrett Mann**, Kansas State University, Manhattan, KS, United States, **Ning Zhang**, McNeese State University, Lake Charles, LA, United States

2:40pm **Pleasingly Parallel Matrix Free Discontinuous Least-Squares Spectral Element Algorithm for Fluid Flow With Nonconformal Element Refinement**

**Technical Publication. FEDSM2016-7510**

**Jaber J. Hasbestan, Simcenter**, University of Tennessee at Chattanooga, East Ridge, TN, United States, **James C. Newman**, SimCenter: National Center for Computational Engineering, Chattanooga, TN, United States, **Abdollah Arabshahi**, University of Tennessee Chattanooga, Chattanooga, TN, United States

3:00pm **Massively Parallel Curved Spectral/Finite Element Mesh Generation of Industrial Cad Geometries in Two and Three Dimensions**

**Technical Publication. FEDSM2016-7600**

**Arash Ghasemi, Lafayette K. Taylor, James C. Newman**, SimCenter: National Center for Computational Engineering, Chattanooga, TN, United States

3:20pm **Parallel Performance of CaFunwave for IBM Applications**

**Technical Presentation Only. FEDSM2016-7852**

**Xiao Han, Adam Oler, Ning Zhang**, McNeese State University, Lake Charles, LA, United States

## WEDNESDAY, JULY, 13

### TRACK 27, 16TH INTERNATIONAL SYMPOSIUM ON FLUID POWER

#### 27-1 TURBOMACHINERY AND ELECTROHYDRODYNAMICS

**Glacier** 8:30am - 10:10am

Session Organizer: Yangkun Song, Virginia Polytechnic Institute and State University, Blacksburg, VA, United States

Session Co-Organizer: Jeffrey Feaster, Virginia Polytechnic Institute and State University, Blacksburg, VA, United States, Ivaylo Nedyalkov, University of New Hampshire, Durham, NH, United States

8:30am **Numerical Investigations on Intake Tube Design of Micro Kaplan Hydro-Turbine System**

**Technical Publication. FEDSM2016-7569**

**Ryoichi Amano, Tarek Elgammal**, University of Wisconsin-Milwaukee, Glendale, WI, United States, **Yi Hsin Yen**, UW-Milwaukee, Milwaukee, WI, United States, **Joseph Millevolte, Randal Mueller**, Cadens LLC, Milwaukee, WI, United States, **Bruno Lequesne**, E-Motors Consulting, LLC, Menomonee Falls, WI, United States

8:50am **Electrohydrodynamics (EHD)-Induced Flow in Different Channel Configurations**

**Technical Publication. FEDSM2016-7704**

**Chean Chin Ngo, Meet Sanghvi, Jinkal Patel**, California State University, Fullerton, Fullerton, CA, United States

# Technical Sessions Fluids Engineering

9:10am **Hydraulic Optimization and Loss Analyses of a Low Specific-Speed Centrifugal Pump With Variable-Thickness Blades**

Technical Publication. FEDSM2016-7814

**Shiyang Li, Peng Wu**, Zhejiang University, Hangzhou, Zhejiang, China, **Dazhuan Wu**, Zhejiang University, Zhejiang, Zhejiang, China

9:30am **Analyses of Pressure Fluctuation and Fluctuation Reduction of an Automobile Fuel Pump**

Technical Publication. FEDSM2016-7820

**Lu Zhang, Peng Wu**, Zhejiang University, Hangzhou, Zhejiang, China, **Dazhuan Wu**, Zhejiang University, Zhejiang, Zhejiang, China

9:50am **A Study of the Effect of Various Recess Shapes on Hybrid Journal Bearing using CFD and Response Surface Method**

Technical Publication. FEDSM2016-7907

**Gen Fu, Alexandrina Untaroiu**, Virginia Polytechnic Institute and State University, Blacksburg, VA, United States

## WEDNESDAY, JULY, 13

### TRACK 28 PERFORMANCE OF MULTIPHASE FLOW SYSTEMS

#### 28-1 PERFORMANCE OF MULTIPHASE FLOW SYSTEMS

**Grand Teton** 8:30am - 10:10am

Session Organizer: Jinkook Lee, Eaton Aerospace, Cleveland, OH, United States

8:30am **On the Improvement of CFD-DEM Coarse Graining Predictions**

Technical Publication. FEDSM2016-7805

**Husam Elghannay, Danesh Tafti**, Virginia Polytechnic University and State Institute, Blacksburg, VA, United States, **Kuahai Yu, Henan** University of Science and Technology, Luoyang, Henan, China

8:50am **Coalescence Prevention Algorithm for Level Set Method**

Technical Publication. FEDSM2016-7608

**Matthew L. Talley, Matthew D. Zimmer, Igor A. Bolotnov**, North Carolina State University, Raleigh, NC, United States

9:10am **Influence of Inclination Angle in Intermittent Two Phase Flows**

Technical Publication. FEDSM2016-7696

**Josep Escrig Escrig, Buddhika Hewakandamby, Georgios Dimitrakis, Barry Azzopardi**, University of Nottingham, Nottingham, United Kingdom

9:30am **Sand Flow Regimes in Slightly Upward Inclined Gas-Liquid Stratified Flow**

Technical Publication. FEDSM2016-7729

**Ramin Dabirian, Ram Mohan, Ovadia Shoham**, University of Tulsa, Tulsa, OK, United States, **Gene Kouba**, Independent Consultant, Katy, TX, United States

9:50am **A Semi-Implicit Phase Field Model for Droplet Evolution**

Technical Presentation Only. FEDSM2016-7516

**Mohammadhassan Kazemi, David Salac**, University at Buffalo, Buffalo, NY, United States

## WEDNESDAY, JULY, 13

### TRACK 29, 3RD SYMPOSIUM ON THE FLUID DYNAMICS OF WIND ENERGY

#### 29-1 FLUID DYNAMICS OF WIND ENERGY I - CROSS-FLOW TURBINES

**Congressional D** 8:30am - 10:10am

Session Organizer: Martin Wosnik, University of New Hampshire, Newmarket, NH, United States

Session Co-Organizer: Francisco Diez, Rutgers University, Piscataway, NJ, United States, Zhongquan Zheng, University of Kansas, Lawrence, KS, United States

8:30am **The Effect of Advance Ratio, Solidity, and Wake Interactions on a 2D Vertical Axis Turbine**

Technical Publication. FEDSM2016-7801

**Adam Norman, Danesh Tafti**, Virginia Polytechnic Institute and State University, Blacksburg, VA, United States



8:50am **Performance Evaluation of a Small Darius Wind Turbine Installed at Duckjeok Island in Korea**

**Technical Publication. FEDSM2016-7818**

**Sang-Moon Lee, Choon-Man Jang**, Korea Institute of Civil Engineering and Building Technology, Goyang-Si, Gyunggi-Do, Korea (Republic)

9:10am **Influence of Fixed Pitch Angle on the Performance of Small Scale H-Darrieus**

**Technical Publication. FEDSM2016-7503**

**Teresa Parra-Santos, Diego J. Palomar-Trullen, Maria Regidor-Sanchez, Francisco Castro**, University of Valladolid, Valladolid, Spain, **Armando Gallegos**, University of Guanajuato, Salamanca, Mexico, **Cristobal N. Uzarraga**, Technologic Institute of Durango, Durango, Mexico,

9:30am **Theoretical Analysis of a Cyclic Pitch Turbine**

**Technical Publication. FEDSM2016-7878**

**Jubilee Prasad Rao, Arturo Villegas, Francisco Diez**, Rutgers University, Piscataway, NJ, United States,

9:50am **Numerical Analysis of Transient Aerodynamic Forces and Moment Arms on a Newly Developed Savonius Style Wind Turbine for Various Tip Speed Ratios**

**Technical Presentation Only. FEDSM2016-7764**

**Sukanta Roy**, IRPHE, Marseille, France, **Antoine Ducoin**, LHEEA Laboratory, Ecole Centrale de Nantes, Nantes, France

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## **29-2 FLUID DYNAMICS OF WIND ENERGY II AND MARINE RENEWABLE ENERGY**

**Congressional D** **4:00pm - 5:40pm**

Session Organizer: Zhongquan Zheng, University of Kansas, Lawrence, KS, United States

Session Co-Organizer: Francisco Diez, Rutgers University, Piscataway, NJ, United States, Martin Wosnik, University of New Hampshire, Newmarket, NH, United States

4:00pm **Further Developments in Numerical Simulations of Wind Turbine Flows Using the Actuator Line Method**

**Technical Publication. FEDSM2016-7863**

**Murphy O`Dea, Laila Guessous**, Oakland University, Rochester, MI, United States

4:20pm **Application of the Reynolds Stress Model to Direct Modeling and Actuator Disk Simulations of a Small-scale Horizontal-axis Wind Tunnel**

**Technical Publication. FEDSM2016-7595**

**Ryoichi Amano, Randall Jackson**, University of Wisconsin-Milwaukee, Glendale, WI, United States

4:40pm **Optimization of Looped Airfoil Wind Turbine (LAWT) Design Parameters for Maximum Power Generation**

**Technical Publication. FEDSM2016-7613**

**Binhe Song, Subhodeep Banerjee, Ramesh Agarwal**, Washington University in St. Louis, St. Louis, MO, United States, **George Syrov**, Everlift Wind Technology Inc., Lewes, DE, United States

5:00pm **A Study of Performance of New Tidal Energy Converter for Tidal Current Extraction using Computational Fluid Dynamics**

**Technical Publication. FEDSM2016-7755**

**MANH HUNG NGUYEN, Hae Chang Jeong, Changjo Yang**, Mokpo National Maritime University, Mokpo, Jeollanam-do, Korea (Republic)

5:20pm **Improvement of Wind Turbine Efficiency by Using Synthetic Jets**

**Technical Publication. FEDSM2016-7959**

**Nooshin Zeynali Khameneh**, Amirkabir University of Technology, Tehran, Iran, **Mehran Tadjfar**, Amirkabir University of Technology (Tehran Polytechnic), Tehran, Iran

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## **TUESDAY, JULY, 12**

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### **TRACK 30 1ST SYMPOSIUM ON MARINE HYDRODYNAMICS**

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#### **30-1 SHIP MOTION AND WAKE PATTERNS**

**Lexington** **2:00pm - 3:40pm**

Session Organizer: Hua Shan, Naval Surface Warfare Center, Carderock Division, West Bethesda, MD, United States

Session Co-Organizer: Jingsen Ma, Dynaflo, Inc, Jessup, MD, United States

# Technical Sessions Fluids Engineering

2:00pm **Generation and Transport of Potential and Kinetic Energy in the Near Wake of a Marine Vehicle**

**Keynote Presentation. FEDSM2016-7977**

**Eric Paterson, Matthew Jones, Christian Martin, J. Ryan Somero,** Virginia Polytechnic Institute and State University, Blacksburg, VA, United States

2:40pm **Experiments and CFD Analysis on Safe-Return-to-Port of a Damaged Ship in Head and Following Seas**

**Technical Publication. FEDSM2016-7727**

**Jeonghwa Seo, Shin Hyung Rhee,** Seoul National University, Seoul, Korea (Republic)

3:00pm **New Methodology in Analysis of Physical Properties and Roll Decay with Uncertainty Estimates for Surface-Ship Model Experiments**

**Technical Presentation Only. FEDSM2016-7964**

**Joel Park, Charles R. Turner, Mark P. Melendez,** Naval Surface Warfare Center Carderock Division, West Bethesda, MD, United States, **Christopher J. Earls,** Cornell University, Ithaca, NY, United States

3:20pm **Effects of Tail Geometries on the Performance and Wake Pattern in Flapping Propulsion**

**Technical Publication. FEDSM2016-7691**

**Geng Liu, Haibo Dong,** University of Virginia, Charlottesville, VA, United States

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## 30-2 NUMERICAL SIMULATION OF FLOW AROUND SHIPS

**Lexington** **4:00pm - 5:40pm**

Session Organizer: Shawn Aram, Naval Surface Warfare Center, Carderock Division, West Bethesda, MD, United States

4:00pm **Progress on Prediction of Bubbly Flows around Ships**

**Technical Publication. FEDSM2016-7665**

**Jiajia Li, Alejandro M. Castro, Pablo M. Carrica,** The University of Iowa, Iowa City, IA, United States

4:20pm **Modeling Separation and Cavitation behind a Blunt Body**

**Technical Publication. FEDSM2016-7895**

**Jingsen Ma, Chao-tsung Hsiao, Xiongjun Wu, Georges Chahine,** Dynaflo, Inc., Jessup, MD, United States

4:40pm **Near Term Ship Motion Forecasting From Prior Motion**

**Technical Publication. FEDSM2016-7781**

**John Vorwald, Alan Schwartz, Christopher Kent,** Naval Surface Warfare Center, Carderock Div, West Bethesda, MD, United States

5:00pm **A Numerical Approach for Modeling Roughness for Marine Applications**

**Technical Publication. FEDSM2016-7791**

**Abel Vargas, Hua Shan,** Naval Surface Warfare Center, Carderock Division, West Bethesda, MD, United States

5:20pm **Wave Impact Force Prediction of Ships in Extreme Wave Conditions for use in Structural Analysis**

**Technical Presentation Only. FEDSM2016-7800**

**Minyee Jiang,** US Navy, West Bethesda, MD, United States

## MONDAY, JULY, 11

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### TRACK 33 PLENARY SPEAKERS

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#### 33-4 PLENARY SESSION 3

**Regency BC** **8:30am - 10:10am**

8:30am **Verification and Validation in Fluids Engineering: Some Current Issues**

**Plenary Presentation. FEDSM2016-7967**

**Patrick J. Roache,** Consultant, Socorro, NM, United States

## TUESDAY, JULY, 12

### 33-1 PLENARY SESSION 1

**Regency BC** **10:30am - 12:10pm**

10:30am **Nine Decades of Fluid Mechanics**

**Plenary Presentation. FEDSM2016-7514**

**Mohamed Gad-el-Hak**, Virginia Commonwealth University, Richmond, VA, United States

## WEDNESDAY, JULY, 13

### 33-3 FREEMAN SCHOLAR LECTURE

**Regency BC** **10:30am - 12:10pm**

10:30am **Particle Transport, Deposition and Removal - Environmental and Biological Applications**

**Plenary Presentation. FEDSM2016-7960**

**Goodarz Ahmadi**, Clarkson University, Potsdam, NY, United States

### 33-2 PLENARY SESSION 2

**Regency BC** **2:00pm - 3:40pm**

2:00pm **Navy Ship Design Perspective in Fluids Engineering**

**Plenary Presentation. FEDSM2016-7958**

**Joseph Arcano**, Naval Surface Warfare Center, Carderock Division, Damascus, MD, United States

## MONDAY, JULY, 11

### TRACK 34 MONDAY LUNCHEON LECTURE ON "NAE GRAND CHALLENGE SCHOLARS PROGRAM"

#### 34-1 MONDAY LUNCHEON LECTURE

**Regency A** **12:15pm - 1:55pm**

Session Organizer: Yu-Tai Lee, Naval Surface Warfare Center, West Bethesda, MD, United States

Session Co-Organizer: Javid Bayandor, Virginia Polytechnic Institute and State University, Blacksburg, VA, United States

12:15pm **NAE Grand Challenge Scholars Program**

**Keynote Presentation. FEDSM2016-7991**

**C. D. Mote, Jr.**, National Academy of Engineering, Washington, DC, United States

## TUESDAY, JULY, 12

### TRACK 35 TUESDAY LUNCHEON LECTURE ON "EVENTS IN FED'S HISTORY"

#### 35-1 TUESDAY LUNCHEON LECTURE

**Regency A** **12:15pm - 1:55pm**

Session Organizer: Yu-Tai Lee, Naval Surface Warfare Center, West Bethesda, MD, United States

Session Co-Organizer: George Papadopoulos, Innoveering, LLC, Ronkonkoma, NY, United States

12:15pm **Events in FED's History**

**Keynote Presentation. FEDSM2016-7992**

**William B. Morgan**, Retired from David Taylor Model Basin, West Bethesda, MD, United States

## MONDAY, JULY, 11

### TRACK 36 FED FEDERAL FUNDING PANEL

#### 36-1 FED FEDERAL FUNDING PANEL

**Regency BC** **4:00pm - 5:40pm**

Session Organizer: D. Keith Walters, Mississippi State University, Mississippi State, MS, United States

Session Co-Organizer: Yu-Tai Lee, Naval Surface Warfare Center, West Bethesda, MD, United States

4:00pm **NSF Federal Funding Program**

**Keynote Presentation. FEDSM2016-7993**

**William Olbricht**, National Science Foundation, Arlington, VA, United States

# Technical Sessions Fluids Engineering

4:20pm **NASA Federal Funding Program**

**Keynote Presentation. FEDSM2016-7994**

**Jay Dryer, NASA**, Washington, DC, United States

4:40pm **DOE Federal Funding Program**

**Keynote Presentation. FEDSM2016-7995**

**Michael McKittrick**, US Department of Energy - Advanced Manufacturing Office, Washington, DC, United States

5:00pm **AFOSR Federal Funding Program**

**Keynote Presentation. FEDSM2016-7996**

**Robert Kraus**, Air Force Research Laboratory/Air Force Office of Scientific Research, Arlington, VA, United States

5:20pm **ONR Federal Funding Program**

**Keynote Presentation. FEDSM2016-7997**

**Thomas Fu**, Office of Naval Research, Arlington, VA, United States

## MONDAY, JULY, 11

### TRACK 1 SINGLE PHASE GAS FLOWS

#### 1-1 SINGLE PHASE GAS FLOWS IN MICRO AND NANO-SCALES

**Bunker Hill** **10:30am - 12:10pm**

Session Organizer: Norbert Kockmann, Technical University of Dortmund, Dortmund, Germany

Session Co-Organizer: Irina Graur Martin, Aix Marseille University, Marseille, France

10:30am **Experimental and Numerical Study of the Pressure Drop in Transonic Micronozzle Flows Across Multiple Flow Regimes**

Technical Publication. ICNMM2016-7919

**Juan E. Gomez Herrera, Rodion Groll, ZARM** - University of Bremen, Bremen, Bremen, Germany

10:50am **Numerical Investigation of the Effect of Micro Channel Bends Angle**

Technical Publication. ICNMM2016-7950

**Olga Rovenskaya**, Russian Academy of Sciences, Moscow, Russia, **Giulio Croce**, University of Udine, Udine, Italy

11:10am **Velocity Slip and Temperature Jump for Gas Flows Past Anisotropic Surfaces: Analytical Derivation and Numerical Simulation**

Technical Publication. ICNMM2016-7924

**Quy Dong TO, Van Huyen Vu, Guy Lauriat, Celine Leonard**, Université Paris Est Marne la Vallée, Champs sur Marne, France

11:30am **Modeling Surface Force Effects on Nano-channel Gas Mass Transport**

Technical Presentation Only. ICNMM2016-8055

**Murat Barisik**, Izmir Institute of Technology, Izmir, 35430, Turkey, **Ali Beskok**, Southern Methodist University, Plano, TX, United States

11:50am **Investigating the Structure of the Bi-Layered Gas Diffusion Layer using X-ray Computed Tomography**

Technical Publication. ICNMM2016-7964

**Rupak Banerjee, Hang Liu, James Hinebaugh, Aimy Bazylak**, University of Toronto, Toronto, Ontario, Canada

## MONDAY, JULY, 11

### TRACK 2 SINGLE PHASE LIQUID FLOWS

#### 2-1 SINGLE PHASE LIQUID FLOWS

**Thornton B** **8:30am - 10:10am**

Session Organizer: Ali Kosar, Sabanci University, Istanbul, Istanbul, Turkey

Session Co-Organizer: BoHung Kim, University of Ulsan, Ulsan, Korea (Republic)

8:30am **Flow and Heat Transfer in Microchannels with Curvature**

Technical Presentation Only. ICNMM2016-7911

**Xiaowei Tian, Liqiu Wang**, University of Hong Kong, Hong Kong, Hong Kong

8:50am **Experimental Study of a Single Microchannel Flow Under Non-Uniform Heat Flux**

Technical Publication. ICNMM2016-7953

**Ahmed Eltaweel, Ibrahim Hassan**, Texas A&M University at Qatar, Doha, Qatar

9:10am **Hydrodynamic and Thermal Characteristics of the Flow Inside a Rectangular Microchannel With Different Cylindrical Micro Pin Fins**

Technical Publication. ICNMM2016-7993

**Ali Mohammadi, Ali Kosar**, Sabanci University, Istanbul, Turkey

9:30am **Heat Transfer Characteristics of Downward Supercritical Kerosene Flow in Minutubes**

Technical Publication. ICNMM2016-8014

**Jinpin Lin, Jingzhi Zhang, Wei Li**, Zhejiang University, Hang-Zhou City, China, **Ekaterina Sokolova**, Peter the Great Saint Petersburg Polytechnic university, St. Petersburg, Russia

# Technical Sessions Nanochannels, Microchannels, and Minichannels

9:50am **Vortex Laden Flows in a Micro-gap for Enhanced Direct Chip Cooling**

Technical Publication. ICNMM2016-8047

**Amir Gorodetsky, Herman Haustein**, Tel Aviv University, Tel Aviv, Tel Aviv, Israel

1:50am **Molecular Dynamics Investigation of the Desalination Efficacy of MFI Zeolites**

Technical Presentation Only. ICNMM2016-7938

**Geoffrey A. Vaartstra, Shalabh Maroo**, Syracuse University, Syracuse, NY, United States

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## 2-2 SINGLE PHASE LIQUID FLOWS

**Thornton B** 10:30am - 12:10pm

Session Organizer: Prashanta Dutta, Washington State University, Pullman, WA, United States

Session Co-Organizer: Daniel Attinger, Iowa State University, Ames, IA, United States

10:30am **Momentum and Heat Transfer in Force-Driven Nano-Channel Flows**

Technical Presentation Only. ICNMM2016-8053

**Jafar Ghorbanian, Alper Celebi**, Southern Methodist University, Dallas, TX, United States, **Ali Beskok**, Southern Methodist University, Plano, TX, United States

10:50am **Molecular Dynamics Simulations of Water Confined in Graphene Nano-Channels**

Technical Presentation Only. ICNMM2016-8056

**Alper Tunga Celebi, Jafar Ghorbanian**, Southern Methodist University, Dallas, TX, United States, **Murat Barisik**, Izmir Institute of Technology, Izmir, 35430, Turkey, **Ali Beskok**, Southern Methodist University, Plano, TX, United States

11:10am **Water Transport in Nanoscale Porous Media**

Technical Presentation Only. ICNMM2016-8065

**S. Sevinc Sengor, Jianing Li**, Southern Methodist University, Dallas, TX, United States, **Ali Beskok**, Southern Methodist University, Plano, TX, United States

11:30am **Flow Enhancement of Methanol and Ethanol through Nanoporous AAO Membranes**

Technical Presentation Only. ICNMM2016-8092

**Donald Fehlinger, Emre Olceroglu, Matthew McCarthy**, Drexel University, Philadelphia, PA, United States

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## 2-3 SINGLE PHASE LIQUID FLOWS

**Thornton B** 4:00pm - 5:40pm

Session Organizer: BoHung Kim, University of Ulsan, Ulsan, Korea (Republic)

Session Co-Organizer: Ali Kosar, Sabanci University, Istanbul, Istanbul, Turkey

4:00pm **Capillary Viscometer Based on Ideal Gas Law**

Technical Presentation Only. ICNMM2016-8079

**Xiaolong Luo, Luis Bautista**, Catholic University of America, Washington, DC, United States

4:20pm **Accurate and Inexpensive Thermal Flow Meter Design for Measuring Refrigerant Velocities in Minichannels**

Technical Presentation Only. ICNMM2016-8083

**Allison J Mahvi, Bashir El Fil, Srinivas Garimella**, Georgia Institute of Technology, Atlanta, GA, United States

4:40pm **Heat Transfer Characteristics of Supercritical Aviation Kerosene at Different Tube Diameters**

Technical Publication. ICNMM2016-8096

**Xiaoqiang Hong, Dan Huang, Wei Li, Hua Zhu**, Zhejiang University, Hangzhou, China

5:00pm **Fluid Friction of Liquid Flow in 3D-printed Rectangular Microchannel**

Technical Presentation Only. ICNMM2016-8114

**Heesung Park, Jaehyun Park**, Changwon National University, Changwon, Korea (Republic)

5:20pm **Modeling of the Chinese Tea Ppet called Pee-pee Boy - a Heat Engine and a High-amplification Temperature Sensor**

**Technical Presentation Only. ICNMM2016-8080**

**Daniel Attinger**, Iowa State University, Ames, IA, United States, **Vincent Lee**, Georgia Institute of Technology, Atlanta, GA, United States

## MONDAY, JULY, 11

### TRACK 3 TWO-PHASE FLOWS

#### 3-1 TWO-PHASE FLOWS

**Concord** **8:30am - 10:10am**

Session Organizer: Saeed Moghaddam, University of Florida, Gainesville, FL, United States

Session Co-Organizer: Satish Kandlikar, Rochester Institute of Technology, Rochester, NY, United States

8:30am **Heat Dissipation Beyond 1 kW/cm<sup>2</sup> With Low Pressure Drop and High Heat Transfer Coefficient for Flow Boiling Using Open Microchannels With Tapered Manifold**

**Technical Publication. ICNMM2016-7918**

**Ankit Kalani, Satish Kandlikar**, Rochester Institute of Technology, Rochester, NY, United States

8:50am **Experimental Study on Local Subcooled Flow Boiling Heat Transfer in a Vertical Mini-gap Channel**

**Technical Publication. ICNMM2016-7959**

**Junye Li, Kan Zhou, Wei Li, Zhejiang** University, Hang-Zhou City, China, **Zhaozan Feng**, CRRC Zhuzhou Institute Co., Ltd., Hunan, China, **Carolyn Coyle**, MIT, West Hills, CA, United States, **Thomas J McKrell, Jacopo Buongiorno**, Massachusetts Institute of Technology, Cambridge, MA, United States

9:10am **Flow Boiling in a Horizontal Tube at High Vapor Qualities**

**Technical Publication. ICNMM2016-7978**

**Han Deng, Maria Fernandino, Carlos Dorao**, Norwegian University of Science and Technology, Trondheim, Norway

9:30am **Analysis of Microchannel Flow Boiling Models using Unprecedented Microscale Experimental Data**

**Technical Presentation Only. ICNMM2016-8020**

**Sajjad Bigham, Saeed Moghaddam**, University of Florida, Gainesville, FL, United States

9:50am **Enhanced CHF of Flow Boiling in Microchannels through Coupling Multiple Nozzles and Reentry Microcavities**

**Technical Presentation Only. ICNMM2016-8093**

**Wenming Li, Chen Li, Tamanna Alam**, University of South Carolina, Columbia, SC, United States

#### 3-2 TWO-PHASE FLOWS

**Concord** **10:30am - 12:10pm**

Session Organizer: Satish Kandlikar, Rochester Institute of Technology, Rochester, NY, United States

Session Co-Organizer: Saeed Moghaddam, University of Florida, Gainesville, FL, United States

10:30am **Flow Boiling Instabilities under Nonuniform Heating in a Single Microchannel**

**Technical Presentation Only. ICNMM2016-7955**

**Muhammad Sajid, Ahmed Eltaweel, Ibrahim Hassan**, Texas A&M University at Qatar, Doha, Qatar

10:55am **Experimental Investigation and Discussion of Heat Transfer Mechanisms During Flow Boiling in Mini-Channels Using Refrigerant R134a**

**Technical Publication. ICNMM2016-7957**

**Nicolas La Forgia, Carlos Dorao, Maria Fernandino**, Norwegian University of Science and Technology, Trondheim, Norway

11:20am **Impact of Nanostructures on Surface Heat Transfer in Microchannel Flow Boiling of FC-72**

**Technical Presentation Only. ICNMM2016-8022**

**Sajjad Bigham, Saeed Moghaddam**, University of Florida, Gainesville, FL, United States

# Technical Sessions Nanochannels, Microchannels, and Minichannels

11:45am **Hydrodynamics of Gas Bubbles in Micro-Capillaries - Experimental and Numerical Results**

**Technical Presentation Only. ICNMM2016-8111**

**Peter Lakshmanan, Peter Ehrhard**, Technical University Dortmund, Dortmund, Germany

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## 3-3 TWO-PHASE FLOWS

**Concord** **4:00pm - 5:40pm**

Session Organizer: Masahiro Kawaji, City College of New York, New York, NY, United States

Session Co-Organizer: Saeed Moghaddam, University of Florida, Gainesville, FL, United States

4:00pm **Two-Phase Flow Instabilities in Minichannels**

**Technical Presentation Only. ICNMM2016-7932**

**Dolaana Khovalyg, Predrag Hrnjak, Anthony Jacobi**, University of Illinois at Urbana-Champaign, Urbana, IL, United States

4:20pm **Towards the Understanding of Transformation of Annular to Droplet-annular Gas-liquid Flow**

**Technical Publication. ICNMM2016-7948**

**Parmod Kumar, Arup Kumar Das**, IIT Roorkee, Roorkee, Uttarakhand, India, **Sushanta Mitra**, York University, Toronto, ON, Canada

4:40pm **Oil-water Flow Visualization and Flow Regimes in a 3.7-mm Minichannel**

**Technical Publication. ICNMM2016-7966**

**Kevin K. Bultongez, Melanie Derby**, Kansas State University, Manhattan, KS, United States

5:00pm **Flow Visualization of a Microchannel Heat Exchanger via Neutron Imaging**

**Technical Presentation Only. ICNMM2016-7991**

**Patrick Geoghegan**, Oak Ridge National Laboratory, Oak Ridge, TN, United States

5:20pm **Generation of Uniform Liquid Droplets in a Microfluidic Chip using a High-speed Gaseous Microflow**

**Technical Publication. ICNMM2016-8061**

**Pooyan Tirandazi, Carlos H. Hidrovo**, Northeastern University, Boston, MA, United States

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## TUESDAY, JULY, 12

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### 3-4 TWO-PHASE FLOWS

**Concord** **10:30am - 12:10pm**

Session Organizer: Satish Kandlikar, Rochester Institute of Technology, Rochester, NY, United States

Session Co-Organizer: Masahiro Kawaji, City College of New York, New York, NY, United States

10:30am **Influence of Physical Properties of Phases on Hydrodynamics and Mass Transfer Characteristics of a Liquid-Liquid Circular Microchannel**

**Technical Publication. ICNMM2016-7954**

**Mehdi Sattari-Najafabadi, Bengt Sunden, Zan Wu**, Lund University, Lund, Sweden, **Mohsen Nasr Esfahany**, Isfahan University of Technology, Isfahan, Iran

10:55am **Investigation of Bubble Break-Up in Microchannel Orifices**

**Technical Publication. ICNMM2016-8048**

**Felix Reichmann, Alexander Tollkoetter, Norbert Kockmann**, Technical University of Dortmund, Dortmund, Germany

11:20am **Effect of Surface Roughness on Blood Droplet Spreading and Consequences in Forensics**

**Technical Presentation Only. ICNMM2016-8081**

**Sungu Kim, Yuan Ma, Daniel Attinger**, Iowa State University, Ames, IA, United States

11:45am **Flexible Integrated Structure for Low/high Pressure Solar Steam Generation**

**Technical Presentation Only. ICNMM2016-7982**

**Seyed Mohammad Sajadi, Nazanin Farokhnia, Peyman Irajizad, Hadi Ghasemi**, University of Houston, Houston, TX, United States



## MONDAY, JULY, 11

### TRACK 4 EVAPORATION, BOILING AND CONDENSATION

#### 4-1 MICRO/NANO HIGH FLUX PHASE CHANGE HEAT TRANSFER

**Lexington** **8:30am - 10:10am**

Session Organizer: Yoav Peles, University of Central Florida, Orlando, FL, United States

Session Co-Organizer: Melanie Derby, Kansas State University, Manhattan, KS, United States

8:30am **Two-phase Pressure Drop and Boiling Heat Transfer in Micro Pin Fin Channel**

**Technical Publication. ICNMM2016-7915**

**Ki Moon Jung, Hee Joon Lee**, Kookmin University, Seoul, Korea (Republic)

8:55am **High Heat Flux Boiling Heat Transfer for Laser Diode Arrays**

**Technical Publication. ICNMM2016-7947**

**Taylor Bevis, Todd Bandhauer**, Colorado State University, Fort Collins, CO, United States

9:20am **Critical Heat Flux Enhancement in Pool Boiling: Canopy-Capillary Evaporator Wick**

**Technical Presentation Only. ICNMM2016-7970**

**Yahya Nasersharifi, Gisuk Hwang**, Wichita State University, Wichita, KS, United States

9:45am **Effect of Open Micro-Channels on External Condensation Heat Transfer**

**Technical Publication. ICNMM2016-8062**

**Brandon Hulet, Amy Betz, Melanie Derby**, Kansas State University, Manhattan, KS, United States, **Andres Martinez**, Vanderbilt University, Nashville, TN, United States

#### 4-2 EVAPORATION/POOL BOILING

**Lexington** **10:30am - 12:10pm**

Session Organizer: Melanie Derby, Kansas State University, Manhattan, KS, United States

Session Co-Organizer: Brian M. Fronk, Oregon State University, Corvallis, OR, United States, Todd Bandhauer, Colorado State University, Fort Collins, CO, United States

10:30am **Preliminary Results of Pool Boiling of Seawater**

**Technical Publication. ICNMM2016-7972**

**Pruthvik Raghupathi, Satish Kandlikar**, Rochester Institute of Technology, Rochester, NY, United States

10:50am **Observation of Contact Line Dynamics in Evaporating Droplets under the Influence of Electric Fields**

**Technical Publication. ICNMM2016-7988**

**Collin Burkhart, Kara Maki, Michael Schertzer**, Rochester Institute of Technology, Rochester, NY, United States

11:10am **Heat and Mass Transfer Performance of Nanostructured Evaporator Wicks Combined with Porous Metal Liquid Supply Structures**

**Technical Presentation Only. ICNMM2016-8034**

**Seunggeol Ryu, Youngsuk Nam**, Kyung Hee University, Yongin, Gyeonggi-do, Korea (Republic)

11:30am **Self-assembly during Droplet Evaporation can be controlled by Biomolecular Interactions**

**Technical Presentation Only. ICNMM2016-8089**

**Daniel Attinger, Sahar Andalib, Christophe Frankiewicz**, Iowa State University, Ames, IA, United States, **Cedric Hurth, Andrew Dobos, Frederic Zenhausern**, University of Arizona College of Medicine, Phoenix, AZ, United States, **Rajneesh Bhardwaj**, Indian Institute of Technology Bombay, Mumbai, India,

11:50am **On the Heat Transfer Characteristics of A Single Bubble Growth and Departure During Pool Boiling**

**Technical Publication. ICNMM2016-8097**

**Mostafa Mobli, Chen Li**, University of South Carolina, Columbia, SC, United States

# Technical Sessions Nanochannels, Microchannels, and Minichannels

## MONDAY, JULY, 11

### TRACK 5 ELECTRONICS COOLING & HEAT PIPES

#### 5-1 ELECTRONICS COOLING & HEAT PIPES

Lexington

4:00pm - 5:40pm

Session Organizer: Mark Steinke, Cray Inc., Austin, TX, United States

Session Co-Organizer: Vinod Narayanan, University of California, Davis, Davis, CA, United States

4:00pm **Thermal Performance Analysis of Hybrid Jet Impingement/microchannel Cooling for Concentrated Photovoltaic (CPV) Cells**

Technical Publication. ICNMM2016-7931

**Afzal Husain, Mohd Ariz, Nasser A Al-Azri, Nabeel Al-Rawahi, Sultan Qaboos University, Muscat, Oman, Mohd. Zahid Ansari, PDPM IITDM, Jabalpur, India**

4:20pm **Enhanced Flow Boiling Heat Transfer Using Radial Microchannels**

Technical Publication. ICNMM2016-7975

**Alyssa Recinella, Ankit Kalani, Satish Kandlikar, Rochester Institute of Technology, Rochester, NY, United States**

4:40pm **Oscillating Heat Pipe Performance with Modified Evaporator Geometries**

Technical Publication. ICNMM2016-7980

**Mitchell P. Hoelsing, Gregory J. Michna, South Dakota State University, Brookings, SD, United States**

5:00pm **Development and Verification of an Elementary Numerical Model Applicable to Design Efficient Heat Pipe**

Technical Presentation Only. ICNMM2016-8071

**Tariq Mahbub, Daniel Attinger, Iowa State University, Ames, IA, United States**

5:20pm **Active Heat Pipes for Extended Distance Heat Transport**

Technical Presentation Only. ICNMM2016-8084

**Renee Hale, Vaibhav Bahadur, University of Texas at Austin, Austin, TX, United States**

## MONDAY, JULY, 11

### TRACK 6 ELECTROKINETIC FLOWS

#### 6-1 ELECTROKINETIC FLOWS

Thornton A

8:30am - 10:10am

Session Organizer: Cetin CANPOLAT, Cukurova University, Adana, Turkey

Session Co-Organizer: Prashanta Dutta, Washington State University, Pullman, WA, United States, Peter Ehrhard, Technical University Dortmund, Dortmund, Germany

8:30am **Experimental Characterization of Induced-Charge Electro-Osmosis**

Technical Presentation Only. ICNMM2016-8037

**Cetin CANPOLAT, Cukurova University, Adana, Turkey, Ali Beskok, Southern Methodist University, Plano, TX, United States**

8:55am **Measurements of Electroosmotic Flows in Microchannels with Internal Electrodes by means of micro-PIV**

Technical Presentation Only. ICNMM2016-8112

**Peter Ehrhard, Carsten Gizewski, Technical University Dortmund, Dortmund, Germany**

9:20am **High Voltage Electrodes Injecting Charges Electrohydrodynamically**

Technical Presentation Only. ICNMM2016-7956

**XUEWEI ZHANG, Texas A&M University - Kingsville, Kingsville, TX, United States**

9:45am **Transient Effects in High Power Electroosmotic Pumps**

Technical Publication. ICNMM2016-8077

**Mena E. Tawfik, Aaron Stern, Shashwat Gupta, F.J. Diez, Rutgers, the State University of NJ, Piscataway, NJ, United States**

## 6-2 ELECTROKINETIC FLOWS

**Thornton A**

**10:30am - 12:10pm**

Session Organizer: Peter Ehrhard, Technical University Dortmund, Dortmund, Germany

Session Co-Organizer: Cetin Canpolat, Cukurova University, Adana, Turkey

10:30am **Optimized AC Electrothermal Micromixing Design for Biofluid Systems**

**Technical Publication. ICNMM2016-8100**

**Alinaghi Salari**, University of Toronto, Toronto, ON, Canada, **Maryam Navi**, Ryerson University, Toronto, ON, Canada, **Colin Dalton**, University Of Calgary, Calgary, AB, Canada

10:55am **Microfluidic-Based Modeling of an Electroosmotic Flow in a Single Pore of the Brain Endothelial Cell Monolayer**

**Technical Publication. ICNMM2016-8016**

**Khashayar Teimoori**, **Limary Cancel**, **Ali Sadegh**, **John Tarbell**, **Marom Bikson**, The City College of the City University of New York, New York, NY, United States

11:20am **Novel Electro-FSI model of Trabecular Network in the Brain Sub Arachnoid Space**

**Technical Publication. ICNMM2016-8094**

**Khashayar Teimoori**, **Ali Sadegh**, **Bhaskar Paneri**, Neuromodec, New York, NY, United States, **Marom Bikson**, The City College of the City University of New York, New York, NY, United States

11:45am **AC Electrothermal Technique in Microchannels**

**Technical Publication. ICNMM2016-8101**

**Alinaghi Salari**, University of Toronto, Toronto, ON, Canada, **Maryam Navi**, Ryerson University, Toronto, ON, Canada, **Colin Dalton**, University Of Calgary, Calgary, AB, Canada

## WEDNESDAY, JULY, 13

### TRACK 7 ENERGY APPLICATIONS OF MICRO- AND NANO-SCALE DEVICES

#### 7-1 ENERGY APPLICATION OF MICRO- AND NANO-SCALE DEVICES

**Thornton Lounge**

**2:00pm - 3:40pm**

Session Organizer: Aimy Bazylak, University of Toronto, Toronto, Ontario, ON, Canada

Session Co-Organizer: Rupak Banerjee, University of Toronto, Toronto, ON, Canada

2:00pm **Enhancement of Mass and Heat Transfer Using Herringbone-Inspired Microstructures for Application in Microfluidic Redox Flow Cells**

**Technical Publication. ICNMM2016-7920**

**Julian Marschewski**, **Dimos Poulikakos**, ETH Zurich, Zurich, ZH, Switzerland, **Patrick Ruch**, **Bruno Michel**, IBM Research Zurich, Ruschlikon, ZH, Switzerland

2:20pm **Modeling and Simulation of Multistage Microcompressor with Passive Microvalves for Micro Coolers**

**Technical Publication. ICNMM2016-7934**

**Shawn Le**, **Hisham Hegab**, Louisiana Tech University, Ruston, LA, United States

2:40pm **Microfluidic Synthesis of Polymer Microgel Beads for Electrostatic Energy Harvesting**

**Technical Presentation Only. ICNMM2016-8095**

**Kaushik Kudtarkar**, **Thomas Smith**, **Patricia Iglesias Victoria**, **Michael Schertzer**, Rochester Institute of Technology, Rochester, NY, United States

3:00pm **Study of Microsystems based on High Speed Impinging Flows for Efficient Emulsified Biofuel Production**

**Technical Presentation Only. ICNMM2016-8109**

**Arab Belkadi**, **Jerome Bellettre**, Laboratoire de Thermocinetique UMR CNRS 6607, Nantes, France, **Agnes Montillet**, GEPEA UMR CNRS 6614, Saint Nazaire, France

# Technical Sessions Nanochannels, Microchannels, and Minichannels

3:20pm **Porous Transport Layer Related Mass Transport Losses in**

**Polymer Electrolyte Membrane Electrolysis: A Review**

Technical Publication. ICNMM2016-7974

**Chung Hyuk Lee, Rupak Banerjee, Faraz Arbabi, James Hinebaugh, Aimy Bazylak**, University of Toronto, Toronto, Ontario, Canada

## TUESDAY, JULY, 12

### TRACK 8 THIN FILM, INTERFACIAL PHENOMENA, AND SURFACE TENSION DRIVEN FLOWS

#### 8-1 THIN FILM, INTERFACIAL PHENOMENA, AND SURFACE TENSION DRIVEN FLOWS

**Thornton B**

**10:30am - 12:10pm**

Session Organizer: Daniel Attinger, Iowa State University, Ames, IA, United States

Session Co-Organizer: Carlos Dorao, Norwegian University of Science and Technology, Trondheim, Norway

10:30am **Wetting Effect on Interfacial Film Dynamics of Liquid-Gas Plug Flow in a Capillary**

Technical Presentation Only. ICNMM2016-7929

**Changfei Yan, Huihe Qiu**, The Hong Kong University of Science & Technology, Kowloon, Hong Kong

10:50am **Underwater Wetting Behavior on Micro-Patterned Surfaces**

Technical Publication. ICNMM2016-7941

**Surjyasish Mitra, Naga Gunda, Sushanta Mitra**, York University, Toronto, ON, Canada

11:10am **Design of an Experimental Setup to Investigate an Oscillating and Evaporating Meniscus Using a Feedback Control Loop**

Technical Publication. ICNMM2016-7976

**Alyssa Recinella, Joseph Baldwin, Charles Krouse, Robert Walkowiak, Pruthvik Raghupathi, Satish Kandlikar**, Rochester Institute of Technology, Rochester, NY, United States

11:30am **Investigation of Evaporative Self-assembly in a Sessile Dispersion Drop with Optical Microscopy and Infra-red thermography.**

Technical Presentation Only. ICNMM2016-8090

**Sahar Andalib, Daniel Attinger**, Iowa State University, Ames, IA, United States

11:50am **Study of Contact Angle And Impact of Water Droplets on Graphene**

Technical Presentation Only. ICNMM2016-8118

**Espen Rogstad, Maria Fernandino**, Norwegian University of Science and Technology, Trondheim, Sør-Trøndelag, Norway

#### 8-2 THIN FILM, INTERFACIAL PHENOMENA, AND SURFACE TENSION DRIVEN FLOWS (TECHNICAL)

**Thornton C**

**2:00pm - 3:40pm**

Session Organizer: Sushanta Mitra, York University, Toronto, ON, Canada

Session Co-Organizer: Carlos Dorao, Norwegian University of Science and Technology, Trondheim, Norway

2:00pm **Penetration Dynamics on Membrane Surfaces during Droplet Impact**

Technical Presentation Only. ICNMM2016-7981

**Seunggeol Ryu, Youngsuk Nam, Choongyeop Lee**, Kyung Hee University, Yongin, Gyeonggi-do, Korea (Republic)

2:20pm **Rational Micro/nano Structuring for Thin-film Evaporation**

Technical Presentation Only. ICNMM2016-7986

**Nazanin Farokhnia, Peyman Irajizad, Seyed Mohammad Sajadi, Hadi Ghasemi**, University of Houston, Houston, TX, United States

2:40pm **On the Impact of Liquid Drops on Immiscible Liquids**

Technical Publication. ICNMM2016-8059

**Eduardo Castillo Orozco**, University of Central Florida, Winter Park, FL, United States, **Ashkan Davanlou, Pretam K. Choudhury, Ranganathan kumar**, University of Central Florida, Orlando, FL, United States

3:00pm **Any material becomes superhydrophobic, if you can make it rough enough**

**Technical Presentation Only. ICNMM2016-8060**

**Daniel Attinger**, Iowa State University, Ames, IA, United States,  
**Christophe Frankiewicz**, Iowa State University, Ames, IA, United States

3:20pm **Flow Phenomena of Coating Beads during Extrusion-On-Demand of Patterned Thin Films**

**Technical Presentation Only. ICNMM2016-8121**

**Ara Parsekian, Tequila A. L. Harris**, Georgia Institute of Technology, Atlanta, GA, United States

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## **8-3 THIN FILM, INTERFACIAL PHENOMENA, AND SURFACE TENSION DRIVEN FLOWS**

**Thornton C** **4:00pm - 5:40pm**

Session Organizer: Daniel Attinger, Iowa State University, Ames, IA, United States

Session Co-Organizer: Sushanta Mitra, York University, Toronto, ON, Canada

4:00pm **Influence on Capillary Flow of Human Blood in PDMS Micro Channels due to various Surface Treatments**

**Technical Presentation Only. ICNMM2016-8122**

**Bharath Babu Nunna, Shiqiang Zhuang, Eon Soo Lee**, New Jersey Institute of Technology, Newark, NJ, United States

4:25pm **Comparative Studies on Water Self-Diffusivity Confined in Graphene Nanogap: Molecular Dynamics Simulation**

**Technical Publication. ICNMM2016-7962**

**Mohammad Moulod, Gisuk Hwang**, Wichita State University, Wichita, KS, United States

4:50pm **Effect of Nanostructures and Wettability on the Instability of Thin Water Films on a Solid Surface: A Molecular Dynamics Study**

**Technical Publication. ICNMM2016-7921**

**Liyong Sun, Jun Zhou, Phil Jones**, Penn State Erie, The Behrend College, Erie, PA, United States

5:15pm **Solid-Liquid Interface Effects on Ion Concentrations and Velocity Profiles in Nanoscale Electro-osmotic Flows**

**Technical Presentation Only. ICNMM2016-7946**

**Truong Q. Vo, BoHung Kim**, University of Ulsan, Ulsan, Ulsan, Korea (Republic)

## **WEDNESDAY, JULY, 13**

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### **TRACK 9 SURFACE ENGINEERING FOR PHASE-CHANGE HEAT TRANSFER**

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#### **9-1 SURFACE ENGINEERING FOR PHASE-CHANGE HEAT TRANSFER - POOL BOILING**

**Thornton C**

**8:30am - 10:10am**

Session Organizer: Amy Betz, Kansas State University, Manhattan, KS, United States

Session Co-Organizer: Maria Fernandino, Norwegian University of Science and Technology, Trondheim, Norway

8:30am **Dip Coating of Electrochemically Generated Graphene and Graphene Oxide Coatings to Enhance Pool Boiling Performance**

**Technical Publication. ICNMM2016-7973**

**Arvind Jaikumar, Satish Kandlikar, Anju Gupta**, Rochester Institute of Technology, Rochester, NY, United States

8:50am **Wicking-Enhanced Critical Heat Flux for Highly Wetting Fluids**

**Technical Presentation Only. ICNMM2016-7995**

**MD Mahamudur Rahman**, Drexel University, Upper Darby, PA, United States, **Matthew McCarthy**, Drexel University, Philadelphia, PA, United States

9:10am **Fouling and Degradation of Engineered Surfaces during Enhanced Boiling**

**Technical Presentation Only. ICNMM2016-8007**

**Jordan Pollack, Shakerur Ridwan, Matthew McCarthy**, Drexel University, Philadelphia, PA, United States, **MD Mahamudur Rahman**, Drexel University, Upper Darby, PA, United States

# Technical Sessions Nanochannels, Microchannels, and Minichannels

9:30am **Modifying the Wettability of Large Copper Surface using Subtractive and Additive Process**

**Technical Presentation Only. ICNMM2016-8072**

**Tariq Mahbub, Xin Chen, Daniel Attinger**, Iowa State University, Ames, IA, United States

9:50am **Thin Film Condensation on Structured Surfaces**

**Technical Presentation Only. ICNMM2016-8091**

**Emre Olceroglu, Matthew McCarthy**, Drexel University, Philadelphia, PA, United States

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## 9-2 SURFACE ENGINEERING FOR PHASE-CHANGE HEAT TRANSFER - FLOW AND FILM BOILING

**Thornton C** **10:30am - 12:10pm**

Session Organizer: Matthew McCarthy, Drexel University, Philadelphia, PA, United States

Session Co-Organizer: Amy Betz, Kansas State University, Manhattan, KS, United States

10:30am **Vertical Annular Flow Boiling Heat Transfer from Plain and Superhydrophilic Surfaces in a Mini-gap Channel**

**Technical Presentation Only. ICNMM2016-7958**

**Junye Li, Wei Li**, Zhejiang University, Hang-Zhou City, China, **Zhaozan Feng**, CRRC Zhuzhou Institute Co., Ltd., Hunan, China

10:50am **Effect of Micropillar Characteristics on Leidenfrost Temperature of Impacting Droplets**

**Technical Publication. ICNMM2016-7963**

**Il Woong Park, Maria Fernandino, Carlos Dorao**, Norwegian University of Science and Technology, Trondheim, Norway

11:10am **Three-Dimensional VOF Simulations of Laminar Fluid Flows in Micro-Pipes Containing Superhydrophobic Walls with Micro-Posts and Micro-Ridges**

**Technical Publication. ICNMM2016-7992**

**Mohamed E. Eleshaky**, College of Technological Studies, Public Authority for Applied Education & Training, Hawally, Kuwait

11:30am **Hierarchical Biphilic Micro/nanostructures for a New Generation Phase-change Heat Sink with 1700 W/cm<sup>2</sup> CHF Limit**

**Technical Presentation Only. ICNMM2016-8025**

**Abdy Fazeli, Saeed Moghaddam**, University of Florida, Gainesville, FL, United States

11:50am **The Leidenfrost Phenomenon on Silicon Nanowires**

**Technical Publication. ICNMM2016-8032**

**Manuel Auliano, Carlos Dorao, Maria Fernandino**, Norwegian University of Science and Technology, Trondheim, Norway, **Peng Zhang**, SJTU, Shanghai, China

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## 9-3 SURFACE ENGINEERING FOR PHASE-CHANGE HEAT TRANSFER - CONDENSATION, EVAPORATION, AND FREEZING

**Thornton C** **2:00pm - 3:40pm**

Session Organizer: Maria Fernandino, Norwegian University of Science and Technology, Trondheim, Norway

Session Co-Organizer: Matthew McCarthy, Drexel University, Philadelphia, PA, United States

2:00pm **How Can Surface Morphology and Wettability of Leaves Influence Water Harvesting?**

**Technical Presentation Only. ICNMM2016-8069**

**Talukder Jubery, Ankush Algudkar, Daniel Attinger, Nick Lauter**, Iowa State University, Ames, IA, United States

2:20pm **A Study on Robustness and Longevity of Superhydrophobic Nanostructured Surfaces for Jumping Droplet Condensation**

**Technical Presentation Only. ICNMM2016-8067**

**Banafsheh Barabadi, Luis Gasca, Daniel J. Preston, Dion S. Antao, Jacob A. Del Priore, Evelyn Wang**, Massachusetts Institute of Technology, Cambridge, MA, United States

2:40pm **Experimental Characterization and Modeling of Capillary-pumped Thin-film Evaporation from Micropillar Wicks**

**Technical Publication. ICNMM2016-8085**

**Solomon Adera, Dion S. Antao, Evelyn Wang**, Massachusetts Institute of Technology, Cambridge, MA, United States, **Rishi Raj**, Indian Institute of Technology Patna, Patna, Bihar, India

3:00pm **Surface Modifications to Alter Droplet Dynamics Prior to Freezing**

**Technical Presentation Only. ICNMM2016-8117**

**Amy Betz, Melanie Derby, Nanxi Li**, Kansas State University, Manhattan, KS, United States, **Cara Snyder**, Highland Park High School, Topeka, KS, United States, **Chuang Qu, Edward Kinzel**, Missouri S&T, Rolla, KS, United States

3:20pm **Hierarchical Biphilic Micro/nanostructures for a New Generation Phase-change Heat Sink with 1700 W/cm<sup>2</sup> CHF Limit**

**Technical Presentation Only. ICNMM2016-8026**

**Abdy Fazeli, Saeed Moghaddam**, University of Florida, Gainesville, FL, United States

## TUESDAY, JULY, 12

### TRACK 10 BIOMEDICAL AND LAB-ON-A-CHIP APPLICATIONS

#### 10-1 CELL APPLICATIONS

**Thornton B**

**2:00pm - 3:40pm**

Session Organizer: Dirk Janasek, Leibniz-Institut für Analytische Wissenschaften - ISAS - e.V., Dortmund, Germany

Session Co-Organizer: German Drazer, Rutgers University, Skillman, NJ, United States

2:00pm **An Integrated Microfluidics Device for Magnetic Activated Cell Analysis**

**Technical Presentation Only. ICNMM2016-7922**

**Fan Liu, Pawan KC, Ge Zhang, Jiang Zhe**, University of Akron, Akron, OH, United States

2:20pm **Lab-on-a-chip Meditated RNA Purification from 3D Cell Spheroids via Solid Phase Gene Extraction Technique**

**Technical Presentation Only. ICNMM2016-7928**

**Gergana Nestorova, Nam Nguyen, Mark A. DeCoster, Niel D. Crews**, Louisiana Tech University, Ruston, LA, United States, **Karl H. Hasenstein**, University of Louisiana at Lafayette, Lafayette, LA, United States

2:40pm **Development of a Rare Cell Isolator using Size and Dielectrical Differences among Cells**

**Technical Presentation Only. ICNMM2016-8040**

**Anil Koklu, Amin Mansoorifar, Hamidreza Bayat, Ahmet Can Sabuncu**, Southern Methodist University, Dallas, TX, United States, **Ali Beskok**, Southern Methodist University, Plano, TX, United States

3:00pm **Ultrathin Silicon Nitride Membrane as an Enabling Platform for Cell-culture, Bioseparation, and Shear-free Cell Handling.**

**Technical Presentation Only. ICNMM2016-8051**

**Henry Chung, Kilean Lucas, Tejas Khire, Tucker Burgin, Alfred Clark, Jr., James McGrath**, University of Rochester, Rochester, NY, United States

3:20pm **A Magnetophoretic Chip for Detection of Circulating Tumor Cells from Peripheral Blood**

**Technical Presentation Only. ICNMM2016-8082**

**Seth Jackson, Jeff Darabi, Joseph Schober**, Southern Illinois University Edwardsville, Edwardsville, IL, United States

#### 10-2 PARTICLE SEPARATION AND MODELING

**Thornton B**

**4:00pm - 5:40pm**

Session Organizer: Mark A. Levenstein, University of Leeds, Leeds, United Kingdom

Session Co-Organizer: Dirk Janasek, Leibniz-Institut für Analytische Wissenschaften - ISAS - e.V., Dortmund, Germany

4:00pm **INVESTIGATION OF THE INERTIAL FOCUSING BEHAVIOR IN CURVED MICROFLUIDIC CHANNELS FOR DIFFERENT ASPECT RATIO**

**Technical Publication. ICNMM2016-7965**

**Alireza Setayesh Hagh, Istanbul Technical University, Istanbul, Turkey, Ali Dinler**, Istanbul Medeniyet University, Istanbul, Turkey

4:20pm **Dipole-Dipole Interaction between Particle Complexes in a Magnetophoretic Bioseparation Chip**

**Technical Publication. ICNMM2016-8030**

**Manjurul Alam, Jeff Darabi**, Southern Illinois University Edwardsville, Edwardsville, IL, United States

# Technical Sessions Nanochannels, Microchannels, and Minichannels

4:40pm **Separation in Microfluidics using Periodic Structures**

**Technical Presentation Only. ICNMM2016-8058**

**German Drazer**, Rutgers University, Skillman, NJ, United States

5:00pm **Gravity Driven Deterministic Lateral Displacement for Suspended Particles in a Reconfigurable 3D Obstacle Array**

**Technical Presentation Only. ICNMM2016-8068**

**Siqi Du**, Piscataway, NJ, United States, **German Drazer**, Rutgers University, Skillman, NJ, United States

5:20pm **Particle Separation utilizing particle and interface interaction in a T-shaped microfluidic channel**

**Technical Presentation Only. ICNMM2016-8076**

**Siqi Du**, Piscataway, NJ, United States, **Tianyu Yan**, **Joelle Frechette**, Johns Hopkins University, Baltimore, MD, United States, **German Drazer**, Rutgers University, Skillman, NJ, United States

## WEDNESDAY, JULY, 13

### 10-3 DETECTION IN MICROFLUIDIC PLATFORMS

**Thornton B**

**8:30am - 10:10am**

Session Organizer: **Ahmet Can Sabuncu**, Southern Methodist University, Dallas, TX, United States

Session Co-Organizer: **Dirk Janasek**, Leibniz-Institut für Analytische Wissenschaften - ISAS - e.V., Dortmund, Germany

8:30am **A Modular Droplet Microfluidic Platform for Time-Resolved Crystallization Analysis**

**Technical Presentation Only. ICNMM2016-7917**

**Mark A. Levenstein**, **Yi-Yeoun Kim**, **Shunbo Li**, **Fiona C. Meldrum**, **Nikil Kapur**, University of Leeds, Leeds, United Kingdom

8:50am **Microfluidic Measurements of Drug Dissolution using a Quartz Crystal Microbalance**

**Technical Publication. ICNMM2016-7930**

**Shelly Gulati**, **Janpierre A. Bonoan**, **Kylee V. Schesser**, **Joshua F. Arucan**, **Xiaoling Li**, University of the Pacific, Stockton, CA, United States

9:10am **A Microfluidic Device for Real-Time Electrical Studies of a Small Number of Cells**

**Technical Presentation Only. ICNMM2016-8046**

**Amin Mansoorifar**, **Anil Koklu**, **Ahmet Can Sabuncu**, Southern Methodist University, Dallas, TX, United States, **Ali Beskok**, Southern Methodist University, Plano, TX, United States

9:30am **Portable Blood Typing Devices**

**Technical Presentation Only. ICNMM2016-8107**

**Cheng-Po Wang**, **Chun-Hui Yang**, **Chien-Fu Chen**, National Chung Hsing University, Taichung, Taiwan

9:50am **Microfluidic Study of Chemotactic Decision Making in Swimming Microorganisms**

**Technical Presentation Only. ICNMM2016-8012**

**Mohammad Mehdi Salek**, **Vicente Fernandez**, **Francesco Carrara**, Massachusetts Institute of Technology, Cambridge, MA, United States, **Jeffrey Guasto**, Tufts University, Medford, MA, United States, **Roman Stocker**, ETH Zurich, Zurich, Switzerland

### 10-4 MICRO/NANOFABRICATION

**Thornton B**

**10:30am - 12:10pm**

Session Organizer: **German Drazer**, Rutgers University, Skillman, NJ, United States

Session Co-Organizer: **Mark A. Levenstein**, University of Leeds, Leeds, United Kingdom

10:30am **Enhancement of Transport-Limited Chemical Reactions via Functionalized Carbon Nanotube Microarray Membranes**

**Technical Presentation Only. ICNMM2016-7997**

**Benjamin J. Brownlee**, **Brian D. Iverson**, Brigham Young University, Provo, UT, United States, **Kevin M. Marr**, L-3, Richardson, TX, United States, **Jonathan C. Claussen**, Iowa State University, Ames, IA, United States

10:50am **Lipid Bilayer Formation in Microfluidics Towards Highly Stable Artificial Cell Membrane**

**Technical Presentation Only. ICNMM2016-8074**

**Xiaolong Luo**, **Alex Laprade**, Catholic University of America, Washington, DC, United States



11:10am **Low Cost Graphene Electrodes for Performing Digital Microfluidic Operations on a Hand held Portable Platform**

**Technical Publication. ICNMM2016-8078**

**Mohamed Yafia, Homayoun Najjaran**, University of British Columbia, Kelowna, BC, Canada

11:30am **Ultra-thin Microfluidic Devices Built via Thermal Lamination.**

**Technical Presentation Only. ICNMM2016-8104**

**Fernando Ontiveros**, St. John Fisher College, Rochester, NY, United States, **James R. McDowell**, University of Albany, Albany, NY, United States

11:50am **Novel Preparation of Monodisperse Microbubbles by Integrating Oscillating Electric Fields with Microfluidics**

**Technical Presentation Only. ICNMM2016-8123**

**Anjana Kothandaraman, Anthony Harker, Yiannis Ventikos, Mohan Edirisinghe**, University College London, London, United Kingdom, **Muhammad Qureshi, Yasir Alfadhli, Xiaodong Chen**, Queen Mary University of London, London, United Kingdom

## TUESDAY, JULY, 12

### TRACK 11 MODELING AND SIMULATION

#### 11-1 MODELING AND SIMULATION I

**Sequoia** **2:00pm - 3:40pm**

Session Organizer: Rui Qiao, Virginia Polytechnic Institute & State University, Blacksburg, VA, United States

Session Co-Organizer: BoHung Kim, University of Ulsan, Ulsan, Korea (Republic)

2:00pm **Lattice Boltzmann Simulation of Flow in a Multiple Layer Water Filter**

**Technical Publication. ICNMM2016-7906**

**Yan Su, E11-4074**, University of Macau, Macau, Macau, **Liyong Sun**, Penn State Erie, The Behrend College, Erie, PA, United States

2:25pm **Adsorption-Controlled Thermal Diode: Nonequilibrium Molecular Dynamics Simulation**

**Technical Publication. ICNMM2016-7936**

**Tadeh Avanesian, Gisuk Hwang**, Wichita State University, Wichita, KS, United States

2:50pm **Multi-scale Modeling and Hybrid Atomistic-continuum Simulation for Condensation of Gas Flow in a Micro-channel**

**Technical Publication. ICNMM2016-7971**

**Van Huyen Vu, Benoît Trouette, Quy Dong To, Eric Chenier**, Université Paris Est Marne la Vallée, Champs sur Marne, France

3:15pm **Nonlinear Study of Convective Heat Transfer in Tightly Curved Rectangular Microchannels**

**Technical Publication. ICNMM2016-7912**

**Fang Liu**, Shanghai University of Electric Power, Shanghai, China

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#### 11-2 MODELING AND SIMULATION II

**Sequoia** **4:00pm - 5:40pm**

Session Organizer: BoHung Kim, University of Ulsan, Ulsan, Korea (Republic)

Session Co-Organizer: Rui Qiao, Virginia Polytechnic Institute & State University, Blacksburg, VA, United States

4:00pm **Modeling of Evaporation Phenomenon Considering Liquid and Vapor Phase Conduction Effects – Stefan Problems**

**Technical Publication. ICNMM2016-7968**

**Isaac Perez-Raya, Satish Kandlikar**, Rochester Institute of Technology, Rochester, NY, United States

4:25pm **Numerical Simulation of Viscoelastic Fluid Flow using Log-conformation Reformulation by OpenFOAM**

**Technical Presentation Only. ICNMM2016-8005**

**Meng Zhang, Hongna Zhang, Fengchen Li**, Harbin Institute of Technology, Harbin, China

# Technical Sessions Nanochannels, Microchannels, and Minichannels

4:50pm **Gradient Augmented Level set Method for Two Phase Flow Simulations with Phase Change**

Technical Presentation Only. ICNMM2016-8044

**China Rama Lakshman Anumolu, Mario F. Trujillo, Mridul Aanjaneya, Eftychios Sifakis**, University of Wisconsin Madison, Madison, WI, United States

5:15pm **A Two-Phase Model for Analysis of Blood Flow and Rheological Properties in the Elastic Microvessel**

Technical Publication. ICNMM2016-8103

**Xiaohui Lin, Chibin Zhang, Changbao Wang, Wenquan Chu, Zhaomin Wang**, Southeast university, Nanjing, jiangsu, China

## WEDNESDAY, JULY, 13

### TRACK 12 CONJUGATE MICRO- AND NANO-SCALE HEAT TRANSFER

#### 12-1 CONJUGATE MICRO- AND NANO-SCALE HEAT TRANSFER

**Thornton B** 2:00pm - 3:40pm

Session Organizer: Leandro Sphaier, Universidade Federal Fluminense, Niteroi, RJ, Brazil

Session Co-Organizer: Satish Kandlikar, Rochester Institute of Technology, Rochester, NY, United States

2:00pm **Heat Transfer Enhancement using Miniaturized Channel Sections with Surface Modifications**

Technical Presentation Only. ICNMM2016-7910

**Mohammed Mayeed**, Kennesaw State University, Marietta, GA, United States, **Soumya Patnaik**, Air Force Research Laboratory, Dayton, OH, United States

2:33pm **Conjugate Heat Transfer in a Hexagonal Micro Channel Using Hybrid Nano Fluids**

Technical Publication. ICNMM2016-7961

**Shreyas Hegde, Narendran Ganesan**, National Institute of Technology Karnataka Surathkal, Mangalore, India, **Nagarajan Gnanasekaran**, National Institute of Technology Karnataka Surathkal, Chennai, Tamil Nadu, India

3:06pm **Characterization of Tubular Micro-/Milli-Fluidic Heat-Exchangers by Non-Invasive Temperature Measurement**

Technical Publication. ICNMM2016-8008

**Lukas Hohmann, Safa Kutup Kurt, Naser Pouya Far, Daniel Vieth, Norbert Kockmann**, Technical University of Dortmund, Dortmund, Germany

## WEDNESDAY, JULY, 13

### TRACK 13 MIXING, MASS TRANSFER AND CHEMICAL REACTIONS

#### 13-1 CHEMICAL REACTIONS IN MICROSCALE

**Congressional D** 10:30am - 12:10pm

Session Organizer: Saeed Moghaddam, University of Florida, Gainesville, FL, United States

Session Co-Organizer: Ashkan Davanlou, University of Central Florida, Orlando, FL, United States

10:30am **Generation and Reactions of Perfluoroalkyl-substituted Organolithiums Using Flow Microreactors**

Technical Presentation Only. ICNMM2016-7909

**Aiichiro Nagaki**, Kyoto University, Kyoto, Japan

10:50am **Modular Concept of a Smart Scale Helically Coiled Tubular Reactor for Continuous Operation of Multiphase Reaction Systems**

Technical Publication. ICNMM2016-8004

**Safa Kutup Kurt, Mohd Akhtar, Norbert Kockmann**, Technical University of Dortmund, Dortmund, Germany, **Krishna D.P. Nigam**, Indian Institute of Technology, Department of Chemical Engineering, New Delhi, India

11:10am **Design of Anode Flow Channels and Headers for a Large PEMFC Operating at Ultra-Low Stoichiometric Flow Conditions at the Anode Exit**

Technical Publication. ICNMM2016-8018

**Omid B. Rizvandi, Serhat Yesilyurt**, Sabanci University, Istanbul, Turkey

11:30am **Reaction Calorimetry for a Microreactor System Made of Ultrasonic Hot Embossed Polymer Foils Using Seebeck Elements**

**Technical Presentation Only. ICNMM2016-8049**

**Felix Reichmann, Norbert Kockmann**, Technical University of Dortmund, Dortmund, Germany

11:50am **Extraction of Liquid/liquid Slug-flow in a Micro-capillary Reactor**

**Technical Presentation Only. ICNMM2016-8113**

**Christian Heckmann, Peter Ehrhard**, Technical University of Dortmund, Dortmund, Germany

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## **13-2 MIXING, MASS TRANSFER AND CHEMICAL RECTIONS**

**Congressional D** **2:00pm - 3:40pm**

Session Organizer: Ashkan Davanlou, University of Central Florida, Orlando, FL, United States

Session Co-Organizer: Saeed Moghaddam, University of Florida, Gainesville, FL, United States

2:00pm **Experimental Characterization of Electrokinetic based Mixing in a Pressure Driven Flow**

**Technical Presentation Only. ICNMM2016-8027**

**Dilara Uslu, Okan D. Yilmaz, Barbaros Cetin**, Bilkent University, Ankara, Turkey, **Cetin CANPOLAT**, Cukurova University, Adana, Turkey

2:25pm **Investigation of Mixing in Colliding Droplets Generated in Flow-Focusing Configurations Using Laser Induced Fluorescence**

**Technical Publication. ICNMM2016-8063**

**David Bedding, Carlos H. Hidrovo**, Northeastern University, Boston, MA, United States

2:50pm **The Flow and Enrichment Behavior of Ferric Chloride Solution in Gradient Magnetic Field**

**Technical Presentation Only. ICNMM2016-8099**

**Han Ren, Ping Wu, Li Wang, Shiping Zhang**, University of Science and Technology Beijing, Beijing, China

3:15pm **Mass Transfer Characterization of Chemical Absorption of CO<sub>2</sub> in Microchannel Absorbers**

**Technical Publication. ICNMM2016-8042**

**Ziqiang Yang, Tariq Khan, Mohamed Alshehhi, Yasser Alwahedi**, The Petroleum Institute, Abu Dhabi, United Arab Emir.

## **WEDNESDAY, JULY, 13**

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### **TRACK 15 TRANSPORT IN MEMBRANES AND NANOFUIDS**

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#### **15-1 TRANSPORT IN MEMBRANES AND NANOFUIDS**

**Congressional C** **10:30am - 12:10pm**

Session Organizer: Thomas R. Gaborski, Rochester Institute of Technology, Rochester, NY, United States

Session Co-Organizer: Clement Tang, University of North Dakota, Grand Forks, ND, United States

10:30am **Ultrathin Membrane Fouling Mechanism Transitions in Dead-End Filtration of Protein**

**Technical Publication. ICNMM2016-7989**

**Karl Smith, Joshua D. Winans, James McGrath**, University of Rochester, Rochester, NY, United States

10:55am **GO-based filtration membrane for removal of Endocrine Disrupting Compounds (EDCs) from water resources**

**Technical Presentation Only. ICNMM2016-8033**

**Abhilash Paneri, Saeed Moghaddam**, University of Florida, Gainesville, FL, United States

11:20am **Ultrathin Silicon Membranes for Improving Extracorporeal Blood Therapies**

**Technical Publication. ICNMM2016-8052**

**Tucker Burgin, Dean Johnson, Henry Chung, Alfred Clark, Jr., James McGrath**, University of Rochester, Rochester, NY, United States

11:45am **Feasibility of Isolating Exosomes from Biofluids using Ultrathin Nanomembranes**

**Technical Presentation Only. ICNMM2016-8120**

**Mehdi Dehghani, Thomas R. Gaborski**, Rochester Institute of Technology, Rochester, NY, United States

# Technical Sessions Nanochannels, Microchannels, and Minichannels

## 15-2 TRANSPORT IN MEMBRANES AND NANOFUIDS

Congressional C

2:00pm - 3:40pm

Session Organizer: James McGrath, University of Rochester, Rochester, NY, United States

Session Co-Organizer: Thomas R. Gaborski, Rochester Institute of Technology, Rochester, NY, United States

2:00pm **Metallic Nanoemulsion for Microchannel Heat-Sink**

Technical Publication. ICNMM2016-8010

**Yoshikazu Hayashi, Gordon Yip, Yoon Jo Kim, Jong-Hoon Kim,**  
Washington State University Vancouver, Vancouver, WA, United States

2:33pm **Heat Transfer of Silica-Water Nanofluid Flow in Laminar Thermal Entrance Region for Circular and Square Minichannels**

Technical Presentation Only. ICNMM2016-7996

**Sarbottam Pant,** Meiden America, Inc., Northville, MI, United States,  
**Md. Tanveer Sharif,** University of Pittsburgh, Pittsburgh, PA, United States,  
**Clement Tang,** University of North Dakota, Grand Forks, ND, United States

3:06pm **Dispensing Nano-pico Droplets of Ferrofluids**

Technical Presentation Only. ICNMM2016-7979

**Peyman Irajizad, Nazanin Farokhnia, Hadi Ghasemi,** University of Houston, Houston, TX, United States

## TUESDAY, JULY, 12

### TRACK 17 POSTERS

#### 17-1 ICNMM POSTER SESSION

Regency Foyer

6:00pm - 7:30pm

Session Organizer: Amy Betz, Kansas State University, Manhattan, KS, United States

Session Co-Organizer: Fatemeh Hassanipour, University of Texas at Dallas, Richardson, TX, United States

**Hierarchical biphilic micro/nanostructures for a new generation phase-change heat sink with 1700 W/cm<sup>2</sup> CHF limit**

Abdy Fazeli, Saeed Moghaddam

**Impact of Nanostructures on Surface Heat Transfer in Microchannel**

**Flow Boiling of FC-72**

Abdy Fazeli, Saeed Moghaddam

**A modular Droplet Microfluidic Platform for Time-Resolved Crystallization Analysis**

Mark A. Levenstein, Yi-Yeoun Kim, Shunbo Li, Fiona C. Meldrum, Nikil Kapur

**Dispensing nano-pico droplets of ferrofluids**

Peyman Irajizad, Nazanin Farokhnia, Hadi Ghasemi

**Rational micro/nano structuring for thin-film evaporation**

Nazanin Farokhnia, Peyman Irajizad, Seyed Mohammad Sajadi, Hadi Ghasemi

**Flexible integrated structure for low/high pressure solar steam generation**

Seyed Mohammad Sajadi, Nazanin Farokhnia, Peyman Irajizad, Hadi Ghasemi

**Dip coating of Electrochemically Generated Graphene and Graphene Oxide Coatings to enhance Pool Boiling Performance**

Arvind Jaikumar, Satich G. Kandlikar, Anju Gupta

**Enhanced Flow Boiling Heat Transfer Using Radical Microchannels**

Alyssa Recinella, Ankit Kalani, Satish Kandlikar

**Gravity driven deterministic lateral displacement for suspended particles in a 3D obstacle array**

Siqi Du, German Drazer

**Electro-kinetic Fluid transport in a charged Graphene Nanochannel**

Truong Quoc Vo, Bohung Kim

**Modular Concept of a smart scale helically coiled tubular reactor for continuous operation of Multiphase Reaction systems**

Safa Kutup Kurt, Mohd Akhtar, Krishna D.Pnigam, Norbert Kockmann

**Oil water flow visualization and flow regime in 3.7mm mini-channel**

Kevin Bultongez, Melanie Derby

## **Numerical modelling of phase change in Ansys Fluent**

Isaac Perez-Raya, Satish G. Kandlikar

## **Performance Characterization of an adversity Manufactured Titanium (Ti64) Heat Exchanger for Dry cooling of Power Plant**

Dr. Martinus Adrian Arie, Dr. Amir Shhostari, Dr.Serguei Dessiatoun, Dr. Michael Ohadi

## **μEDGE ( Microfluidic aErosol Droplet Generator)**

Pooyan Tirandazi, Carlos H. Hidrovo

## **Effect of open micro channels on external condensation heat transfer**

Brandon Hulet, Andres Martinez, Amy Rachel Betz, Melanie Derby

## **Characterization of Tubular Micro-/Milli-Fluidic-Heat Exchanger by Non Invasive Temperature Measurement**

Lukas Hohmann, Safa Kutup Kurt, Naser Pouya Far, Danile Vieth, Nobert Kochmann

## **Experimental characterization and modeling of capillary-pumped thin-film evaporation from micropillar wicks.**

Soloman Adrea, Dion s Antao, Rishi Raj, Evelyn N. Wang

## **Utilizing Laser Induced Fluorescence to investigate high speed droplet collision**

David Bedding, Carlos Hidrovo

## **Manufacturing of large scale superhydrophobic surface from copper**

Tariq Mahbub, Xin Chen, Daniel Attinger

## **Steering air bubbles with an add-on vacuum layer for biopolymer membranes biofabrication in microfluidics**

Phu Pham, Thanh Vo, Xiaolong Luo

## **Microfluidics-Generated static Gradients of Biomolecules for studying Cell dynamics**

Thanh Hiep Vo, Phu Pham, Fahd Jambi , John Choy, Xiaolong Luo

## **A phenomenological continuum model for transport in nano scale confined liquid flows**

Jafar Ghorbanian, Alper tunga Celebi, Ali Beskok

## **A microfluidic device for dielectrophoretic capture and real time electrical studies of cells**

Amin Mansoorifar , Anil Koklu, Ahmet Can Sabuncu, Ali Beskok

## **Preliminary results of pool boiling of sea water**

Pruthvik Raghupatthi, Dr Satish Kandlikar

## **Stains as bisensors: Evaporative self assembly controlled by biomolecular interactions**

Sahar Andalib, Cedric Hurth, Rajneesh Bharadwaj, Sahar Andalib, Christopher Frankiewicz, Andrew dobos, Frederic Zenhausern

## **Accurate and Inexpensive thermal Time of flight Sensor for Measuring Refrigerant flow in Minichannels**

Allison J.Mahvi, Bachir El Fil, Srinivas Garimella

## **Interdigitated flow fields for miniaturized redox flow batteries: Tapered multi-pass architectures.**

Julian Marschewski, Lorenz Brenner, Dr. Neil Ebejer, Dr.Patrick ruch, Dr. Bruno Michel, Prof. Dimos Poulikakos

## **Influence on capillary flow of human blood in PDMS micro channels due to various surface treatments**

Bharath Babu Nunna, Shiquiang Zhuang, Eon Soo Lee

## **Impact of Nanostructures on surface Heat Transfer in Microchannel Flow boiling of FC-72**

Sajjad Bigham, Dr. Saeed Moghaddam

## **External Forced-Convection Jumping-Droplet Condensation**

Patrick Birbarah, Nenad Miljkovic

## **MONDAY, JULY, 11**

### **TRACK 18 PLENARY SPEAKERS**

#### **18-1 PLENARY SESSION 1**

**Regency BC**

**2:00pm - 3:40pm**

Session Organizer: Amy Betz, Kansas State University, Manhattan, KS, United States

# Technical Sessions Nanochannels, Microchannels, and Minichannels

2:00pm **Impact of Thermal Engineering Research on Building Energy Efficiency**

**Keynote Presentation. ICNMM2016-7935**

**Patrick Phelan**, Arizona State University, Tempe, AZ, United States

## TUESDAY, JULY, 12

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### 18-2 PLENARY SESSION 2

**Regency BC** **8:30am - 10:10am**

Session Organizer: Norbert Kockmann, Technical University of Dortmund, Dortmund, Germany

8:30am **The Benefits of Being Thin: How Ultrathin Membranes Will Revolutionize Biology and Medicine**

**Plenary Presentation. ICNMM2016-8019**

**James L. McGrath**, University of Rochester, Rochester, NY, United States

## WEDNESDAY, JULY, 13

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### 18-3 PLENARY SESSION 3

**Regency BC** **4:00pm - 5:40pm**

Session Organizer: Ali Beskok, Southern Methodist University, Plano, TX, United States

4:00pm **Nanoscale Hydrodynamics**

**Plenary Presentation. ICNMM2016-8029**

**Narayana Aluru**, University Illinois at Urbana-Champaign, Urbana, IL, United States

## TUESDAY, JULY, 12

### TRACK 1 MULTIPHASE FLOW AND HEAT TRANSFER

#### 1-1 GAS-LIQUID FLOWS 1

**Yosemite** **10:30am - 12:10pm**

Session Organizer: Joseph Katz, Johns Hopkins University, Baltimore, MD, United States

Session Co-Organizer: Deborah Pence, Oregon State University, Corvallis, OR, United States

10:30am **Bubble Tracking Simulations of Turbulent Two-Phase Flows**

Technical Publication. HTFEICNMM2016-1005

**Jun Fang, Igor A. Bolotnov**, North Carolina State University, Raleigh, NC, United States

10:50am **Transitional Two Phase Flows Around 90° Bends at Different Orientation**

Technical Publication. HTFEICNMM2016-1012

**Rajab Omar, Barry Azzopardi, Buddhika Hewakandamby**, The University of Nottingham, Nottingham, United Kingdom

11:10am **Visual Observations of Chamber Volume Effect on Ebullience from Submerged Orifice Plates**

Technical Publication. HTFEICNMM2016-1014

**Sanjivan Manoharan, Milind Jog, Raj M. Manglik**, University of Cincinnati, Cincinnati, OH, United States

11:30am **Collision Dynamics and Internal Mixing of Equal-size Droplets of Non-Newtonian Liquids**

Technical Publication. HTFEICNMM2016-1016

**Peng Zhang**, The Hong Kong Polytechnic University, Hong Kong, Hong Kong

11:50am **Suppression of Cavitation in High-Speed Centrifugal Pump by Variable Pitch Inducer**

Technical Presentation Only. HTFEICNMM2016-1024

**Qiangqiang Sun, Jin Jiang, You Fu, Yanhui Li, Xiaohong Weng**, Wuhan University, Wuhan, Hubei Province, China

#### 1-2 GAS-LIQUID FLOWS 2

**Yosemite** **2:00pm - 3:40pm**

Session Organizer: Mark R. Duignan, Savannah River National Laboratory, Aiken, SC, United States

Session Co-Organizer: Vinod Narayanan, University of California, Davis, CA, United States

2:00pm **Comparison of Gas Hold-Up Profiles in Co-Current, Counter-Current and Batch Bubble Column Reactors Measured Using Gamma Densitometry and Surface of Revolution Method**

Technical Publication. HTFEICNMM2016-1025

**Freddy Hernandez-Alvarado, Dinesh Kalaga, Sanjoy Banerjee, Masahiro Kawaji**, City College of New York, New York, NY, United States

2:20pm **Numerical and Experimental Analysis of Single Phase Jet Interactions**

Technical Publication. HTFEICNMM2016-1026

**Freddy Hernandez-Alvarado, Randy Samaroo, Dinesh Kalaga, Taehun Lee, Sanjoy Banerjee, Masahiro Kawaji**, City College of New York, New York, NY, United States

2:40pm **Effect of Surfactant Addition on Void Fraction Distributions Measured by a Wire Mesh Sensor**

Technical Publication. HTFEICNMM2016-1047

**Simon Kleinbart, Freddy Hernandez-Alvarado, Dinesh Kalaga, Damon Turney, Sanjoy Banerjee, Masahiro Kawaji**, City College of New York, New York, NY, United States, **Jorge Pulido**, LanzaTech, Skokie, IL, United States

3:00pm **Study of Bubble Size and Velocity in a Vibrating Bubble Column**

Technical Publication. HTFEICNMM2016-1056

**Shahrouz Mohagheghian, Brian Elbing**, Oklahoma State University, Stillwater, OK, United States

3:20pm **Multiphase Effects in Dynamic Systems under Vibration**

Technical Publication. HTFEICNMM2016-1074

**Timothy O'Hern, John Torczynski, Jon Clausen**, Sandia National Labs, Albuquerque, NM, United States

# Technical Sessions Interdisciplinary

## 1-3 LIQUID-SOLIDS FLOWS

Yosemite

4:00pm - 5:40pm

Session Organizer: Deborah Pence, Oregon State University, Corvallis, OR, United States

Session Co-Organizer: Hongbin Ma, University Of Missouri, Columbia, MO, United States

4:00pm **Numerical Analysis of Particulate Flow Applied to Fluid Loss Control in Fractured Channels**

Technical Publication. HTFEICNMM2016-1028

Marcos V. Barbosa, Fernando C. De Lai, Silvio L.M. Junqueira, UTFPR, Curitiba, Parana, Brazil

4:25pm **Wear Rate to Stainless Steel Pipe from Liquid-Solid Slurry**

Technical Publication. HTFEICNMM2016-1049

Mark R. Duignan, Marissa M. Reigel, Kenneth J Imrich, Michael L. Restivo, Mark D. Fowley, Savannah River National Laboratory, Aiken, SC, United States

4:50pm **Magnitude and Location of Maximum Erosion in S-Bend with Water-Sand Mixture**

Technical Publication. HTFEICNMM2016-1053

Quamrul Mazumder, Siwen Zhao, University of Michigan-Flint, Flint, MI, United States

5:15pm **Simulation of a Yield Stress Influence on Nusselt Number in Turbulent Flow of Kaolin Slurry**

Technical Publication. HTFEICNMM2016-1080

Artur Bartosik, Kielce University of Technology, Kielce, Swietokrzyskie, Poland

## WEDNESDAY, JULY, 13

## 1-4 TWO-LIQUIDS, LIQUID-LIQUID, & GAS-LIQUID-SOLIDS FLOWS

Yosemite

8:30am - 10:10am

Session Organizer: Vinod Narayanan, University of California, Davis, CA, United States

Session Co-Organizer: Joseph Katz, Johns Hopkins University, Baltimore, MD, United States

8:30am **Numerical Solution of Coupled Cahn-Hilliard and Navier-Stokes System Using the Least-Squares Spectral Element Method**

Technical Publication. HTFEICNMM2016-1008

Keunsoo Park, C.A. Dorao, M. Fernandino, Norwegian University of Science and Technology, Trondheim, Norway, Norway

8:50am **Investigation of Emission Characteristics of Ethanol and Methanol Blended With Mahua Oil, Rape Seed Oil and Mango Seed Oil as Substitute Fuels in CI Engine**

Technical Publication. HTFEICNMM2016-1009

Dr. Hiregoudar Yerrennagoudaru, Manjunatha K, Rao Bahadur.Y. Mahabaleswarappa Engineering College, Bellary-583104; Karnataka-State, India, India

9:10am **Visualization Study on Two-Phase Flow Behaviors in the Gas-Liquid-Solid Microreactor for Hydrogenation of Nitrobenzene**

Technical Publication. HTFEICNMM2016-1011

Hao Feng, Xun Zhu, Rong Chen, Chongqing University, Chongqing, China, Qiang Liao, Chongqing University, Chongqing 4000-44, China

9:30am **Heat Sink Performance Improvement by Way of Nanofluids**

Technical Publication. HTFEICNMM2016-1027

Jose-Luis Zuñiga-Cerroblando, C. Ulises Gonzalez-Valle, Abel Hernandez-Guerrero, University of Guanajuato, Salamanca, GTO, Mexico, Daniel Lorenzini-Gutierrez, Georgia Institute of Technology, Atlanta, GA, United States, Jaime Cervantes de Gortari, National University of Mexico, Mexico City, Mexico

9:50am **Analysis of Chaotic Wavy Stratified Fluid-Fluid Flow with the 1D Fixed-Flux Two-Fluid Model**

Technical Publication. HTFEICNMM2016-1058

Avinash Vaidheeswaran, Krishna Chetty, Martin Lopez De Bertodano, Purdue University, West Lafayette, IN, United States, William D. Fullmer, University of Colorado Boulder, Boulder, CO, United States, Raul G. Marino, Universidad Nacional de Cuyo, Facultad de Ciencias Exactas y Naturales, Mendoza, Argentina



## 1-5 MULTIPHASE FLOWS AND HEAT TRANSFER

**Yosemite**

**10:30am - 12:10pm**

Session Organizer: Hongbin Ma, University Of Missouri, Columbia, MO, United States

Session Co-Organizer: Mark R Duignan, Savannah River National Laboratory, Aiken, SC, United States

10:30am **A Critical Assessment of Nanofluid Mass Transfer**

**Technical Presentation Only. HTFEICNMM2016-1041**

**Stathis Michaelides**, Texas Christian University, Fort Worth, TX, United States

10:50am **Numerical Investigation of Flow Structure and Heat Transfer Produced By a Single Highly Confined Bubble in a Pressure-Driven Channel Flow**

**Technical Publication. HTFEICNMM2016-1060**

**John Willard, D. Keith Hollingsworth**, University of Alabama in Huntsville, Huntsville, AL, United States

11:10am **Gas Phase Distribution Effects on Heat Transfer In Upward Vertical Bubbly Channel Flows**

**Technical Publication. HTFEICNMM2016-1062**

**Haden Hinkle, Deify Law**, California State University, Fresno, Fresno, CA, United States

11:30am **Thermal Energy Transport at Solid-Gas and Solid-Vapor Interfaces**

**Technical Presentation Only. HTFEICNMM2016-1064**

**Chunmei Wu, Lin Ding, Yourong Li**, Chongqing University, Chongqing, Chongqing, China

11:50am **Free Convection in Viscoplastic Fluid due to Partial Bi-heating From Bottom**

**Technical Publication. HTFEICNMM2016-1065**

**Naushad Hasin Khan**, Maulana Azad College of Engineering and Technology, Patna, India, **M A Hassan**, BIT Patna, PATNA, India

## WEDNESDAY, JULY, 13

### TRACK 2 TRANSPORT PHENOMENA IN MANUFACTURING AND MATERIALS PROCESSING

#### 2-1 TRANSPORT PHENOMENA IN MANUFACTURING AND MATERIALS PROCESSING I

**Yosemite**

**2:00pm - 3:40pm**

Session Organizer: Dennis Siginer, Universidad de Santiago de Chile (USACH), Santiago in Chile & Palapye in Botswana, Chile

Session Co-Organizer: Mhamed Boutaous, CETHIL INSA de Lyon, Villeurbanne, France

2:00pm **Discrete Elements Method to Simulate the Balling Phenomena in Laser Sintering Process of Metallic Powders**

**Technical Publication. HTFEICNMM2016-1070**

**Xin Liu, Mhamed Boutaous, Shihe Xin**, CETHIL INSA de Lyon, Villeurbanne, France, **Dennis Siginer**, Universidad de Santiago de Chile (USACH), Santiago in Chile & Palapye in Botswana, Chile

2:20pm **Numerical Simulations of Electric Field Driven Hierarchical Self-assembly of Monolayers of Mixtures of Particles**

**Technical Publication. HTFEICNMM2016-1050**

**Pushpendra Singh, Edison Amah, Ian Fischer, Naga Aditya Musunuri**, New Jersey Institute of Technology, Newark, NJ, United States, **MD. Shahadat Hossain**, Queensborough Community College, Bayside, NY, United States

2:40pm **Performance Characterization of an Additively Manufactured Titanium (Ti64) Heat Exchanger for an Air-Water Cooling Application**

**Technical Publication. HTFEICNMM2016-1059**

**Martinus Arie, Amir H. Shooshtari, Serguei Dessiatoun, Michael Ohadi**, University of Maryland, College Park, MD, United States

3:00pm **Herschel Bulkley Viscoplastic Flow in Tubes of Non-Circular Cross-Section**

**Technical Publication. HTFEICNMM2016-1069**

**Mario Letelier, Felipe Godoy, Cesar Rosas**, University of Santiago of Chile, Santiago, Chile, **Dennis Siginer**, Universidad de Santiago de Chile (USACH), Santiago in Chile & Palapye in Botswana, Chile

# Technical Sessions Interdisciplinary

3:20pm **Transient Electrohydrodynamic Manipulation of Particles on the Surface of a Drop**

Technical Publication. HTFEICNMM2016-1051

**Edison Amah, Pushendra Singh, Ian Fischer**, New Jersey Institute of Technology, Newark, NJ, United States

## WEDNESDAY, JULY, 13

### TRACK 3 TRANSPORT PROCESSES IN FUEL CELLS AND HEAT PIPES

#### 3-1 TRANSPORT PROCESSES IN FUEL CELLS AND HEAT PIPES

**Yosemite** **4:00pm - 5:40pm**

Session Organizer: Raj M. Manglik, University of Cincinnati, Cincinnati, OH, United States

Session Co-Organizer: Steve Cai, Teledyne Scientific, Thousand Oaks, CA, United States, Scott Thompson, Mississippi State University, Starkville, MS, United States

4:00pm **Constructal Microchannel Heat-Sink Network for Efficient Microchip Cooling**

Technical Presentation Only. HTFEICNMM2016-1029

**Alan Lugarini, Admilson T. Franco**, Federal University of Technology, Curitiba, Parana, Brazil

4:20pm **CFD Modelling of the Dehydrogenation Reaction of Isobutane to Isobutylene in a Fixed Bed Reactor**

Technical Publication. HTFEICNMM2016-1071

**Tarek J. Jamaledine, Ramsey M. Bunama**, SABIC, Riyadh, Saudi Arabia

4:40pm **The Structure of Hydronium in the Confinement Channel of Nafion**

Technical Presentation Only. HTFEICNMM2016-1043

**Ning Zhang, Xuehua Ruan, Xiaoming Yan, Gaohong He, Dalian** University of Technology, Dalian, China

5:00pm **Thermal Analysis of Closed Loop Pulsating Heat Pipe: An Experimental Study**

Technical Presentation Only. HTFEICNMM2016-1061

**Pramod Pachghare**, Government College of Engineering, Amravati, Amravati, India, **Pallavi Chaudhari**, Prof. Ram Meghe Institute of Technology & Research, Badnera, Amravati, Maharashtra State, India

5:20pm **Adaptation of Vapor Chamber Heat Spreaders for Ergonomics-Based Thermal Performance Requirements in Ultrathin Mobile Devices**

Technical Presentation Only. HTFEICNMM2016-1086

**Gaurav Patankar, Justin A. Weibel, Suresh Garimella**, Purdue University, West Lafayette, IN, United States

## MONDAY, JULY, 11

### TRACK 4 BOILING AND CONDENSATION IN MACRO, MICRO AND NANOSYSTEMS

#### 4-1 BOILING IN MACRO, MICRO, AND NANO SYSTEMS

**Redwood** **8:30am - 10:10am**

Session Organizer: Amitabh Narain, Michigan Technological University, Houghton, MI, United States

Session Co-Organizer: Sushant Anand, University of Illinois at Chicago, Chicago, IL, United States

8:30am **Critical Heat Flux Maxima Resulting from the Controlled Morphology of Nanoporous Hydrophilic Surface Layers**

Keynote Presentation. HTFEICNMM2016-1095

**Matteo Bucci**, Massachusetts Institute of Technology (MIT), Cambridge, MA, United States

8:55am **Electrical Suppression of Film Boiling During Quenching**

Technical Publication. HTFEICNMM2016-1002

**Arjang Shahriari, Mark Hermes, Vaibhav Bahadur**, University of Texas at Austin, Austin, TX, United States

9:20am **A Computational Approach to Study Heat Transfer Enhancement in Film Boiling due to the Addition of Surfactants**

**Technical Publication. HTFEICNMM2016-1003**

**Kannan Nandha Premnath, Farzaneh Hajabdollahi, Samuel WJ Welch**, University of Colorado Denver, Denver, CO, United States

9:45am **Two-Phase Heat Transfer Behaviors of R-134a Refrigerant and Air-Water Mixture in a 1 mm Internal Diameter Tube**

**Technical Publication. HTFEICNMM2016-1004**

**Sira Saisorn, Pakorn Wongpromma, Adirek Suriyawong, Somchai Wongwises, Phakkhanan Benjawun**, King Mongkut's Institute of Technology Ladkrabang, Chumphon, Thailand

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## **4-2 BOILING AND CONDENSATION IN MACRO, MICRO, AND NANO SYSTEMS**

**Redwood** **2:00pm - 3:40pm**

Session Organizer: Sushant Anand, University of Illinois at Chicago, Chicago, IL, United States

Session Co-Organizer: Amitabh Narain, Michigan Technological University, Houghton, MI, United States

2:00pm **Laser-Induced Bubble Formation on a Micro Gold Particle Levitated Under Ultrasound**

**Technical Publication. HTFEICNMM2016-1006**

**Ho-young Kwak, Jaekyoon Oh, Yungpil Yoo**, Chung-Ang University, Seoul, Korea (Republic), **Samsun Seung**, Kangwon National University, Samcheok, Korea (Republic)

2:25pm **Effect of the Wettability on the IR Laser Photothermally Induced Phase Change in Microchannels**

**Technical Publication. HTFEICNMM2016-1007**

**Xuefeng He, Rong Chen, Xun Zhu, Qiang Liao**, Chongqing University, Chongqing, China

2:50pm **Two-dimensional Flow Boiling with Wettability Gradient in Microchannel Heat Sinks**

**Technical Presentation Only. HTFEICNMM2016-1019**

**Gordon Yip, Yoon Jo Kim**, Washington State University Vancouver, Vancouver, WA, United States

3:15pm **Experimental study and analysis of dropwise condensation using quartz crystal microbalance**

**Technical Publication. HTFEICNMM2016-1033**

**Junwei Su, Murat Inalpolat, Tingjian Ge, Hamed Esmaeilzadeh, Hongwei Sun**, University of Massachusetts Lowell, Lowell, MA, United States

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## **4-3 BOILING AND CONDENSATION AT MACRO, MICRO, AND NANO SYSTEMS**

**Redwood** **4:00pm - 5:40pm**

Session Organizer: Sushant Anand, University of Illinois at Chicago, Chicago, IL, United States

Session Co-Organizer: Amitabh Narain, Michigan Technological University, Houghton, MI, United States

4:00pm **Characterization and Prediction of Condensate Droplet Jumping Behavior on Hierarchical Superhydrophobic Surfaces**

**Technical Presentation Only. HTFEICNMM2016-1084**

**Xuemei Chen, Justin A. Weibel, Suresh Garimella**, Purdue University, West Lafayette, IN, United States

4:25pm **Using Micron-Scaled Heating Elements to Demonstrate a Selective Leidenfrost Effect**

**Technical Presentation Only. HTFEICNMM2016-1083**

**Linzi Dodd, David Wood**, Durham University, Durham, County Durham, United Kingdom, **Nicasio Gheraldi, Ben Xu, Gary Wells, Glen McHale**, Northumbria University, Newcastle upon Tyne, United Kingdom, **Simone Stuart-Cole, James Martin, Reece Innovation**, Newcastle upon Tyne, United Kingdom, **Michael Newton**, Nottingham Trent University, Nottingham, United Kingdom

4:50pm **Heat Transfer Characteristics of a Quasi-Steady Vapor Bubble in Pool Boiling**

**Technical Presentation Only. HTFEICNMM2016-1078**

**An Zou, Ashish Chanana, Shalabh Maroo**, Syracuse University, Syracuse, NY, United States, **Amit Agrawal**, National Institute of Standards and Technology, Gaithersburg, MD, United States, **Peter Wayner**, Rensselaer Polytechnic Institute, Troy, NY, United States

# Technical Sessions Interdisciplinary

5:15pm **Embedded Two-Phase Cooling in Hierarchical Manifold Microchannel Heat Sink Arrays**

Technical Presentation Only. HTFEICNMM2016-1085

Kevin P. Drummond, Justin A. Weibel, Suresh Garimella, Purdue University, West Lafayette, IN, United States

## MONDAY, JULY, 11

### TRACK 5 SYMPOSIUM IN HONOR OF PROFESSOR RICHARD H. PLETCHER

#### 5-1 CONTEMPORARY RESEARCH TO HONOR PROF. PLETCHER'S LEGACY

Yosemite **2:00pm - 3:40pm**

Session Organizer: S.A. Sherif, University of Florida, Gainesville, FL, United States

Session Co-Organizer: Raj M Manglik, Univ Of Cincinnati, Cincinnati, OH, United States

2:00pm **The Life and Legacy of Professor Richard H. Pletcher**

Technical Presentation Only. HTFEICNMM2016-1045

S.A. Sherif, University of Florida, Gainesville, FL, United States, Francine Battaglia, Virginia Polytechnic Institute and State University, Blacksburg, VA, United States, Raj M Manglik, University of Cincinnati, Cincinnati, OH, United States

2:20pm **Turbulent Kinetics and Their Impact in the Neutral Boundary layer**

Technical Presentation Only. HTFEICNMM2016-1040

Joon Sang Lee, Yonsei University, Seoul, Korea (Republic)

2:40pm **Numerical Investigation of Slot Film Cooling over a Flat Plate. Part 1: Free-stream Turbulence Effect**

Technical Presentation Only. HTFEICNMM2016-1087

Yousef Kanani, Sumanta Acharya, University of Memphis, Memphis, TN, United States

3:00pm **Numerical Investigation of Slot Film Cooling over a Flat Plate. Part 2: Plenum Turbulence Effect**

Technical Presentation Only. HTFEICNMM2016-1088

Yousef Kanani, Sumanta Acharya, University of Memphis, Memphis, TN, United States

3:20pm **Implementation of CFD-Based PID Controller on Exothermic Multiphase Multistage Reactor**

Technical Presentation Only. HTFEICNMM2016-1037

Wayne Strasser, Eastman Chemical Co, Kingsport, TN, United States

#### 5-2 PANEL IN HONOR OF PROFESSOR RICHARD H. PLETCHER AND HIS SEMINAL WORK IN COMPUTATIONAL FLUID MECHANICS AND HEAT TRANSFER

Yosemite **4:00pm - 5:40pm**

Session Organizer: Francine Battaglia, Virginia Polytechnic Institute and State University, Blacksburg, VA, United States

Session Co-Organizer: Sumanta Acharya, University of Memphis, Memphis, TN, United States

4:00pm **Some of Prof. Pletcher's Early Work at Iowa State University**

Panel Presentation. HTFEICNMM2016-1094

Ron Nelson, Iowa State University, Ames, IA, United States

4:25pm **Overview of Professor Pletcher's Experimental Work on Turbulent Jets and Plumes in a Water Channel**

Panel Presentation. HTFEICNMM2016-1090

S.A. Sherif, University of Florida, Gainesville, FL, United States

4:50pm **A Brief Overview of Professor RH Pletcher's Contributions in Computational Fluid Dynamics**

Panel Presentation. HTFEICNMM2016-1091

Joseph Prusa, Teraflux Corp, Boca Raton, FL, United States

5:15pm **Using CFD to Verify HVAC Testing Standard Requirements**

Panel Presentation. HTFEICNMM2016-1093

Michael Pate, Texas A&M University, College Station, TX, United States

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GALLANDAT	NORIS	1-2	HARNIK	RON S.	1-2	IHLEFELD	JON F.	1-1	KHAKPASH	NASSER	5-1
GALUPPO	WAGNER	2-1	HARRIS	MAURICE	1-2	IHLEFELD	JON F.	1-2	KHALIFA	H. EZZAT	8-3-2
GANJEH	YASHAR	2-2	HASSAN	IBRAHIM	2-1	ISHIKO	YUTA	1-1	KHALIFA	H. EZZAT	8-4-1
GANJEH	YASHAR	2-2	HAUSTEIN	HERMAN	1-2	ISHIKO	YUTA	1-1	KHAN	TARIQ AMIN	4-1
GARIMELLA	SURESH V	8-4-1	HAUSTEIN	HERMAN	1-2	ISHINO	YOJIRO	1-1	KHAN	MD. IMRAN	1-3
GARIMELLA	SRINIVAS	1-4	HAYASHI	NAOKI	1-1	ISHINO	YOJIRO	1-1	KHAN	SAMEERA	6-3
GASKINS	JOHN	1-1	HAYASHI	NAOKI	1-1	JACOBI	ANTHONY	1-1	KHAN	JAMIL	8-7-1
GASKINS	JOHN	1-3	HE	ZHIHONG	1-2	JAIN	AAKRITI	8-4-1	KHANAL	PRABESH	8-2
GASKINS	JOHN	4-2	HELFIG	CHRISTIAN	2-3	JALURIA	YOGESH	5-1	KIM	HYOUNGKEUN	1-1
GASKINS	JOHN	4-3	HELMNS	ANDREA	2-1	JANKOWSKI	NICHOLAS R.	1-1	KIM	YOUNG-JUN	3-2
GERBOTH	MATTHEW D.	4-3	HENRY	ASEGUN	1-1	JANKOWSKI	NICHOLAS R.	1-3	KIM	JUNGHO	8-3-1
GERBOTH	MATTHEW D.	3-3	HENRY	ASEGUN	3-1	JANKOWSKI	NICHOLAS R.	1-4	KIM	YONG W.	3-4
GERBOTH	MATTHEW D.	1-1	HENRY	ASEGUN	3-1	JANNE-PETTERI	NIEMELÄ	4-1	KING	WILLIAM	6-4
GHAFFARI	OMIDREZA	1-2	HENRY	ASEGUN	3-1	JARRAHI	MOJTABA	1-2	KING	WILLIAM	1-2
GHANEKAR	ALOK	2-1	HENRY	ASEGUN	3-3	JAYADEEP	U B	8-1	KIRK	TOBY	1-1
GHANEKAR	ALOK	3-1	HERNANDEZ	JORGE	1-2	JEON	WOO-JIN	5-2	KIRK	TOBY	1-4
GHANEKAR	ALOK	3-1	HERRERA	FRANCISCO	2-3	JEONG	SANGKWON	1-1	KITAMURA	REI	3-1
GHANEKAR	ALOK	5-1	HIDROVO	CARLOS	4-1	JEONG	CHAN HO	1-4	KIVISALU	MICHAEL	5-1
GHOLIVAND	HAMED	7-2	HJERRILD	NATASHA	8-1	JI	YULONG	4-3	KNOBLOCH	JOSHUA	1-2
GHOSH	AVIK W.	4-2	HODES	MARC	3-1	JI	YULONG	1-1	KOH	YEE KAN	1-2
GHOSH	AVIK W.	4-2	HODES	MARC	1-1	JI	PENGFEEI	1-2	KOH	YEE KAN	7-1
GHOSH	AVIK W.	3-1	HODES	MARC	1-4	JI	BING	1-1	KOH	YEE KAN	7-1
GHOSHDASTIDAR	P.S.	8-1	HODGES	WYATT	1-1	JIANG	PUQING	1-2	KOH	YEE KAN	7-2
GIRI	ASHUTOSH	4-1	HOGAN	ROY	2-1	JIANG	RUI	1-1	KOLI	SRUSHTI	1-4
GIRI	ASHUTOSH	4-2	HONG	SAHNGKI	1-1	JIN	LINGXUE	1-1	KONDURU	VINAYKUMAR	1-4
GLANZER	EVAN M.	1-2	HOPKINS	PATRICK	1-1	JIN	HONGQING	8-3-2	KONG	XIANGFEI	3-1
GO	DAVID	2-3	HOPKINS	PATRICK	1-1	JIN	KUN	1-1	KONG	XIANGFEI	3-1
GO	DAVID	3-3	HOPKINS	PATRICK	1-1	JINGZHI	ZHOU	1-2	KOU	JUNLONG	2-1
GOMEZ RAMIREZ	DAVID	3-4	HOPKINS	PATRICK	5-1	JOSHI	YOGENDRA	1-5	KOZ	MUSTAFA	8-3-2
GONG	WEI	4-3	HOPKINS	PATRICK	1-2	JUNQUEIRA	SILVIO L.M.	4-1	KOZ	MUSTAFA	8-4-1
GONG	WEI	2-1	HOPKINS	PATRICK	1-3	KABBARA	MOE	8-3-1	KOZAK	YORAM	2-1
GONZALEZ-NINO	DAVID	1-3	HOPKINS	PATRICK	3-1	KADOKO	JONAH	1-4	KOZAK	YORAM	3-2
GOOLSBY	BRADLEY D.	2-1	HOPKINS	PATRICK	4-2	KAHWAJI	SAMER	1-3	KUKULKA	DAVID	20-1-1
GORDIZ	KIARASH	3-1	HOPKINS	PATRICK	4-3	KAKIMOTO	KAZUMA	1-1	KUMAR	NAVIN	2-1
GORGITRATANAGUL	PATCHARAPOL	5-1	HOPKINS	PATRICK	1-2	KAKIMOTO	KAZUMA	1-1	KUMAR	SATISH	3-3
GRANDIO	DIANA	3-3	HSU	YING-CHI	1-2	KAKODKAR	ROHIT	4-2	KUMAR	NAVIN	8-2-1
GROULX	DOMINIC	8-3-1	HSUAN	GRACE	8-3-1	KALBFLEISCH	ALAN	2-1	KUMAR	NAVIN	5-1
GROULX	DOMINIC	1-2	HU	HAN	4-1	KAMINSKI	DEBORAH	2-1	KUNKLE	CLAIRE	8-7-1
GROULX	DOMINIC	1-3	HU	HAN	2-1	KANG	DONG HOON	5-2	LADEINDE	FOLUSO	1-3
GUNAY	A. ALPEREN	3-1	HU	YONGJIE	1-2	KANG	JOON SANG	1-2	LAGE	JOSE	4-1
GUNNAM	HANMESH	1-1	HU	HAN	8-3-1	KANJIRAKAT	ANOOP	1-2	LAGE	JOSE	21-1-1
GUO	ZHIXIONG	4-1	HU	HAN	8-7-1	KANJIRAKAT	ANOOP	1-2	LAM	LISA	3-1
GUO	KAIKAI	5-1	HU	YU-PENG	3-3	KAPLOW	DEBORAH	8-3-1	LAN	ZHONG	8-5-1
GUO	YANG	1-1	HUA	CHENGYUN	1-2	KAPTEYN	HENRY	1-2	LAN	ZHONG	1-1
GUO	YUN	1-1	HUANG	BIN	1-2	KARA	DOGACAN	3-2	LANGLEY	MORIAH	2-1
GUO	ZHIXIONG	1-1	HUANG	BIN	7-1	KARAMANIS	GEORGIOS	1-1	LARA	ARACELI	3-1
GUO	ZHIXIONG	1-1	HUANG	YI-HSUAN	8-4-1	KARAMANIS	GEORGIOS	1-4	LARA	ARACELI	3-2
GUVEN	OGUZ	8-2	HUANG	YONGHUA	8-4-1	KARNIADAKIS	GEORGE	2-1	LARSEN	MARVIN	2-1
GUVENC YAZICIOGLU	ALMILA	1-2	HUANG	GUANGHAN	8-4-1	KASHFI	RAANA	5-1	LAWSON	ANDREW	1-4
HABIBI PARSIA	SHADI	1-2	HUANG	SZU CHI	1-1	KE	MING	1-2	LE	NAM Q.	4-2
HAJJIMIRZA	SHIMA	5-1	HUCKABY	DAVID	1-1	KEDUKODI	SANDEEP	3-4	LE	NAM Q.	4-2
HAMMAD	KHALED J.	3-1	HUGHES	MICHAEL	2-1	KENIAR	KHOUDOR	1-4	LEBRUN	ALEXANDER	1-1
HANRAHAN	BRENDAN M.	1-1	IBITAYO	DIMEJI	1-3	KENIG	EUGENY Y.	1-1	LECLAIR	MALCOLM	4-1
HARIHARAN	PRASANNA	1-1	IHLEFELD	JON F.	1-1	KERESZTES	IVAN	1-1	LEE	HYEON-A	3-2

AUTHOR LAST NAME	AUTHOR FIRST NAME	SESSION NUMBER	AUTHOR LAST NAME	AUTHOR FIRST NAME	SESSION NUMBER	AUTHOR LAST NAME	AUTHOR FIRST NAME	SESSION NUMBER	AUTHOR LAST NAME	AUTHOR FIRST NAME	SESSION NUMBER
LEE	CHEONKYU	1-1	LIM	HYUNG-SOO	1-1	MA	XUEHU	8-5-1	MILJKOVIC	NENAD	5-2
LEE	JUNGH0	1-1	LIN	CHENG-XIAN	3-1	MA	JIAXUAN	8-5-1	MILJKOVIC	NENAD	5-2
LEE	SANG GUN	1-1	LIN	LAURA	3-1	MA	RONGHUI	1-1	MILJKOVIC	NENAD	6-3
LEE	SEONG HYUK	1-3	LIN	CHENG-XIAN	1-1	MA	TING	1-1	MILJKOVIC	NENAD	6-3
LEE	JUNGH0	1-3	LIN	LINYU	8-7-1	MA	XUEHU	1-1	MILJKOVIC	NENAD	6-3
LEE	JUNGH0	1-4	LIN	CHENG-XIAN	1-4	MA	HONGBIN	1-1	MILJKOVIC	NENAD	6-4
LEE	SANG GUN	1-4	LIN	MENG	1-1	MA	HONGBIN	1-3	MILJKOVIC	NENAD	6-4
LEE	SEONG HYUK	1-4	LIN	JINPIN	3-3	MACKOWSKI	DANIEL W.	2-2	MILJKOVIC	NENAD	6-4
LEE	VINCENT	20-1-1	LIU	DONG	2-3	MADHU	A K	8-1	MILJKOVIC	NENAD	1-1
LEI	XIANLIANG	3-1	LIU	HUA	3-1	MAJUMDAR	SHUBHADITYA	4-1	MILJKOVIC	NENAD	1-2
LEI	XIANLIANG	3-1	LIU	JIALUN	3-1	MAJUMDAR	ARUN	19-1-1	MILJKOVIC	NENAD	1-2
LENERT	ANDREJ	2-2	LIU	ZHENYU	1-2	MALEN	JONATHAN	4-1	MILJKOVIC	NENAD	1-3
LETAN	RUTH	8-2-1	LIU	CHANDLER	2-2	MALEN	JONATHAN	3-2	MINNICH	AUSTIN	3-1
LI	HUIXIONG	3-1	LIU	ZHENYU	4-1	MANCA	ORONZIO	3-2	MINNICH	AUSTIN	1-1
LI	HUIXIONG	3-1	LIU	JING	7-1	MANCA	ORONZIO	4-2	MINNICH	AUSTIN	1-2
LI	WEI	4-1	LIU	DONG	6-1	MANCA	ORONZIO	4-2	MINNICH	AUSTIN	4-3
LI	MAN	1-1	LIU	JUN	7-2	MANGLIK	RAJ M	1-3	MINNICH	AUSTIN	2-1
LI	SINING	1-2	LIU	DONG	6-4	MANSOURI	ABRAHAM	4-1	MIREHEI	S. MOUSSA	4-1
LI	XIAOBIN	1-2	LIU	BAOAN	2-1	MARABLE	DREW C.	2-1	MISHRA	COLUMBIA	3-2
LI	FENGCHEN	1-2	LIU	CHUANPING	2-1	MARCONNET	AMY	1-1	MITRA	KUNAL	1-4
LI	HUIXIONG	5-1	LIU	QUANYI	1-1	MARIA	JON-PAUL	5-1	MOBALLEGH	ALI	1-1
LI	PENGFEE	4-1	LIU	ZHENYU	8-2-1	MARIA	JON-PAUL	1-2	MOGHADDAM	SAEED	3-2
LI	XIANGYU	4-1	LIU	MINJIE	8-3-2	MAROO	SHALABH	5-1	MONTAZERI	KIMIA	6-1
LI	MO	1-3	LIU	YAO-HSIEN	8-4-1	MAROO	SHALABH	5-1	MONTAZERI	KIMIA	6-4
LI	ZHAOER	6-3	LIU	YAO-HSIEN	1-1	MAROO	SHALABH	6-1	MOON	JAERYUN	3-1
LI	DONGYAO	7-2	LIU	YONGWEN	1-1	MAROO	SHALABH	2-3	MOON	HEE KOO	3-4
LI	XIANGYU	4-2	LIU	YU	20-1-1	MASCIARELLI	CAIO	1-2	MORTAZAVI	FARZAM	2-1
LI	PENGFEE	4-3	LIVONI	LINDSEY A.	2-1	MASON	JERRY	3-4	MORTAZAVI	FARZAM	5-1
LI	DEYU	4-3	LIZARDI	ARTURO	3-1	MATHUR	SANJAY	3-2	MU	XIN	3-3
LI	GEN	4-3	LIZARDI	ARTURO	3-2	MATHUR	SANJAY	2-1	MULEY	ARUN	1-3
LI	PENGFEE	2-1	LOGAN	TREVOR W.	2-1	MAYOR	RHETT	1-2	MUNOZ-CARPIO	VICENTE D.	3-4
LI	DEYU	3-3	LONG	DANIEL	1-1	MAZUMDER	SANDIP	3-2	MUNUHE	TIMOTHY	1-1
LI	CHIH-CHIEH	1-2	LONG	FEI	1-4	MAZUMDER	SANDIP	2-1	MURNANE	MARGARET	1-2
LI	JIAQI	8-2-1	LOPEZ	RAYMUNDO	3-1	MCCARTHY	MATTHEW	2-3	MURTHY	JAYATHI	3-2
LI	WEI	8-5-1	LOPEZ	RAYMUNDO	3-2	MCCARTHY	MATTHEW	4-1	MURTHY	JAYATHI	2-1
LI	CHEN	8-5-1	LOSEGO	MARK	4-3	MCCARTHY	MATTHEW	8-3-1	MURTHY	JAYATHI	2-1
LI	CHEN	8-5-1	LOY	JAMES	3-2	MCCARTHY	MATTHEW	8-3-1	MUTHUSAMY	JAYAVEERA	1-2
LI	CHEN	8-7-1	LU	YI	6-1	MCCARTHY	KEVIN	1-5	MUTHUSAMY	JAYAVEERA	1-2
LI	WEI	8-4-1	LU	YI	6-4	MCCARTHY	MATTHEW	1-4	MYERS	MATTHEW	1-1
LI	CHEN	8-4-1	LUBNER	SEAN	1-3	MCCLOSKEY	DAVID	1-3	NABIL	MAHDI	8-5-1
LI	MENGZHUO	1-1	LUO	FENG	2-1	MCCLUSKEY	F. PATRICK	1-4	NABIL	MAHDI	2-3
LI	XIANGLONG	1-1	LUO	TENGFEE	2-3	MCGAUGHEY	ALAN J.H.	4-1	NAGARAJAN	NAVEEN	3-1
LI	HAIWANG	1-1	LUO	TENGFEE	3-3	MCGAUGHEY	ALAN	4-9-1	NAGASE	KIMIHIRO	1-1
LI	WEI	1-1	LUO	FENG	20-1-1	MCMASTERS	ROBERT	2-1	NAGASE	KIMIHIRO	1-1
LI	XIONGHUI	1-1	LV	WEI	3-3	MELHEM	OMAR	1-2	NAIK	RANJEETH	5-1
LI	WENMING	1-1	LYONS	AUSTIN	7-1	MESGARI	SARA	8-1	NAIR	YADUKRISHNAN	3-3
LI	LONG	1-1	MA	BINJIAN	5-1	MEYER	DONNA	2-2	NALLAPANENI	MANEESH	6-4
LI	ZHENG	2-3	MA	HAO	4-1	MEYER	KELSEY	1-2	NARAIN	AMITABH	5-1
LI	WEI	3-3	MA	HONGBIN	4-3	MEYER	KELSEY	4-3	NARDINI	SERGIO	3-2
LI	YOU-RONG	3-3	MA	BINJIAN	8-2	MEYHOFER	EDGAR	2-2	NARDINI	SERGIO	4-2
LI	YOU-RONG	3-3	MA	QIUJU	1-1	MEYHOFER	EDGAR	2-2	NARDINI	SERGIO	4-2
LI	ZHAOER	1-3	MA	HONGBIN	1-1	MI	PENGFEE	8-4-1	NAWAZ	KASHIF	5-2
LI	WEI	20-1-1	MA	HONGBIN	1-2	MICHNA	GREGORY J.	1-2	NAWAZ	KASHIF	1-1
LIAO	CHANGJIANG	3-1	MA	BINJIAN	8-2-1	MILJKOVIC	NENAD	3-1	NAZARI	AHMAD ZAID	1-1

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AUTHOR LAST NAME	AUTHOR FIRST NAME	SESSION NUMBER	AUTHOR LAST NAME	AUTHOR FIRST NAME	SESSION NUMBER	AUTHOR LAST NAME	AUTHOR FIRST NAME	SESSION NUMBER	AUTHOR LAST NAME	AUTHOR FIRST NAME	SESSION NUMBER
NAZARI	AHMAD ZAID	1-1	PRASAD	BHAMIDI	3-3	SANT	GAURAV	1-2	STEKLI	JOSEPH	21-1-1
NG	Y.W.	1-1	PRASHER	RAVI	1-1	SCHÄFER	MIRKO	1-1	SU	FENGMIN	1-1
NGO	CHEAN CHIN	20-1-1	PRASHER	RAVI	4-1	SEN	OZLEM	3-2	SU	MING	1-1
NIU	YUZHEN	8-5-1	QIU	LU	1-2	SENGUPTA	ADITI	8-1	SUIB	STEVEN L.	5-1
NORRIS	PAMELA	6-1	QUINTERO	PEDRO O.	1-3	SEO	MANSU	1-1	SUN	YING	2-3
NORRIS	PAMELA	4-2	RAMEZAN POUR	BAHAREH	2-2	SEO	JEONG-MIN	1-1	SUN	YING	4-1
NORRIS	PAMELA	4-2	RAMOS-ALVARADO	BLADIMIR	3-3	SERINCAN	MUSTAFA FAZIL	2-1	SUN	FENGZHONG	4-1
OCHS	THOMAS	1-1	RASTGARKAFSH-GARKOLAEI	ROUZBEH	4-2	SEZER	HAYRI	3-4	SUN	YING	2-1
OGLETREE	DAVID FRANK	1-3	RASTGARKAFSH-GARKOLAEI	ROUZBEH	4-2	SHABGARD	HAMIDREZA	2-3	SUN	MINGDI	3-1
OHADI	MICHAEL	1-3	RATTNER	ALEXANDER	5-2	SHABGARD	HAMIDREZA	8-3-1	SUN	BO	7-2
OKOSUN	TYAMO	1-2	RATTNER	ALEXANDER	8-5-1	SHAERI	MOHAMMAD REZA	1-1	SUN	YING	8-3-1
OKOSUN	TYAMO	3-4	RATTNER	ALEXANDER	1-4	SHAKKOTTAI	VENKATESHAN	3-3	SUN	YING	8-3-1
OLSON	RYAN M.	5-1	RATTNER	ALEXANDER	2-3	SHAW	SURUPA	4-2	SUN	YING	8-7-1
O'MALLEY	SEAN	1-2	RAVICHANDRAN	NAVANEETHA	1-1	SHAW	JIUNN-HAUR	1-2	SUN	LIYONG	1-1
OZBAY	EKMEL	3-2	RAVICHANDRAN	NAVANEETHA	1-2	SHELTON	CHRISTOPHER	1-2	SUNDEN	BENGT	1-2
PAISLEY	ELIZABETH	1-1	REGNER	KEITH	3-2	SHEN	SHENG	4-1	SUNDEN	BENGT	8-2-1
PAISLEY	ELIZABETH	1-2	REN	CONGCONG	1-1	SHEN	SHENG	4-3	SUR	ARITRA	6-1
PALACIOS	TOMAS	1-3	REPLOGLE	JONATHAN J.	2-1	SHEN	SHENG	2-1	SUR	ARITRA	6-4
PAPAGEORGIU	DEMETRIOS	1-1	RICHARD	BRADLEY	1-1	SHI	YUETAO	4-1	SURESH	S	8-2
PARK	DEONGEUN	5-2	RICHARD	BRADLEY	1-4	SHI	YANPING	8-5-1	SWANN	DANIEL R.	2-1
PARK	HYUN-SIK	5-2	RICKLEFS	ALEXANDER	1-2	SHIH	TOM	8-5-1	SZWEJKOWSKI	CHESTER	4-2
PARK	WONJUN	4-1	RIOS PEREZ	CARLOS	4-1	SHIN	SEUNGA	2-1	TABATABAEI MALAZI	MAHDI	2-1
PARK	WONJUN	4-2	ROBERTS	NICK	1-1	SHIN	SEUNGA	7-1	TAFTI	DANESH	1-1
PARK	CHANGGI	1-1	ROKONI	ARIF A.	4-1	SHIN	JEONG-HEON	1-2	TAMAKUWALA	HARSH	5-1
PASCENTE	CARMEN	6-1	ROKONI	ARIF A.	2-1	SHIN	DONG HWAN	1-3	TAMAKUWALA	HARSH	2-1
PASCENTE	CARMEN	6-4	ROKONI	ARIF A.	8-7-1	SHIN	DONG HWAN	1-4	TAMAKUWALA	HARSH	5-1
PAUL	JITHU	8-1	RONNEY	PAUL	1-4	SHINDE	PRADEEP	1-1	TAMAKUWALA	HARSH	5-1
PEARLMAN	HOWARD	1-4	ROSE	BENJAMIN	8-2	SHMUELI	HAVATZELET	8-2-1	TANG	GUANGWU	1-2
PEERHOSSAINI	HASSAN	1-2	ROSSETTI, JR.	GEORGE A.	5-1	SHOURIDEH	AMIR HOSSEIN	4-1	TANG	GUANGWU	1-2
PELES	YOAV	1-2	ROST	CHRISTINA M.	5-1	SHRESTHA	RAMESH	4-1	TANG	GUANGWU	3-4
PENG	BENLI	8-5-1	ROY	RONITA	8-2-1	SIDDIQUI	KAMRAN	2-1	TAO	ZHI	1-1
PENG	BENLI	8-5-1	ROZENFELD	AVI	3-2	SIDDIQUI	KAMRAN	8-3-2	TAYLOR	ROBERT	8-1
PEPIOT	PERRINE	1-1	ROZENFELD	TOMER	3-2	SINGH	DHIRENDRA P.	5-1	TEKIN	BILGEHAN	1-2
PEPPER	DARRELL	1-4	ROZENFELD	TOMER	1-2	SINGH	DHIRENDRA P.	5-1	TENCER	JOHN	2-1
PERDIKARIS	PARIS	2-1	RUAN	XIULIN	4-1	SINGH	HARJIT	8-2	TERRES	HILARIO	3-1
PERHACH	NICOLAS J.	2-1	RUAN	XIULIN	4-2	SINGLA	NITISH	5-2	TERRES	HILARIO	3-2
PETERSON	GEORGE	3-3	RUAN	XIULIN	4-9-2	SINGLA	NITISH	6-3	THERMEAU	JEAN-PIERRE	1-2
PETTES	MICHAEL	5-1	RUCHHOEFT	PAUL	6-1	SMITH	ANDREW N.	1-1	THIELE	ALEXANDER	1-2
PHAM	QUANG	6-1	RUCHHOEFT	PAUL	6-4	SMITH	ANDREW N.	1-2	THOMPSON	DAKOTAH	2-2
PHAM	QUANG	6-4	RYDDNER	DOUG	2-3	SOBHAN	CHOONDAL B	8-1	THOMPSON	DAKOTAH	2-2
PHAN	LONG	1-4	RYU	SUNG UK	5-2	SOHN	JEONG LAK	1-1	TIAN	YONGSHENG	2-1
PHELAN	PATRICK	21-1-1	SAAVEDRA	ARTURO	3-4	SOKOLOVA	EKATERINA	8-4-1	TIAN	ZHITING	4-1
PHILLIPS	DAN	1-1	SADAT	SEID	2-2	SOLEIMANIKU-TANAEI	SOHEIL	3-1	TIAN	JUNJIAO	6-4
PIEDRA	DANIEL	1-3	SADH	SEPEHR	1-4	SOLOVITZ	STEPHEN A.	1-2	TIAN	RUNHE	1-1
PIERCY	BRANDON	4-3	SADR	REZA	1-2	SONG	BAI	2-2	TIAN	JUNJIAO	1-2
PILON	LAURENT	3-1	SADR	REZA	1-2	SONG	BAI	2-2	TOMKO	JOHN	1-2
PILON	LAURENT	1-2	SAIKI	YU	1-1	SONG	YACHAO	1-1	TOMPKINS	BRIAN	2-1
PIPER	MARK	1-1	SAIKI	YU	1-1	SOTELO	JESUS	3-1	TONG	LIGE	2-1
POLANCO	CARLOS	4-2	SAMPATH	RAM	8-7-1	SOUJJOUDI	RAMIN	3-1	TRAN	JULIAN M.	1-1
POLANCO	CARLOS	4-2	SANEIE	NAVID	6-3	SPECTOR	MARK	1-5	TRIVEDI	SHREY	1-4
POLANCO	CARLOS	3-1	SANGI REDDY	PRAMOD	2-2	SPECTOR	MARK	21-1-1	TRUJILLO	MARIO F	2-3
POLETTI	VINICIUS G.	4-1	SANGI REDDY	PRAMOD	2-2	SRINIVASAN	RAM	3-4	TRUPIANO	MARK	1-1
POP	ERIC	7-1				STARK	ADDISON	21-1-1	UNNI	VINEET	3-1
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									VALAVADE	AVINASH	3-1



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VENKATARAMANAN	ARJUN	4-1	WU	MENGKE	4-3	YU	JIA-JIA	3-3	ZHOU	CHENN	3-4
VERMA	NITA	8-2	WU	PING	2-1	YU	JIA-JIA	3-3	ZHOU	BIN	20-1-1
VON NESS	RYAN	2-1	WU	BIN	1-2	YUAN	PENGYU	7-2	ZHU	JIE	1-3
VUTHA	ASHWIN KUMAR	1-2	WU	BIN	1-2	YUE	YANAN	1-1	ZHU	GAOHUA	7-2
WADEKAR	VISHWAS	8-2-1	WU	ZAN	8-2-1	YUE	YANAN	1-1	ZHU	ZIQIN	8-3-2
WALKER	GREG	4-3	WU	HUIYING	8-2-1	YUKSEL	ANIL	2-1	ZHU	LIANG	1-1
WALKER	GREG	3-3	WU	PING	1-1	ZENG	YUQIANG	1-1	ZHU	YANYAN	20-1-1
WALKER	GREG	1-1	WU	PING	1-1	ZEUTHEN	ERIC	1-1	ZISKIND	GENNADY	2-1
WANG	NAIHUA	2-1	WU	CHUN-MEI	3-3	ZHANG	QIAN	3-1	ZISKIND	GENNADY	3-2
WANG	DEXIN	3-1	WU	CHUN-MEI	3-3	ZHANG	WEIQIANG	3-1	ZISKIND	GENNADY	1-2
WANG	XIAOJUAN	4-1	WU	BIN	3-4	ZHANG	QIAN	3-1	ZISKIND	GENNADY	8-2-1
WANG	LIQIU	2-2	XIA	XIN-LIN	3-1	ZHANG	MENG	1-2	ZOU	AN	5-1
WANG	JIABING	4-1	XU	BEN	4-1	ZHANG	HONGNA	1-2	ZOU	AN	5-1
WANG	XINWEI	7-1	XU	CHENYU	6-3	ZHANG	WEIXING	2-1			
WANG	JIAN-PING	1-3	XU	YUHAO	1-1	ZHANG	ZONGQIN	2-1			
WANG	XIAOJIA	1-3	XU	FAYAO	8-2-1	ZHANG	ZONGQIN	2-2			
WANG	LEI	1-3	XU	WEI	8-5-1	ZHANG	WEIXING	2-2			
WANG	XINWEI	7-2	XU	BEN	8-3-1	ZHANG	ZONGQIN	3-1			
WANG	YINGYING	1-2	XU	GUOQIANG	1-1	ZHANG	QING	5-1			
WANG	LI	2-1	XU	YUEHAN	1-2	ZHANG	WEIQIANG	5-1			
WANG	ZHENHUA	1-2	YAN	YUYING	8-4-1	ZHANG	HANG	1-1			
WANG	LEI	1-2	YAN	DAN	1-1	ZHANG	HANG	1-2			
WANG	YI	8-2-1	YAN	DAN	1-1	ZHANG	DE-LIN	1-3			
WANG	PENGTAO	8-7-1	YANG	KUN	4-1	ZHANG	RUIGANG	7-2			
WANG	EVELYN	1-3	YANG	LIN	4-3	ZHANG	JINGJIE	4-2			
WANG	LI	1-1	YANG	YANG	4-3	ZHANG	JINGJIE	4-2			
WANG	QIUWANG	1-1	YANG	LIN	3-3	ZHANG	JINGJIE	3-1			
WANG	XIULING	3-4	YANG	RUI	1-1	ZHANG	QIAN	4-3			
WANG	YUFENG	3-4	YANG	WEIHUA	1-2	ZHANG	QIAN	3-3			
WANG	SHUO	1-2	YANG	HONGJOO	8-2-1	ZHANG	HUI	1-1			
WANG	GUOYOU	1-3	YANG	WEIHUA	1-1	ZHANG	TAOLUE	1-2			
WANG	EVELYN	1-3	YANG	WEIHUA	1-1	ZHANG	LIANG	8-2-1			
WANG	NAIHUA	20-1-1	YANG	JINGUANG	1-1	ZHANG	JINGZHI	8-5-1			
WARZOKA	RONALD	1-2	YANG	FANGHAO	1-1	ZHANG	YONGHAI	8-5-1			
WATERS	JIAJIA	1-4	YANG	MO	2-3	ZHANG	SHIPING	1-1			
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WEIBEL	JUSTIN A.	1-1	YD	SUMITH	6-1	ZHANG	YUWEN	2-3			
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WEMHOFF	AARON	2-3	YE	NING	4-2	ZHAO	NANNAN	1-2			
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WINGERT	MATTHEW	1-3	YIN	SHAOWU	2-1	ZHENG	YI	5-1			
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WON	YOONJIN	6-4	YOU	SEUNG M.	1-2	ZHENG	JIANLIN	1-3			
WONG	ED	1-3	YOUSEFZADI NOBAKHT	ALI	7-1	ZHENG	YING	1-4			
WONG	K.L.	1-1	YU	BOWEN	2-1	ZHOU	CHENN	1-2			
WOODSIDE	RIGEL	1-1	YU	ZITAO	8-2-1	ZHOU	CHENN	1-2			
WU	HUIYING	1-2	YU	ZITAO	8-3-2	ZHOU	JUN	1-1			
WU	HUIYING	4-1				ZHOU	PENG	3-4			

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ARABNEJAD KHANOUKI	HADI	20-2	BENYAHIA	SOFIANE	6-1	CHO	HEEJIN	15-2	ELGAMMAL	TAREK	27-1
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ARAM	SHAWN	13-3	BHUSHAN	SHANTI	8-2	CHOI	SHINHWA	9-1	ENDO	MAYASA	24-2
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GALERKIN	YURI	2-4	HECHT	JOHN	21-1	KAIHO	YUICHI	25-2	KUSANO	KAZUYA	8-1
GALERKIN	YURY	2-4	HELCIG	CHRISTIAN	14-1	KAIHO	YUICHI	25-2	KWON	JEONGKI	2-2
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HACHEM	HOUDA	22-1	HUR	NAHMKEON	21-1	KIM	DONGIL	9-5	LI	FENGCHEN	14-3
HACHEM	HOUDA	22-1	HUSAIN	AFZAL	2-3	KIM	YOUNG-JUN	9-5	LI	JINGJING	20-2
HAH	CHUNILL	9-1	HUSAIN	AFZAL	24-2	KIM	DAE-JIN	20-1	LI	HUIYING	21-1
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HASAN	MOHAMMED	15-1	JIN	YAN	9-4	KRAUS	ROBERT	36-1	LIU	SISI	22-1
			JOHNSON	RUDY	14-3	KUBERRY	PAUL ALLEN	11-1	LIU	GENG	30-1
			JONES	MATTHEW	30-1	KUHLMANN	HENDRIK CHRISTOPH	14-3	LORAIN	GREG	5-1

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LUNA SANDOVAL	GABRIEL	1-1	MUSUNURI	NAGA ADITYA	4-1	PASSMANN	MAXIMILIAN	25-3	SAKURAI	TAKAKI	9-4
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MAHDABI	MARZIEH	6-1	NEDYALCOV	IVAYLO	5-1	PEI	YUYI	3-1	SATO	KOTARO	13-1
MAHDABI	MARZIEH	6-1	NEDYALCOV	IVAYLO	20-2	PEI	JI	9-2	SATO	KOTARO	14-3
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MCLAURY	BRENTON	20-2	NYGAARD	RUNAR	11-1	RAGHAV	VRISHANK	14-1	SHEN	LU	13-3
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SU	CHEFU	19-1	TSUKAHARA	TAKAHIRO	25-2	WOOD	HOUSTON G.	2-2	ZHANG	FAN	9-2
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TACHIE	M.F	10-2	VORWALD	JOHN	30-2	XIAOHUI	WANG	9-6	ZHUANG	MEI	13-1
TACHIE	M.F	20-2	VOURC'H	THOMAS	13-2	XU	WANJUN	2-2	ZHUGE	WEILIN	9-5
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Track 18: Heat Transfer in Nuclear Energy	Sang Muk Kwark, Praxair Inc., Track Co-Organizer
Track 18: Heat Transfer in Nuclear Energy	Jun Liao, Westinghouse Electric Company LLC, Track Co-Organizer
Track 18: Heat Transfer in Nuclear Energy	Bostjan Koncar, Jozef Stefan Inst, Track Co-Organizer
Track 19: Plenary Speakers	Sumanta Acharya, Univ of Memphis, Track Organizer
Track 20: General Papers	Chris Kobus, Oakland Univ, Track Organizer
Track 20: General Papers	Nesrin Ozalp, KU Leuven, Track Co-Organizer
Track 21: Federal Funding Opportunities in the Thermal-Sciences	Sumanta Acharya, Univ of Memphis, Track Organizer

# Acknowledgments

## TRACK ORGANIZERS FLUIDS ENGINEERING

Track 1: Forum on Advances in Fluids Engineering Education	Ray Taghavi, University of Kansas, Track Organizer
Track 1: Forum on Advances in Fluids Engineering Education	Ganesh Raman, Illinois Institute of Technology, Track Co-Organizer
Track 2: 17th Symposium on Turbomachinery Flow Simulation and Optimization	Yu-Tai Lee, Naval Surface Warfare Center, Track Organizer
Track 2: 17th Symposium on Turbomachinery Flow Simulation and Optimization	Chunill Hah, NASA Glenn Research Center, Track Co-Organizer
Track 2: 17th Symposium on Turbomachinery Flow Simulation and Optimization	Hiroyoshi Watanabe, Ebara Corporation, Track Co-Organizer
Track 3: Symposium on Applications in CFD	Yassin Hassan, Texas A&M University, Track Organizer
Track 3: Symposium on Applications in CFD	Zhongquan Zheng, University of Kansas, Track Co-Organizer
Track 3: Symposium on Applications in CFD	Michael Brzoska, Eastern Washington Univ, Track Co-Organizer
Track 3: Symposium on Applications in CFD	Xia Wang, Oakland Univ, Track Co-Organizer
Track 3: Symposium on Applications in CFD	Elia Merzari, Argonne National Laboratory, Track Co-Organizer
Track 4: 7th Symposium on Bio-Inspired and Bio-medical Fluid Mechanics	Javid Bayandor, Virginia Tech, Track Organizer
Track 4: 7th Symposium on Bio-Inspired and Bio-medical Fluid Mechanics	Mory Gharib, Caltech, Track Co-Organizer
Track 4: 7th Symposium on Bio-Inspired and Bio-medical Fluid Mechanics	Michael Plesniak, George Washington University, Track Co-Organizer
Track 4: 7th Symposium on Bio-Inspired and Bio-medical Fluid Mechanics	Hassan Peerhossaini, Université Paris Diderot, Track Co-Organizer
Track 4: 7th Symposium on Bio-Inspired and Bio-medical Fluid Mechanics	D. Keith Walters, Mississippi State University, Track Co-Organizer
Track 5: 51st Cavitation and Multiphase Flow Forum	William Straka, Pennsylvania State University, Track Organizer
Track 5: 51st Cavitation and Multiphase Flow Forum	Mark Wendel, Oak Ridge National Laboratory, Track Co-Organizer
Track 5: 51st Cavitation and Multiphase Flow Forum	Ivaylo Nedyalkov, University of New Hampshire, Track Co-Organizer
Track 6: 86th Symposium on CFD Verification and Validation	Yassin Hassan, Texas A&M University, Track Organizer
Track 6: 86th Symposium on CFD Verification and Validation	Elia Merzari, Argonne National Laboratory, Track Co-Organizer
Track 6: 86th Symposium on CFD Verification and Validation	Richard Schultz, Idaho State University, Track Co-Organizer
Track 7: Symposium On Development and Applications of Immersed Boundary Methods	Zhongquan Zheng, University of Kansas, Track Organizer
Track 7: Symposium On Development and Applications of Immersed Boundary Methods	Jianming Yang, University of Iowa, Track Co-Organizer
Track 8: 11th Symposium on DNS, LES and Hybrid RANS/LES Methods	Miguel Visbal, Air Force Research Laboratory, Track Organizer
Track 8: 11th Symposium on DNS, LES and Hybrid RANS/LES Methods	Daniel Garmann, Air Force Research Laboratory, Track Co-Organizer
Track 9: 28th Symposium on Fluid Machinery	Kwang-yong Kim, Inha Univ, Track Organizer
Track 9: 28th Symposium on Fluid Machinery	Uendra Rohatgi, Brookhaven National Laboratory, Track Co-Organizer
Track 9: 28th Symposium on Fluid Machinery	Hans Josef Dohmen, University of Duisburg-Essen, Track Co-Organizer
Track 9: 28th Symposium on Fluid Machinery	Yoshinobu Tsujimoto, Osaka University, Track Co-Organizer
Track 9: 28th Symposium on Fluid Machinery	Ricardo Martinez-Botas, Imperial College London, Track Co-Organizer
Track 9: 28th Symposium on Fluid Machinery	Shouqi Yuan, Jiangsu University, Track Co-Organizer
Track 9: 28th Symposium on Fluid Machinery	Yangjun Zhang, Tsinghua University, Track Co-Organizer
Track 9: 28th Symposium on Fluid Machinery	Jinkook Lee, Eaton Aerospace, Track Co-Organizer
Track 10: Forum on Fluid Measurements and Instrumentation	Judith A. Bamberger, Pacific Northwest National Laboratory, Track Organizer
Track 10: Forum on Fluid Measurements and Instrumentation	Gerald Morrison, Texas A&M University, Track Co-Organizer
Track 10: Forum on Fluid Measurements and Instrumentation	Joel Park, Naval Surface Warfare Center Carderock Division, Track Co-Organizer
Track 10: Forum on Fluid Measurements and Instrumentation	Jun Chen, Purdue University, Track Co-Organizer
Track 10: Forum on Fluid Measurements and Instrumentation	Francisco Diez, Rutgers Univ, Track Co-Organizer
Track 10: Forum on Fluid Measurements and Instrumentation	Pavlos Vlachos, Purdue University, Track Co-Organizer
Track 11: 17th International Symposium on Fluid-Structure Interaction and Flow-Induced Noise in Industrial Applications	Caleb Barnes, Air Force Research Laboratory, Track Organizer

Track 11: 17th International Symposium on Fluid-Structure Interaction and Flow-Induced Noise in Industrial Applications	Miguel Visbal, Air Force Research Laboratory, Track Co-Organizer
Track 12: 10th International Symposium on Flow Applications in Aerospace	Javid Bayandor, Virginia Tech, Track Organizer
Track 12: 10th International Symposium on Flow Applications in Aerospace	Yu-Tai Lee, Naval Surface Warfare Center, Track Co-Organizer
Track 12: 10th International Symposium on Flow Applications in Aerospace	David Davis, NASA Glenn Research Center, Track Co-Organizer
Track 13: 11th Symposium on Active Fluid Dynamics and Flow Control - Theory, Experiments and Implementation	Hassan Peerhossaini, Université Paris Diderot, Track Organizer
Track 13: 11th Symposium on Active Fluid Dynamics and Flow Control - Theory, Experiments and Implementation	Mihir Sen, Univ Of Notre Dame, Track Co-Organizer
Track 14: 19th Symposium on Fundamental Issues and Perspectives in Fluid Mechanics	Khaled J. Hammad, Central Connecticut State University, Track Organizer
Track 14: 19th Symposium on Fundamental Issues and Perspectives in Fluid Mechanics	Francine Battaglia, Virginia Tech, Track Co-Organizer
Track 14: 19th Symposium on Fundamental Issues and Perspectives in Fluid Mechanics	Ivana Milanovic, University of Hartford, Track Co-Organizer
Track 14: 19th Symposium on Fundamental Issues and Perspectives in Fluid Mechanics	David Davis, NASA Glenn Research Center, Track Co-Organizer
Track 14: 19th Symposium on Fundamental Issues and Perspectives in Fluid Mechanics	Javid Bayandor, Virginia Tech, Track Co-Organizer
Track 14: 19th Symposium on Fundamental Issues and Perspectives in Fluid Mechanics	Stefan aus der Wiesche, University of Applied Sciences Muenster, Track Co-Organizer
Track 15: 23rd Symposium on Industrial and Environmental Applications of Fluid Mechanics	George Chamoun, Eastman Chemical Company, Track Organizer
Track 15: 23rd Symposium on Industrial and Environmental Applications of Fluid Mechanics	Wayne Strasser, Eastman Chemical Co, Track Co-Organizer
Track 15: 23rd Symposium on Industrial and Environmental Applications of Fluid Mechanics	Judith A. Bamberger, Pacific Northwest National Laboratory, Track Co-Organizer
Track 18: Open Forum on Multiphase Flows - Work in Progress	Joseph Katz, Johns Hopkins University, Track Organizer
Track 18: Open Forum on Multiphase Flows - Work in Progress	Deborah Pence, Oregon State University, Track Co-Organizer
Track 18: Open Forum on Multiphase Flows - Work in Progress	Malcolm Andrews, Los Alamos Natl Lab, Track Co-Organizer
Track 18: Open Forum on Multiphase Flows - Work in Progress	Mark R. Duignan, Savannah River National Laboratory, Track Co-Organizer
Track 18: Open Forum on Multiphase Flows - Work in Progress	Timothy O'Hern, Sandia National Laboratories, Track Co-Organizer
Track 19: 4th International Symposium on Multiscale Methods for Multiphase Flow	Greтар Tryggvason, University of Notre Dame, Track Organizer
Track 19: 4th International Symposium on Multiscale Methods for Multiphase Flow	Arturo Fernandez, North Carolina A&T State University, Track Co-Organizer
Track 19: 4th International Symposium on Multiscale Methods for Multiphase Flow	Jules Lindau, Penn State - Applied Research Lab, Track Co-Organizer
Track 20: Symposium on Noninvasive Measurements in Single and Multiphase Flows	Judith A. Bamberger, Pacific Northwest National Laboratory, Track Organizer
Track 20: Symposium on Noninvasive Measurements in Single and Multiphase Flows	Theodore Heindel, Iowa State Univ, Track Co-Organizer
Track 20: Symposium on Noninvasive Measurements in Single and Multiphase Flows	Bahram Khalighi, General Motors Research Labs, Track Co-Organizer
Track 20: Symposium on Noninvasive Measurements in Single and Multiphase Flows	Joel Park, Naval Surface Warfare Center Carderock Division, Track Co-Organizer
Track 20: Symposium on Noninvasive Measurements in Single and Multiphase Flows	Francisco Diez, Rutgers Univ, Track Co-Organizer

# Acknowledgments

## TRACK ORGANIZERS FLUIDS ENGINEERING (CONTINUED)

Track 21: 16th International Symposium on Numerical Methods for Multiphase Flow	Malcolm Andrews, Los Alamos Natl Lab, Track Organizer
Track 21: 16th International Symposium on Numerical Methods for Multiphase Flow	Francine Battaglia, Virginia Tech, Track Co-Organizer
Track 21: 16th International Symposium on Numerical Methods for Multiphase Flow	Marianne Francois, Los Alamos National Lab, Track Co-Organizer
Track 22: 9th Symposium on Transport Phenomena in Energy Conversion from Clean and Sustainable Resources	Khaled J. Hammad, Central Connecticut State University, Track Organizer
Track 22: 9th Symposium on Transport Phenomena in Energy Conversion from Clean and Sustainable Resources	Fethi Aloui, University of Valenciennes (UVHC), Track Co-Organizer
Track 22: 9th Symposium on Transport Phenomena in Energy Conversion from Clean and Sustainable Resources	Chih-Jen Sung, University of Connecticut, Track Co-Organizer
Track 23: 15th Symposium on Transport Phenomena in Materials Processing and Manufacturing Processes	Dennis Siginer, Botswana International University of Science and Technology & Universidad de Santiago de Chile, Track Organizer
Track 23: 15th Symposium on Transport Phenomena in Materials Processing and Manufacturing Processes	M'hamed Boutaous, Institut national des sciences appliquées de Lyon, Track Co-Organizer
Track 24: 9th Symposium on Transport Phenomena in Mixing	Khaled J. Hammad, Central Connecticut State University, Track Organizer
Track 24: 9th Symposium on Transport Phenomena in Mixing	Ivana Milanovic, University of Hartford, Track Co-Organizer
Track 24: 9th Symposium on Transport Phenomena in Mixing	George Papadopoulos, Simvotech, Track Co-Organizer
Track 24: 9th Symposium on Transport Phenomena in Mixing	Theodore Heindel, Iowa State Univ, Track Co-Organizer
Track 25: 7th International Symposium on Turbulent Flows - Issues and Perspectives	Kamran Siddiqui, University of Western Ontario, Track Organizer
Track 25: 7th International Symposium on Turbulent Flows - Issues and Perspectives	Hassan Peerhossaini, Université Paris Diderot, Track Co-Organizer
Track 26: Symposium on Algorithms and Applications for High Performance CFD Computation	Ning Zhang, McNeese State University, Track Organizer
Track 26: Symposium on Algorithms and Applications for High Performance CFD Computation	Raymond Gordnier, Air Force Research Lab, Track Co-Organizer
Track 26: Symposium on Algorithms and Applications for High Performance CFD Computation	Zhongquan Zheng, University of Kansas, Track Co-Organizer
Track 27: 16th International Symposium on Fluid Power	Javid Bayandor, Virginia Tech, Track Organizer
Track 27: 16th International Symposium on Fluid Power	Adiel Guinzburg, Boeing, Track Co-Organizer
Track 27: 16th International Symposium on Fluid Power	Sylvester Abanteriba, RMIT University, Track Co-Organizer
Track 28: Performance of Multiphase Flow Systems	Gene Kouba, Independent Consultant, Track Organizer
Track 28: Performance of Multiphase Flow Systems	Jinkook Lee, Eaton Aerospace, Track Co-Organizer
Track 28: Performance of Multiphase Flow Systems	Upendra Rohatgi, Brookhaven National Laboratory, Track Co-Organizer
Track 29: 3rd Symposium on the Fluid Dynamics of Wind Energy	Martin Wosnik, University of New Hampshire, Track Organizer
Track 29: 3rd Symposium on the Fluid Dynamics of Wind Energy	Francisco Diez, Rutgers Univ, Track Co-Organizer
Track 29: 3rd Symposium on the Fluid Dynamics of Wind Energy	Hui Hu, Iowa State University, Track Co-Organizer
Track 29: 3rd Symposium on the Fluid Dynamics of Wind Energy	Zhongquan Zheng, University of Kansas, Track Co-Organizer
Track 30: 1st Symposium on Marine Hydrodynamics	Hua Shan, Naval Surface Warfare Center, Carderock Division, Track Organizer
Track 30: 1st Symposium on Marine Hydrodynamics	Shawn Aram, Naval Surface Warfare Center, Carderock Division, Track Co-Organizer
Track 30: 1st Symposium on Marine Hydrodynamics	Jingsen Ma, Dynaflo, Inc, Track Co-Organizer
Track 32: Graduate Student Paper Competition	Javid Bayandor, Virginia Tech, Track Organizer
Track 32: Graduate Student Paper Competition	D. Keith Walters, Mississippi State University, Track Co-Organizer
Track 32: Graduate Student Paper Competition	Khaled J. Hammad, Central Connecticut State University, Track Co-Organizer

## TRACK ORGANIZERS ICNMM

Track 1: Single Phase Gas Flows	Norbert Kockmann, Technical University of Dortmund, Track Organizer
Track 1: Single Phase Gas Flows	Irina Graur Martin, Aix Marseille University, Track Co-Organizer
Track 1: Single Phase Gas Flows	Stéphane Colin, University of Toulouse, Track Co-Organizer
Track 2: Single Phase Liquid Flows	Ali Kosar, Sabanci University, Track Organizer
Track 2: Single Phase Liquid Flows	BoHung Kim, University of Ulsan, Track Co-Organizer
Track 2: Single Phase Liquid Flows	Prashanta Dutta, Washington State University, Track Co-Organizer
Track 3: Two-Phase Flows	Saeed Moghaddam, University of Florida, Track Organizer
Track 3: Two-Phase Flows	Masahiro Kawaji, City College of New York, Track Co-Organizer
Track 3: Two-Phase Flows	Yuri Muzychka, Memorial University of Newfoundland, Track Co-Organizer
Track 4: Evaporation, Boiling and Condensation	Yoav Peles, University of Central Florida, Track Organizer
Track 4: Evaporation, Boiling and Condensation	Melanie Derby, Kansas State University, Track Co-Organizer
Track 4: Evaporation, Boiling and Condensation	Brian M. Fronk, Oregon State University, Track Co-Organizer
Track 5: Electronics Cooling & Heat Pipes	Mark Steinke, Cray Inc., Track Organizer
Track 5: Electronics Cooling & Heat Pipes	Vinod Narayanan, University of California, Davis, Track Co-Organizer
Track 6: Electrokinetic Flows	Dominik Barz, Queen's University, Track Organizer
Track 6: Electrokinetic Flows	Prashanta Dutta, Washington State University, Track Co-Organizer
Track 7: Energy Applications of Micro- and Nano-scale Devices	Dominik Barz, Queen's University, Track Organizer
Track 7: Energy Applications of Micro- and Nano-scale Devices	Aimy Bazylak, University of Toronto, Track Co-Organizer
Track 7: Energy Applications of Micro- and Nano-scale Devices	Rupak Banerjee, University of Toronto, Track Co-Organizer
Track 8: Thin Film, Interfacial Phenomena, and Surface Tension Driven Flows	Daniel Attinger, Iowa State University, Track Organizer
Track 8: Thin Film, Interfacial Phenomena, and Surface Tension Driven Flows	Carlos Dorao, Norwegian University of Science and Technology, Track Co-Organizer
Track 9: Surface Engineering for Phase-change Heat Transfer	Amy Betz, Kansas State University, Track Organizer
Track 9: Surface Engineering for Phase-change Heat Transfer	Matthew McCarthy, Drexel University, Track Co-Organizer
Track 9: Surface Engineering for Phase-change Heat Transfer	Maria Fernandino, NTNU, Track Co-Organizer
Track 10: Biomedical and Lab-on-a-Chip Applications	Dirk Janasek, Leibniz-Institut für Analytische Wissenschaften, Track Organizer
Track 10: Biomedical and Lab-on-a-Chip Applications	Carolyn Ren, University of Waterloo, Track Co-Organizer
Track 10: Biomedical and Lab-on-a-Chip Applications	Ahmet Can Sabuncu, Southern Methodist University, Track Co-Organizer
Track 11: Modeling and Simulation	Murat Barisik, Izmir Institute of Technology, Track Organizer
Track 11: Modeling and Simulation	Rui Qiao, Virginia Polytechnic Institute & State University, Track Co-Organizer
Track 12: Conjugate Micro- and Nano-Scale Heat Transfer	Leandro Sphaier, Universidade Federal Fluminense, Track Organizer
Track 15: Transport in Membranes and Nanofluids	Thomas R. Gaborski, Rochester Institute of Technology, Track Organizer
Track 16: General Papers	Thomas R. Gaborski, Rochester Institute of Technology, Track Organizer
Track 16: General Papers	Sushanta Mitra, York University, Track Co-Organizer
Track 17: Posters	Amy Betz, Kansas State University, Track Organizer
Track 17: Posters	Fatemeh Hassani-pour, University of Texas at Dallas, Track Co-Organizer
Track 13: Mixing, Mass Transfer and Chemical Reactions	Saeed Moghaddam, University of Florida, Track Organizer
Track 13: Mixing, Mass Transfer and Chemical Reactions	Ashkan Davanlou, University of Central Florida, Track Co-Organizer

# Acknowledgments

## TRACK ORGANIZERS INTERDISCIPLINARY

Track 1: Multiphase flow and heat transfer	Joseph Katz, Johns Hopkins University, Track Organizer
Track 1: Multiphase flow and heat transfer	Deborah Pence, Oregon State University, Track Co-Organizer
Track 1: Multiphase flow and heat transfer	Vinod Narayanan, University of California, Track Co-Organizer
Track 1: Multiphase flow and heat transfer	Hongbin Ma, University Of Missouri, Track Co-Organizer
Track 1: Multiphase flow and heat transfer	Mark R Duignan, Savannah River National Laboratory, Track Co-Organizer
Track 2: Transport phenomena in manufacturing and materials processing	Dennis Siginer, Universidad de Santiago de Chile (USACH), Track Organizer
Track 2: Transport phenomena in manufacturing and materials processing	Milind Jog, University of Cincinnati, Track Co-Organizer
Track 2: Transport phenomena in manufacturing and materials processing	Yi Zheng, University of Rhode Island, Track Co-Organizer
Track 2: Transport phenomena in manufacturing and materials processing	Mhamed Boutaous, CETHIL INSA de Lyon, Track Co-Organizer
Track 3: Transport processes in fuel cells and heat pipes	Raj M Manglik, Univ Of Cincinnati, Track Organizer
Track 3: Transport processes in fuel cells and heat pipes	Steve Cai, Teledyne Scientific, Track Co-Organizer
Track 3: Transport processes in fuel cells and heat pipes	Scott Thompson, Mississippi State University, Track Co-Organizer
Track 4: Boiling and condensation in macro, micro and nanosystems	Amitabh Narain, Michigan Tech Univ, Track Organizer
Track 4: Boiling and condensation in macro, micro and nanosystems	Sushant Anand, University of Illinois at Chicago, Track Co-Organizer
Track 4: Boiling and condensation in macro, micro and nanosystems	Ming-Chang Lu, National Chiao Tung University, Track Co-Organizer
Track 5: Symposium in honor of Professor Richard H. Pletcher	S.A. Sherif, University of Florida, Track Organizer
Track 5: Symposium in honor of Professor Richard H. Pletcher	Francine Battaglia, Virginia Tech, Track Co-Organizer
Track 5: Symposium in honor of Professor Richard H. Pletcher	Raj M Manglik, Univ Of Cincinnati, Track Co-Organizer
Track 5: Symposium in honor of Professor Richard H. Pletcher	Sumanta Acharya, Univ of Memphis, Track Co-Organizer
Track 5: Symposium in honor of Professor Richard H. Pletcher	Javid Bayandor, Virginia Polytechnic Institute and State University, Track Co-Organizer



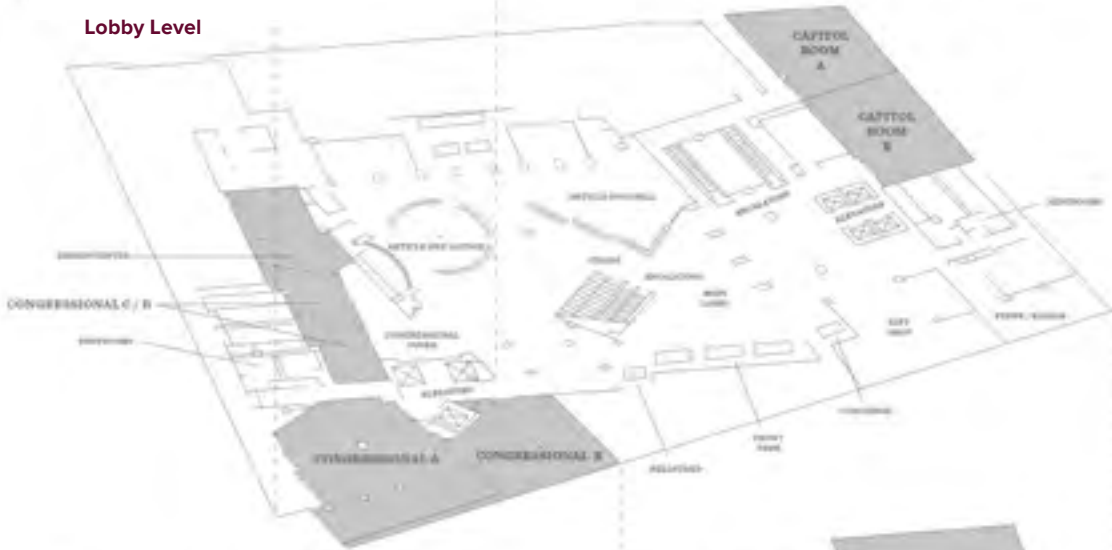
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FLOOR PLAN

11th Floor Thornton Room

Conference Level 2nd Floor



Lobby Level



Ballroom Level



