PennState Behrend

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ASME SETTING THE STANDARD

UPDATED

CONFERENCE PROGRAM

JUNE 10-14, 2019

NAMRC 47 MSEC 2019

2019 International Advanced Manufacturing Conference

Penn State Behrend | Bayfront Convention Center | Erie, PA

TABLE **OF CONTENTS**

CONFERENCE **SCHEDULE**

MONDAY, JUNE 10

TIME	LOCATION	EVENT
8:30-15:00	150	NAMRI Board Meeting
12:00-17:00	170	NSF Proposal Writing Workshop
12:00-20:00	E. Pre-Function	Registration
14:00-17:00	E. Pre-Function	Exhibitor Booth Set Ups
14:00-17:30	S. Great Hall	Poster Set Ups
17:30-19:30	Sunset Terrace/ N. Point Lobby/ E. Pre-Function	Reception

TUESDAY, JUNE 11

TIME	LOCATION	EVENT
7:00-16:00	E. Pre-Function	Registration
7:00-8:00	N. Point Lobby/ E. Pr-function	Breakfast
8:00-9:00	Grand Ballroom	Welcome/Keynote: Shaun Gleason
9:10-10:40	120-160A	Technical Session 1
9:10-10:40	110	MED Student Design Competition I
9:10-10:40	100	NAMRC Student Research Competition I
10:00-17:00	E. Pre-function	Exhibitor Booths Open
10:40-11:00	N. Point Lobby/ E. Pre-function	Morning Break
11:00-12:30	110-160A	Technical Session 2
14:00-15:30	110	MED Student Design Competition II
11:00-12:30	160B	ASME MED 100th Year Anniversary 1
11:00-12:30	100	NAMRC Student Research Competition II
12:30-13:50	Grand Ballroom	Lunch- Keynote: Susan Smyth

12:30-13:50	150	ASME Editorial Board Meeting
14:00-15:30	120-160B	Technical Session 3
14:00-17:30	170	Women in Advanced Manufacturing Forum
15:00-17:00	S. Great Hall	Poster Session
15:30-15:50	N. Point Lobby/ E. Pr-function	Afternoon Break
15:50-16:35	Grand Ballroom	NAMRI Membership Meeting
16:35-17:20	Grand Ballroom	ASME MED Membership Meeting
17:30		Busses leave to ACUTEC
18:00-21:00	Off Site	ACUTEC Precision Aerospace

WEDNESDAY, JUNE 12

TIME	LOCATION	EVENT
7:00-16:00	E. Pre-Function	Registration
7:00-8:00	N. Point Lobby/ E. Pr-function	Breakfast
8:00-9:00	Grand Ballroom	Keynote: Alan Taub
9:00-11:00	Off Site	Optional Industry Tours
9:10-10:40	120-160B	Technical Session 4
9:10-10:40	100	NAMRC Student Research Competition III
9:10-10:40	170	Blue Sky Competition I
10:00-17:00	E. Pre-Function	Exhibitor Booths Open
10:40-11:00	N. Point Lobby/ E. Pr-function	Morning Break
11:00-12:30	120-160B	Technical Session 5

11:00-12:30	170	Blue Sky Competition II
11:00-12:30	110	ASME MED 100th Year Anniversary 2
11:00-12:30	100	NAMRC Student Research Competition IV
12:30-13:50	Grand Ballroom	ASME/MED Award Luncheon
14:00-15:30	110-160B	Technical Session 6
14:00-15:30	170	Federal Agencies Perspective on Advanced Manufacturing
14:00-16:00	Off Site	Optional Industry Tour
15:00-17:00	S. Great Hall	Poster Session
15:30-15:50	N. Point Lobby/ E. Pr-function	Afternoon Break
15:50-17:20	110-160B	Technical Session 7
15:50-17:20	170	NSF Advanced Manufacturing Program Update
17:30-19:00	N. Point Lobby	SME Journal Reception
18:00-21:00	Grand Ballroom	Early Career Forum

THURSDAY, JUNE 13

TIME	LOCATION	EVENT
7:00-16:00	E. Pre-Function	Registration
7:00-8:00	N. Point Lobby/ E. Pr-function	Breakfast
8:00-9:00	Grand Ballroom	Keynote: Mike Molnar
9:00-11:00	Off Site	Optional Industry Tour
9:10-10:40	110-160B	Technical Session 8

9:10-10:40	170	RAMP Competition- Session 1
10:00-17:00	E. Pre-Function	Exhibitor Booths Open
10:40-11:00	N. Point Lobby/ E. Pr-function	Morning Break
11:00-12:30	110-160B	Technical Session 9
11:00-12:30	170	RAMP Competition- Session 2
12:30-13:50	Grand Ballroom	SME Award Luncheon & NAMRI Founders Lecture
14:00-16:00	Off Site	Optional Industry Tour
14:00-15:30	10-160B	Technical Session 10
14:00-15:30	100	ASME MED 100th Year Anniversary 3
14:00-16:00	170	Advanced Polymer Composites & Manufacturing for the Circular Economy
15:00-17:00	S. Great Hall	Poster Session
15:30-15:50	N. Point Lobby/ E. Pr-function	Afternoon Break
15:50-17:20	110-160B	Technical Session 11
15:30-17:20	100	ASME MED 100th Year Anniversary 4
17:00-17:45	E. Pre-Function	Exhibitor Booth Move Out
17:30-20:30	Off Site	Behrend Night

FRIDAY, JUNE 14

TIME	LOCATION	EVENT
7:30-8:30	N. Point Lobby/ E. Pr-function	Breakfast
8:40-10:10	110-160B	Technical Session 12
10:10-10:30	N. Point Lobby/ E. Pr-function	Morning Break
10:30-12:00	110-160B	Technical Session 13
12:00-13:00	E. Pre-function	Boxed Lunch

WIFI:

NETWORK: VNET *NO PASSWORD NEEDED*

TAXI INFO:

ERIE YELLOW CAB
814-461-8294

See next page for shuttle schedule.

***Attendees ride EMTA free with conference badge.*

COMPLIMENTARY SHUTTLE SERVICE

THE FOLLOWING SCHEDULE WILL RUN DAILY STARTING TUESDAY, JUNE 11TH THROUGH THURSDAY JUNE 13TH.
*MONDAY SERVICES WILL BEGIN AT 1:00 PM. *FRIDAY SERVICE WILL END AT 10:00 AM

MONDAY BUS ROUTE

Monday — SERVICE TO CONVENTION **FROM** GANNON UNIVERSITY

GANNON DEPARTURE		CONVENTION DROP OFF
1:00 PM	TO	1:30 PM
4:00PM	TO	4:30 PM

Monday — SERVICE TO GANNON **FROM** CONVENTION CENTER

CONVENTION DEPARTURE		GANNON DROP OFF
3:15 PM	TO	3:45 PM
7:45PM	TO	8:00PM

SERVICE TO CONVENTION **FROM** HOTELS

HOTEL DEPARTURE	CONVENTION DROP OFF
4:45PM	5:15PM

MONDAY WELCOME RECEPTION - 5:30PM -7:30PM

SERVICE TO HOTELS **FROM** CONVENTION CENTER

CONVENTION DEPARTURE		HOTEL DROP OFF
7:45PM	TO	8:15PM

Multiple buses will drop off at Gannon and 1 will drop off at the hotels. Please check for signage of the appropriate bus

GANNON HOUSING ROUTE: T/W/TH

T/W/TH — SERVICE TO CONVENTION **FROM** GANNON UNIVERSITY

GANNON DEPARTURE		CONVENTION DROP OFF
7:00 AM	TO	7:30 AM
10:00 AM	TO	10:30 AM
1:00 PM	TO	1:30 PM
4:00PM	TO	4:30 PM

T/W/TH — SERVICE TO GANNON **FROM** CONVENTION CENTER

CONVENTION DEPARTURE		GANNON DROP OFF
9:15 AM	TO	9:45 AM
12:15 PM	TO	12:45 PM
3:15 PM	TO	3:45 PM
5:00 PM	TO	5:30 PM

HOTEL SHUTTLE SERVICE WILL MAKE ITS FIRST STOP AT THE HOMEWOOD SUITES BY HILTON
(Towneplace Suites and Fairfield Inn guests will also catch the shuttle at this stop).
THE SHUTTLE WILL CONTINUE TO THE SPRINGHILL SUITES HOTEL AS THE 2nd STOP, AND
THEN TO COBBLESTONE HOTEL & SUITES AS THE FINAL PICKUP LOCATION BEFORE DROPPING OFF AT THE CONVENTION CENTER.

HOTEL ROUTE: T/W/TH

T/W/TH — SERVICE TO CONVENTION **FROM** HOTELS

HOTEL DEPARTURE		CONVENTION ARRIVAL
6:45 AM	TO	7:30 AM
10:00 AM	TO	10:45 PM
1:00 PM	TO	1:45 PM
4:15 PM	TO	5:00 PM

T/W/TH — SERVICE TO HOTELS **FROM** CONVENTION CENTER

CONVENTION DEPARTURE		HOTEL ARRIVAL
9:00 AM	TO	9:45 AM
12:00 PM	TO	12:45 PM
3:15 PM	TO	4:00 PM
5:15 PM	TO	6:00 PM

EARLY CAREER FORUM - WEDNESDAY EVENING

Wednesday, June 12th

Bayfront Convention Center, 6:00p - 9:00p

Wednesday — Early Career Forum

EVENT	6:00PM	TO	9:00PM

CONVENTION DEPARTURE		GANNON DROP OFF
9:00PM	TO	9:15PM

Wednesday — SERVICE TO HOTELS **FROM** CONVENTION CENTER

Shuttle service to the hotels will **NOT** be availabe after the ECF. Sorry for the inconvenience.

EVENT SHUTTLE SERVICE

ACUTEC EVENING CONFERENCE DINNER AND TOUR
Tuesday, June 11th
Meadville, 6:00p - 9:00p

Tuesday	ACUTEC DINNER/TOUR		
EVENT	5:30PM	TO	9:00PM

Buses will leave the Convention Center promptly at 5:30pm to go to Acutec

RETURN SERVICE **FROM** ACUTEC

ACUTEC DEPARTURE		ERIE ARRIVAL
9:00 PM	TO	9:45PM

Multiple buses will drop off at Gannon and 1 will drop off at the hotels. Please check for signage of the appropriate bus

PSU BEHREND NIGHT
Thursday, June 13th
Penn State Behrend Campus, 5:30p - 9:00p

Thursday	PSU Behrend Campus Event		
EVENT	5:30PM	TO	8:30PM

Buses will leave the Convention Center promptly at 5:30pm to go to Behrend

RETURN SERVICE **FROM** BEHREND

CAMPUS DEPARTURE
8:30 PM

Multiple buses will drop off at Gannon and 1 will drop off at the hotels. Please check for signage of the appropriate bus

SHUTTLE SCHEDULE - FACILITY TOURS
Wednesday June 12th & Thursday June 13th

ERIEZ MAGNETICS & McINNIS STEEL

9AM TO 11AM

W/TH

CONVENTION DEPARTURE		FACILITY TOUR
8:45 AM	TO	9:15 AM

FACILITY TOUR DEPARTURE		CONVENTION ARRIVAL
10:30 AM	TO	11:00 AM

MODERN INDUSTRIES & BERRY PLASTICS*

2:00PM TO 4:00PM

W*/TH

CONVENTION DEPARTURE		FACILITY TOUR
1:30 PM	TO	2:00 PM

FACILITY TOUR DEPARTURE		CONVENTION ARRIVAL
3:15 PM	TO	3:45 PM

** Berry Plastics tour is only offered on Wednesday*

Welcome from the NAMRC 47/MSEC 2019 Conference Hosts

As the organizers of NAMRC47/MSEC2019, and on behalf of the Erie, Pennsylvania, manufacturing community and the School of Engineering at Penn State Erie, The Behrend College, we warmly welcome you to the co-located conferences of SME NAMRC 47 and ASME MSEC 2019, to be held June 10-14, 2019, at the Bayfront Convention Center on Erie's beautiful waterfront.

Established in 1948, Penn State Behrend is a comprehensive four-year, residential college offering more than forty degrees at the bachelor's, master's, and associate degree levels. Our campus is among the largest in the Penn State system. We're part of the University ranked #1 in a Wall Street Journal survey of business recruiters for producing graduates prepared to succeed, and our School of Engineering is ranked among the top 40 undergraduate engineering programs nationwide by U.S. News & World Report. Please come and enjoy our campus visit for the "Behrend Night" on Thursday, June 13th. Our faculty and staff are looking forward to showing our world-class facilities to you.

Erie, a metropolitan area of 280,000, is located on Lake Erie's beautiful Presque Isle Bay. The region offers many cultural, sports, and recreational resources, including Pennsylvania's most popular state park, Presque Isle. Located within a two-hour drive of Cleveland, Pittsburgh, and Buffalo, Erie is a major industrial, medical, service, and tourism center.

Our sincere appreciations go out to all of our conference sponsors, whose support is key to the success of the conference. We would like to thank our staff member, Kristy Bunce, the School of Engineer office staff, The Office of Strategic Communications, and IT Services. We would also like to recognize the Erie Promotions team of Mark and Renee Concilla, Whitney Rambaldo, Alexandra DeSanti, and Tom Shearer, who have been working tirelessly to organize what promises to be a hallmark conference event. We are indebted to the NAMRI/SME Scientific Committee and the ASME Technical Committee for overseeing the technical paper submissions and editorial processes that have resulted in an outstanding technical program. We are excited to be hosting you, and we think that you will find the conference valuable in expanding your technical knowledge, as well as your network of contacts in the manufacturing research community. Finally, we sincerely wish all of you a very enjoyable stay in Erie and hope you will find inspiration and excitement in this stimulating and manufacturing environment.

Ihab Ragai, Ph.D., PE, FASME
Assistant Professor of Egineering
2019 Conference Organizing Chair

Timothy P. Kurzweg, Ph.D.
Director, School of Egineering
Professor of Electrical & Computer Egineering

WELCOME FROM Chairs of NAMRC 47 Scientific Committee & MSEC 2019 Technical Program

On behalf of the NAMRC 47 Scientific Committee and MSEC 2019 Technical Program, we welcome you to the joint International Manufacturing Conferences hosted by Penn State Erie, The Behrend College, from June 10th to June 14th, 2019, in Erie, Pennsylvania. The conferences are the 47th North American Manufacturing Research Conference (NAMRC 47), sponsored by the North American Manufacturing Research Institution of SME (NAMRI/SME), and the 2019 ASME International Manufacturing Science and Engineering Conference (MSEC 2019), sponsored by the Manufacturing Engineering Division (MED) of ASME. As leading world-class societies in the Mechanical and Manufacturing Engineering fields, SME and ASME act as effective bridges between industries, government laboratories, and academic institutions. This joint conference symbolizes the continued collaboration between these esteemed organizations in research exchange and knowledge dissemination in the Manufacturing fields.

Each of the co-located conferences include technical sessions covering a full range of manufacturing topics. Every single paper submitted to the conferences was put through a rigorous peer review process. We are in debt to all reviewers for their critical assessment of a very large number of submissions. NAMRC 47 received 201 technical paper submissions. Following the review process, 151 papers were accepted for publication in the Proceedings of NAMRI/SME and presentation at the conference in 52 technical sessions. The papers included in the conference address a wide range of basic and applied manufacturing research topics in 6 tracks: (1) Manufacturing Systems, (2) Manufacturing Processes, (3) Material Removal, (4) Additive Manufacturing, (5) Smart Manufacturing and Cyber-Physical Systems,and (6) Industrial Applications and Manufacturing Education. NAMRC 47 also includes a Student Research Presentations Competition.

MSEC 2019 received about 250 draft papers. After a rigorous peer review process, approximately 210 technical papers and 60 posters were accepted for presentation in more than 70 technical sessions. This year, MSEC has 29 symposia in 6 technical tracks: (1) Additive Manufacturing, (2) Manufacturing Equipment and Systems, (3) Manufacturing Processes, (4) Materials, (5) Bio and Sustainable Manufacturing, and (6) Posters. The conference also includes three student-centric events: Early Career Forum, Student Manufacturing Design Competition, and the Reusable Abstractions of Manufacturing Processes (RAMP) Competition and Workshop. MSEC 2019 also features the inaugural Women in Advanced Manufacturing (WIAM) Forum aiming to promote a diverse workforce in the broad field of manufacturing engineering.

NAMRC 47 / MSEC 2019 continue to feature the annual Manufacturing Blue Sky Competition, funded by National Science Foundation (NSF), and two special sessions: "Federal Agencies' Perspectives on Advanced Manufacturing" and "What's New at NSF". The winner of the Blue Sky Competition will receive the NAMRI/SME Dornfeld Manufacturing Vision Award, named in honor of the late Professor David Dornfeld, to recognize outstanding vision and leadership within the manufacturing community.

This conference program is the result of the outstanding efforts of many people. We would like to thank all the authors for their technical paper and poster submissions. We also express our gratitude to all the organizers for their dedicated management of the tracks, symposia, as well as for guarding the quality of the papers and posters to be presented, which has contributed a great deal to the success of the conference technical program. We would also like to thank the Host Organizing Committee, the Conference Coordinating Committee, the NAMRI/SME Scientific Committee, and the ASME MED Executive and Technical Committees. Our thanks also goes to the SME and ASME staff for their outstanding job in presenting conference information on the Internet, managing the submitted technical papers and posters, and ensuring high-quality publication of the conference proceedings for NAMRC 47 and MSEC 2019. We would like to extend our gratitude to all sponsors for providing financial support. Additionally, we would like to thank the Advanced Manufacturing Program within the Civil, Mechanical, and Manufacturing Innovation (CMMI) Division of NSF for sponsoring the Early Career Forum, the Blue Sky Competition, the NSF Proposal Writing Workshop, and for providing registration and accommodation support for selected student participants from US universities. We wish you a productive and enjoyable conference experience at Erie, Pennsylvania. We hope that the proceedings are beneficial and we sincerely wish that you have a long-lasting affiliation with NAMRC and MSEC.

Livan Fratini
University of Palermo, Italy
NAMRI/SME Scientific Committee Chair

ZJ Pei
Texas A&M University, USA
MSEC 2019 Technical Program Chair

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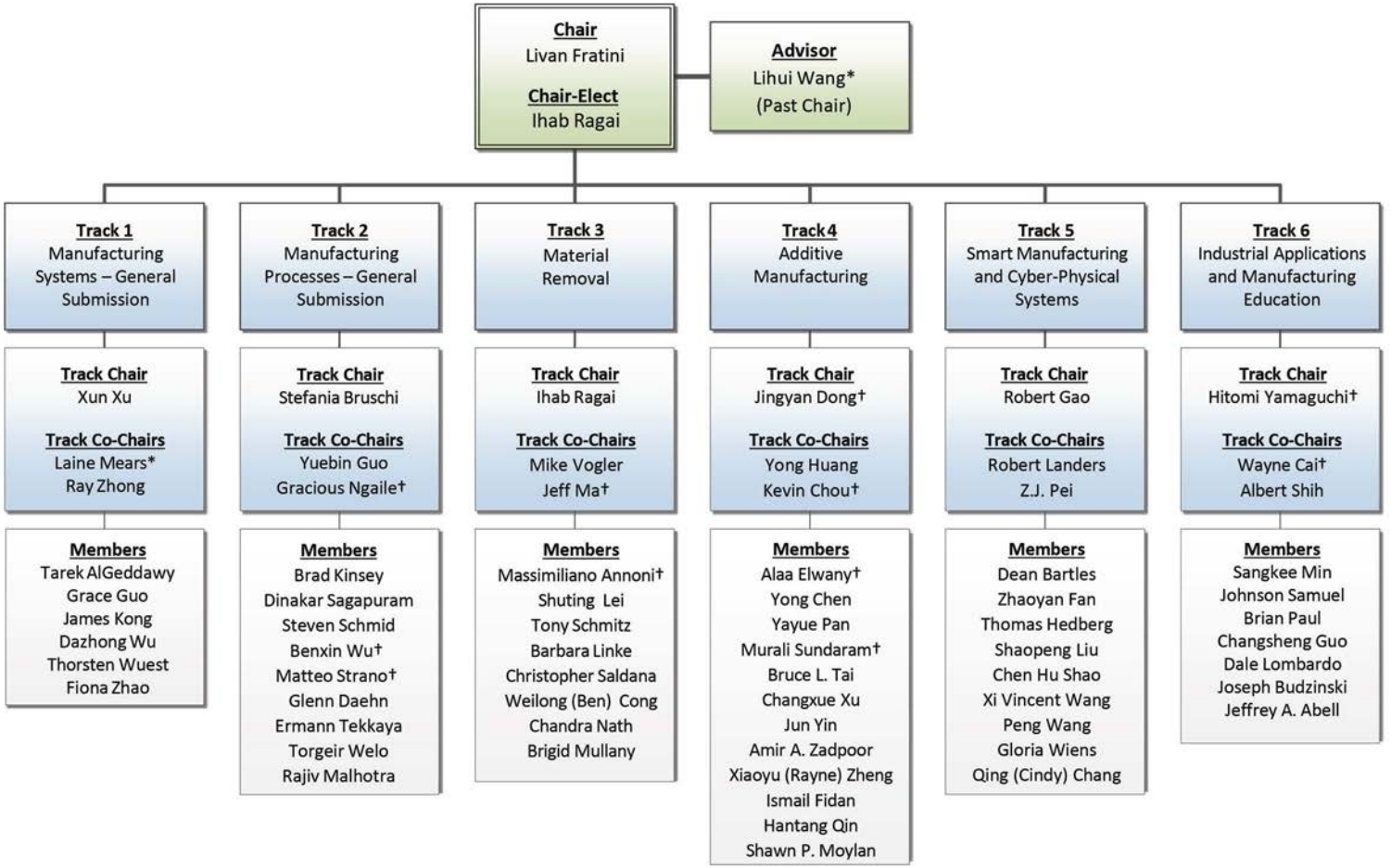

* Associate Editor of Journal of Manufacturing Systems
† Associate Editor of Journal of Manufacturing Processes

Track 1: Additive Manufacturing (John Vickers)

Symposium 1-1: Additive Manufacturing of Ceramics, Concretes, and Composites
Organizers: Chao Ma, John Vickers, Jianguo Wu

Symposium 1-2: Advances in Metal Additive Manufacturing Processes
Organizers: Dong Lin, Ho Yeung, Yalin Dong, Wenchao Zhou

Symposium 1-3: Quality Assurance in Additive Manufacturing Systems: Sensing, Analytics, & Control
Organizers: Prahalad Rao, Olga Wodo, Chi Zhou, William Carter

Track 2: Manufacturing Equipment and Systems (George Hazelrigg Jr.)

Symposium 2-1: Innovations in Equipment Design, Control and Automation
Organizers: Farbod Akhavan Niaki, Hongliang Wang, Keith Bourne

Symposium 2-2: Advances in Competitive Manufacturing Engineering and Operational Excellence
Organizers: Mohamed Gadalla, Sampson Gholston, Ahmed Soliman

Symposium 2-3: State-of-the-Art Research on Smart and Inter-Connected Manufacturing
Organizers: Hui Wang, Qing Chang, Zhen Song

Symposium 2-4: Advances in Data Analytics and Engineering Modeling for Intelligent & Resilient Manufacturing Systems
Organizers: Chenhui Shao, Weihong Guo, Yujie Chen, Xiaoning Jin

Symposium 2-5: Advances in Equipment and Process Health Awareness and Intelligence within Manufacturing Operations
Organizers: Michael Brundage, Brian Weiss, Dazhong Wu, Dean Bartles, Shaopeng Liu

Symposium 2-6: Advances in Modeling, Analysis, and Simulation of Manufacturing Systems for Optimized Throughput and Performance
Organizers: Cary Zhang, Herman Tang

Symposium 2-7: Advances in Quality, Reliability, and Continuous Improvement in Manufacturing Development and Execution
Organizers: Herman Tang, George (Mike) Smith

Symposium 2-8: Manufacturing Systems based on Cloud Technologies and Industrial Internet
Organizers: Xi (Vincent) Wang, Xun Xu, Lihui Wang, Yujie Chen

Symposium 2-9: Simulation Analysis Methodologies for Decision Making in Smart Manufacturing
Organizers: Eunhye Song, Soundar Kumara, Peiling Wu-Smith, Wei Xie

Symposium 2-10: Advances in Cyber Physical Systems, Stochastic Modeling, and Sensor Networks in Advanced Manufacturing
Organizers: Prahalad Rao, Zhenhua (David) Wu, Parikshit Mehta, Vukica Jovanovic

Symposium 2-11: Intelligent Maintenance Decision Making of Manufacturing Systems
Organizers: Yong Wang, Dazhong Wu, Shiming Duan

Track 3: Processes (Anand Tanikella)

Symposium 3-1: Advanced Multi-axis and Multi-tasking Machining Technologies
Organizers: Takashi Matsumura, Keiichi Shirase, Toshiyuki Muraki

Symposium 3-2: Advances in Assisted and Augmented Manufacturing Processes
Organizers: Farbod Akhavan Niaki, Weilong (Ben) Cong, Durul Ulutan

Symposium 3-3: Advances in Modeling, Analysis, and Simulation of Manufacturing Processes
Organizers: Alireza Shirazi, Zhichao (Charlie) Li, Ihab Ragai

Symposium3-4: Advances in Nontraditional Manufacturing Processes
Organizers: Murali Sundaram, Muhammad Jahan, Meng Zhang, Zhigang Wang

Symposium 3-5: Hard Machining and Grinding
Organizers: Rahul Chaudhari, Hitomi Yamaguchi, Fukuo Hashimoto

Symposium 3-6: Laser-based Advanced Manufacturing and Material Processing
Organizers: Chang Ye, Xin Zhao, Dong Lin

Symposium 3-7: Novel Joining Technologies for Dissimilar Materials
Organizers: Yongbing Li, Xun Liu, Wenda TAN, Wayne Cai

Symposium 3-8: Advances in Manufacturing Processes for Energy Applications
Organizers: Nikhil Churi, Andy Henderson, Binil Starly

Symposium 3-9: Tribology of Manufacturing Processes and Machine Elements
Organizers: Dinakar Sagapuram, Mathew Kuttolamadom

Symposium 3-10: Advances in the Mechanics of Materials & Manufacturing Processes
Organizers: Christopher Saldana, Dinakar Sagapuram, Rachid M'Saoubi

Symposium 3-11: Advances in Micro and Nano Manufacturing
Organizers: Martin Jun, Chandra Nath, Rajiv Malhotra, Ping Guo, Jun Zeng, Xinyu Liu

Track 4: Materials (Frank Gayle)

Symposium 4-1: Advances in Processing of Polymers and Polymer Composites
Organizers: Felicia Stan, Fabrizio Quadrini, Anasuya Sahoo

Symposium 4-2: Bio-/Nano-Materials and Self-Organizing Smart Structures
Organizers: Mostafa Bedewy, Sameh Tawfick, Amir Tavakkoli

Track 5: Bio and Sustainable Manufacturing (Tony Schmitz)

Symposium 5-1: Advances in Reusable Abstractions for Manufacturing Process and Unit Process Life Cycle Inventories
Organizers: KC Morris, Barbara Linke, Karl R. Haapala, Michael Overcash

Symposium 5-2: Design, Process, and Systems Advances for Remanufacturing and Recovery
Organizers: Jeremy Rickli, Sara Behdad, Willie Cade

Symposium 5-3: Advances in Analysis, Design, and Manufacturing of Biomedical Devices & Products
Organizers: Yancheng Wang, Yihao Zheng, Carl McGill

Symposium 5-4: Advances in 3D Bioprinting of Tissue Scaffolds and Organs
Organizers: Changxue Xu, Jun Yin, Zhengyi Zhang, Yifei Jin, Jingyuan Yan

Track 6: Posters (Barbara Linke, ZJ Pei)

Track 7: Joint MSEC-NAMRC Symposia

Track 8: Plenary Sessions

Track 9: Student Manufacturing Design Competition (Moneer Helu)

Track 10: Reusable Abstractions of Manufacturing Processes (RAMP) Competition (William Bernstein)

STUDENT TRAVEL **AWARD RECIPIENTS**

Suchana Akter Jahan, *Purdue University*
Mojahed Alkhateeb, *Wayne State University*
Maher Amer, *Washington State University*
Dian-Ru Annie Li, *University of Michigan*
Bugra Ayan, *Penn State University*
Sidharth Baskaran, *Clemson University*
Erina Baynojir Joyee, *University of Illinois at Chicago*
Suman Bhandari, *Northwestern University*
Abhinav Bhardwaj, *Texas A&M University*
Pavan Bhavsar, *Wichita state university*
Hamed Bouzary, *University of Texas at San Antonio*
Denzel Bridges, *University of Tennessee*
Suk Bum Kwon, *University of Wisconsin*
Parth Chansoria, *North Carolina State University*
Ping-Ju Chen, *University of Illinois at Urbana-Champaign*
Yiliang Cheng, *Iowa State University*
Romina Dastoorian, *Western Michigan University*
Harish Devaraj, *Rutgers University*
Tianshu Dong, *University of Michigan*
Katelyn Dudley, *University of New Hampshire*
Thomas Feldhausen, *Georgia Institute Of Technology*
Aniruddha Gaikwad, *University of Nebraska-Lincoln*
Michael Gomez, *UNC Charlotte*
Mercedes Gonzalez, *Missouri University of Science & Technology*
Pu Han, *University of Louisville*
Dustin Harper, *Oregon State University*
Anqi He, *Northeastern University*
Jida Huang, *University at Buffalo*
Jad Imseitif, *Eastern Michigan University*
Bavisha Kalyan, *University of California, Berkeley*
Achyuth Kothuru, *Rochester Institute of Technology*
Ilya Kovalenko, *University of Michigan*
Joseph Kubalak, *Virginia Tech*
Hasan Latif, *North Carolina State University*
Eddie Lee, *Oregon State University*
Kewei Li, *Clemson University*
Liming Li, *Stony Brook University*
Yanglong Lu, *Georgia Institute of Technology*
Jingxuan Lyu, *University of Michigan*
Jonathan Madera, *University of Texas at Dallas*
Shahrima Maharubin, *Texas Tech University*
MD Maksudul Islam, *Texas Tech University*
Rishi Malhan, *University of Southern California*
Elizabeth Mamros, *University of New Hampshire*
Narek Manukyan, *University of Cincinnati*
Bo Mao, *University of Nevada-Reno*
Sameer Mittal, *West Virginia University*
Tyler Moore, *Rensselaer Polytechnic Institute*
Amm Nazmul Ahsan, *North Dakota State University*
Christy Nguyen, *California State University Northridge*
Dinh Nguyen, *Michigan State University/College of Engineering*
James Nowak, *Rensselaer Polytechnic Institute*
Shuaihang Pan, *University of California-Los Angeles*
Gregory Pasken, *St. Louis University Parks Colege*
Maxwell R. Praniewicz, *Georgia Institute of Technology*
Madhumitha Ramachandran, *University of Oklahoma*
Santosh Rauniyar, *University of Louisville*
Avik Samanta, *University of Iowa*
Juan Sandoval, *Michigan State University*
Jessica Schiltz, *University of Notre Dame*
Luis Segura, *University at Buffalo*
Ebrahim Seidi, *University of Hawaii at Manoa*
Arvind Shankar Raman, *Oregon State University*
Fei Shen, *UNC Charlotte*
Mingman Sun, *Kansas State University*
Sumair Sunny, *The University of Texas at Dallas*
Asif Tanveer, *University of Illinois at Urbana-Champaign*
Catherine Tiner, *University of Arkansas*
Fenfen Wang, *Case Western Reserve University*
Hao Wang, *Case Western Reserve University*
Jewel Williams, *Texas A&M University*
Mingtao Wu, *Syracuse University*
Heqi Xu, *Texas Tech University*
Xiaowei Yu, *Missouri University of Science and Technology*
Botao Zhang, *University of Cincinnati*
Dongzhe Zhang, *Texas Tech University*
Hao Zhang, *University of Akron*
Xiao Zhang, *Iowa State University*
Cheng Zhu, *University of Virginia*

TIME	LOCATION	EVENT
8:30-15:00	150	NAMRI Board Meeting
12:00-17:00	170	NSF Proposal Writing Workshop
12:00-20:00	E. Pre-Function	Registration
14:00-17:00	E. Pre-Function	Exhibitor Booth Set Ups
14:00-17:30	S. Great Hall	Poster Set Ups
17:30-19:30	Sunset Terrace/ N. Point Lobby/ E. Pre-Function	Reception

NSF Proposal Writing Workshop

Monday, June 10 | 12:00-17:00 | 170

Organizer: George Hazelrigg, George Mason University
ZJ Pei, Texas A&M University,
Tony Schmitz, University of North Carolina at Charlotte

Sponsored by: National Science Foundation

Purpose: The purpose of this workshop is to provide the knowledge and insights necessary to write competitive research proposals, particularly proposals directed to the National Science Foundation (NSF), and to give attendees an opportunity to meet with current and/or former NSF program directors. The workshop will present the fundamentals of determining whether to respond to potential opportunities for proposal submission, the necessary conditions for funding, framing research goals and objectives, understanding intellectual merit and broader impacts, formulating task statements and formatting the proposal itself.

Extra Information: Lunch will be provided at 12:00. The workshop will be held from 1:00 to 5:00 PM on Monday, June 10, 2019, at the Bayfront Convention Center, Presque Isle Bay, Erie, Pennsylvania, concurrent with the ASME MSEC 2019 and NAMRC 47.

Registration Fee: $50, the registration fee includes lunch.

TUESDAY **JUNE 11, 2019**

TIME	LOCATION	EVENT
7:00-16:00	E. Pre-Function	Registration
7:00-8:00	N. Point Lobby/ E. Pr-function	Breakfast
8:00-9:00	Grand Ballroom	Welcome/Keynote: Shaun Gleason
9:10-10:40	120-160A	Technical Session 1
9:10-10:40	110	MED Student Design Competition I
9:10-10:40	100	NAMRC Student Research Competition I
10:00-17:00	E. Pre-Function	Exhibitor Booths Open
10:40-11:00	N. Point Lobby/ E. Pr-function	Morning Break
11:00-12:30	110-160A	Technical Session 2
11:00-12:30	110	MED Student Design Competition II
11:00-12:30	160B	ASME MED 100th Year Anniversary 1
11:00-12:30	100	NAMRC Student Research Competition II
12:30-13:50	Grand Ballroom	Lunch- Keynote: Susan Smyth
12:30-13:50	150	ASME Editorial Board Meeting
14:00-15:30	120-160B	Technical Session 3
14:00-17:30	170	Women in Advanced Manufacturing Forum
15:00-17:00	S. Great Hall	Poster Session
15:30-15:50	N. Point Lobby/ E. Pr-function	Afternoon Break
15:50-16:35	Grand Ballroom	NAMRI Membership Meeting
16:35-17:20	Grand Ballroom	ASME MED Membership Meeting
17:30		Busses leave to ACUTEC
18:00-21:00	Off Site	ACUTEC Tour

Mayor Joseph Schember

Mayor of the City of Erie
Chancellor

On Jan. 2, 2018, Joseph V. Schember was sworn in as the 48th Mayor of the City of Erie. A lifelong Erie resident, Joe spent high school and the first two years of college at St. Mark's Seminary, studying to become a Catholic priest. After deciding against becoming a priest, he completed his undergraduate degree in English at Gannon University. He went on to obtain a master's degree in English from the University of Dayton and a master's degree in business management from Gannon University.

After teaching at Elk County Christian High School in St. Mary's, Pa. for two years, Joe returned to Erie and began a career in banking at Marine Bank, which became PNC Bank. Joe started as a teller, and worked his way up to regional manager. He was responsible for all 53 branches in the Northwest Pennsylvania, and his reputation for skilled management grew. His final years with the bank were spent as a relationship manager in the Wealth Management Group. What Joe loved about banking is that it is a "people business". That is why he spent 40 years in various banking roles and why he loves being Mayor now.

A dedicated teacher, Joe spent 30 years teaching summer banking classes for the PA Bankers Association and the American Bankers Association at Bucknell, Georgetown, PENN and Penn State Universities. He also used those skills to write and deliver bank training classes, radio and television spots.

In an effort to give back to the community, Joe served as a member of Erie City Council for 5½ years. During this time, he chaired the finance committee and was active in guiding decisions that would help the city's finances.

Now, as mayor, Joe is working hard to "build opportunity, restore hope, and transform Erie" for future generations. By listening and collaborating, he is tackling the tough and complex issues facing this city and region. Whether it is through neighborhood meetings, door-to-door visits, or professional gatherings, he is meeting with community leaders, educators, life-long residents, transplants, immigrants, refugees, and anyone who lives in the Erie region. Joe is committed to being open, honest, transparent, and accessible.

Joe fell in love with his wife, Rhonda Mahoney Schember, at age 19. Rhonda and Joe are very close with their three children: Jaime, Jodi, and Joe.

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Shaun S. Gleason, Ph.D.

Director, Cyber & Applied Data Analytics Division
National Security Sciences Directorate
Oak Ridge National Laboratory

Dr. Shaun S. Gleason is the Director of the Cyber and Applied Data Analytics Division at the Oak Ridge National Laboratory (ORNL). In this role, he is responsible for an R&D portfolio focused on cyber security and data analytics, and more specifically, these thrust areas: (1) cyber and information security, (2) cyber physical systems, (3) software vulnerability science, and (4) multi-modal data analytics and architectures. From 2013 until 2018, Shaun was the Director of the Computational Sciences and Engineering Division at ORNL. From 2011 to 2013, he was Director of the Office of Institutional Planning and was responsible for ORNL's strategic planning process and discretionary R&D investment. From 2008 to 2011, he was the Group Leader of the Imaging, Signals, and Machine Learning (ISML) Group at ORNL. Shaun has 30 years of experience in applied image processing and machine learning for industrial, security, and medical imaging applications. He earned the B.S., M.S., and Ph.D. degrees in Electrical Engineering from the University of Tennessee, Knoxville, with a research focus on x-ray computed tomography and 2D and 3D model-based medical image segmentation. In 1998 he became the co-founder and VP of a preclinical medical imaging company, ImTek, Inc., that successfully transferred ORNL-developed technology into the commercial sector. After ImTek, Inc. was acquired by CTI, Inc. and then merged with Siemens Medical, he became the Director of the Preclinical Research Division of Siemens Medical until 2008, when he returned to ORNL to lead the ISML group in the Measurements Science and Systems Engineering Division. He has authored and coauthored over 100 publications, three book chapters, and has been issued 9 patents in the field of electrical engineering and computer vision. He is a Senior Member of the IEEE, was chair of the East TN Chapter of the IEEE Engineering in Medicine and Biology Society and was an associate editor of the SPIE Journal of Electronic Imaging from 2008 until 2015.

Cyber Physical Security for Advanced Manufacturing

Tuesday, June 11th | 8:00-9:00

Abstract

Increased levels of cyber-enabled infrastructure and automation within the manufacturing industry (e.g. "Industry 4.0") bring about tremendous opportunitiesfor increased agility in design processes, process efficiencies, part production speed, part complexity, and overall qualityand functionality ofmanufactured parts. The advantages of such technological leapsin manufacturing systems are well-known, but the increased risks of cyber-based attacks onsuch systems are less understood and oftentimes overlookedand/or underestimated. It is clear that attacks on cyber-physical systems(integrated systems of hardware, software, sensing, communications and controls) such as energy delivery and transportation systems are increasing rapidly, and there is a large amount of active research and development to enhance the security and resilience of such systems. Cyber-physical manufacturing systems (CPMS)have their own unique set of cyber security risks that can affect the safety of people in the facility, the quality and integrityof the created parts, the security of the manufacturer's intellectual property, and the function of the overall systems into which the manufacturedparts are integrated, just to name a few examples. In addition, there are substantial supply chain security risks that cannot be ignored, but are difficult to comprehend, control, and mitigate. This talk will discuss theunique landscape of CPMS from a cyber security risk perspective, outlinesome basic cyber hygiene best practices, and, finally, present some current and future areas of research and development that have great potential to advance the state-of-the-art in manufacturing system securityand resilience.

Susan Smyth, Ph.D., FSME, NAE

Chief Scientist for GM Manufacturing
Director, Manufacturing Systems Research
General Motors (Ret.)

Dr. Susan Smyth recently retired as the Chief Scientist for global manufacturing at General Motors and the Director of GM R&D Manufacturing Systems Research Labs. In this capacity, she directed the creation of GM's global manufacturing R&D strategies and oversaw innovation and implementation of its advanced manufacturing technology portfolio. In this role at General Motors, Susan was responsible for manufacturing technology research and development enabling the production of world class vehicle and propulsion systems and driving innovations to enhance quality, efficiency and flexibility of GM's manufacturing systems. During her career at GM she held a variety of leadership positions in Manufacturing, Engineering, "Big Data" Analytics, and Research and Development. Susan is recognized as one of the strategic technology leaders inside and outside General Motors. She served as Chair of the U.S. Manufacturing Council, which advises the Secretary of Commerce on government policies and programs that affect United States manufacturing. She was the GM Executive Representative and Chair of the Manufacturing Technology Leadership Council at the United States Council for Automotive Research. She has also served as executive technology advisor to a number of prestigious research institutes (University of Michigan, MIT, Georgia Tech, and Shanghai Jiao-Tong University). Dr. Smyth has been recognized for her technical and business achievements with multiple international awards. She was made a Fellow of the Society of Manufacturing Engineers in 2015, and was elected to the National Academy of Engineering in 2018. She also serves as an advisor to NSF (Directorate for Engineering). She has a Bachelor of Science degree in Physics, a Master of Science degree in Optoelectronics and Information Technology, and a Doctorate in Physics (Queen's University of Belfast, Northern Ireland).

Manufacturing: The People & the Technology

Tuesday, June 11th | 12:30-13:50

Abstract

Workforce development is an approach that attempts to enhance a region's economic stability and prosperity by focusing on people. It is founded in the belief that companies need people , manufacturing plants need a workforce and economically successful countries need manufacturing. This presentation is a brief synopsis of one career in manufacturing which is shared with the goal of encouraging more women to consider manufacturing as a viable career and encouraging those mid career to stay. In summary, it's a short narrative of the technological successes achieved and opportunities taken, mistakes made, and the lessons learned from the people I have worked with.

Women in Advanced Manufacturing Forum

Tuesday, June 11, 2019 in the afternoon

Forum Topic: Advanced Manufacturing – The Diverse Next Generation

Sponsored by: ASME Manufacturing Engineering Division (MED) & ASME Technical Events and Content (TEC) Sector Council

Organizers: Gloria Wiens (University of Florida), Maureen Fang (Lockheed Martin), Barbara Linke (University of California Davis)

Website: *https://event.asme.org/MSEC/Program/Women-in-Advanced-Manufacturing-Forum*

For its inaugural event, the Forum on Women in Advanced Manufacturing (WIAM) aims at showcasing successful career paths, discussing next generation technologies and gender gap in the field of manufacturing engineering (MfgE). The forum is organized by the Manufacturing Engineering Division (MED) and is being held during ASME's 2019 Manufacturing Science and Engineering Conference (MSEC) on June 11, 2019, in Erie, PA. The event will feature (i) panelist presentations from industry, government and academia, (ii) break-out sessions to discuss new opportunities for the diverse next generation in MfgE, and (iii) a networking reception. The expected outcome will be actionable recommendations to the MED leadership team.

The objective is to effectively and collaboratively increase gender inclusion and diversity engagement in MSEC as well as in MED members. The long-term goal is to achieve broader impacts from ASME to societal issues, e.g., a diverse MfgE workforce in U.S.

Program:

Session I (2:00-3:30 pm): Panel of Advanced Manufacturing Leaders

Technology Focus: Industrial Internet of Things (iIoT), digital manufacturing, additive manufacturing automation, robotics, Artificial Intelligence (AI), smart manufacturing

Opening Remarks: Gloria Wiens – University of Florida

Panel Moderator: Maureen Fang, Technical Product Manager – Lockheed Martin

Panelists: ***Dianne Chong***, Recent Vice President for Research and Technology (retired) – Boeing Engineering, Operations & Technology,

Tahany El-Wardany, Fellow, Advanced Manufacturing – United Technologies Research Center Victoria Fry, Technical Solutions Executive – Autodesk, Inc.

Teresa Malueg, Antisubmarine Warfare Sensors (ASW) and Mission Systems Programs Director – Lockheed Martin Corporation

Brigid Mullany, ENG/CMMI: AM & LEAP HI Program Director – National Science Foundation/ Professor – University of North Carolina at Charlotte

Elisabeth Smith, President & CEO – Acutec Precision Aerospace, Inc.

Susan M. Smyth, Chief Scientist for GM Manufacturing and Director, Manufacturing Systems Research – General Motors (retired)
NAMRC/MSEC 2019, Tuesday Luncheon Keynote speaker – 12:30-2:00pm

Danielle Zeng, Technical Expert in Materials and Manufacturing – Ford Research and Innovation Center

Continuous Break: 'In-room' forum break

Session II (3:45-5:15pm): Creating Change and Shaping the Landscape of the Future in MfgE

Working session: Audience participation in ideation of new pathways and opportunities for the diverse next generation in MfgE. To arrive at actionable recommendations for **ASME MED leadership to act upon.**

Moderator: Crystal Morrison, Founder & CEO – EverRise

Closing Remarks: Barbara Linke – University of California Davis

Reception (5:15-5:45pm): Connecting for the Path Forward

Busses Depart (6:00pm): Acutec – Precision Aerospace Inc. Tour and Dinner
(busses will be waiting to transport the Forum's participants to join the rest of the conference attendees)

Attendees: $5 Fee, plus conference registration required (limited to 90 attendees)
For any questions, please contact WIAM Forum organizer, Gloria Wiens <gwiens@ufl.edu>

Travel Info: *https://namrc47-msec2019.behrend.psu.edu/content/travel*

Lodging: *https://namrc47-msec2019.behrend.psu.edu/content/location-lodging*

Registration: *https://namrc47-msec2019.behrend.psu.edu/content/registration#overlay-context=content/home*

WIAM Organizers, Moderators and Panelists Bios:

Dianne Chong, *Vice President for Research and Technology – Boeing Engineering, Operations & Technology (retired)*

Dianne Chong, PhD, NAE, FSME, FASM, was the vice president in the Boeing Research and Technology organization in the Boeing Engineering, Operations & Technology organization. In this position, she led special projects that impacted processes and program integration for the Boeing Enterprise. Prior to this, Chong was the vice president of materials, manufacturing, structures and support in the Boeing Engineering, Operations & Technology organization. In that role, she led the organization responsible for development and support of manufacturing processes and program integration for the Boeing Enterprise.

Dr. Chong has been elected to the National Academy of Engineering and the Washington State Academy of Science for 2017. Chong has served as the St. Louis representative to Military Handbook 5 where she has chaired the Aerospace Users' Group and titanium casting group.

Chong is also serving on the ABET Board of Directors where she represents engineering. In that capacity, she leads the Engineering Area Delegation and supports the Engineering Area Commission. She supports ABET's Global Council and nominations and awards.

Chong is a member of TMS, AIAA, ASM International, SME, SWE, Beta Gamma Sigma and Tau Beta Pi. She has also been a member of the National Materials Advisory Board, served on the board of trustees, is a fellow of ASM International, and in 2007-08, served as the president of ASM International. She is currently the chair of the ASM Women in Materials Engineering Committee and serves on the ASM Action in Education Team. Chong is currently serving on the SME Board of Directors and is a fellow of SME.

She has been recognized for managerial achievements and as a diversity change agent. Chong was also recognized as an outstanding alumna of University of Illinois in 2006 and is the recipient of numerous technical and diversity awards. Chong has also supported National efforts by leading teams for NAE studies on manufacturing and through her service on the National Materials Advisory Board and the Defense Materials, Manufacturing, and Infrastructure group.

Chong received her bachelor's degrees in biology and psychology from the University of Illinois. She also earned master's degrees in physiology and metallurgical engineering. In 1986, Chong received her doctorate in metallurgical engineering from the University of Illinois. She also completed an executive master of manufacturing management at Washington University.

Tahany El-Wardany, *Fellow, Advanced Manufacturing – United Technologies Research Center*

Tahany El-Wardany, Ph.D., is Fellow, Advanced Manufacturing, at United Technologies Research Center (UTRC). As such, El-Wardany identifies and creates new technology areas in materials and manufacturing with widespread impact across United Technologies Corporation (UTC); develops capabilities in the fields of advanced manufacturing and elevator tribology; engages external networks to identify and support business development opportunities; and guides technical project work in advanced manufacturing. Previously, she served as Principal Engineer and a member of UTRC's Surface Mechanics Group, Physical Sciences Department.

During the course of her UTRC career, she has overseen development of novel manufacturing processes (hybrid/additive manufacturing/deep rolling manufacturing, high-speed machining); contributed to ARPA-E winning project proposals; matured methods to mechanically enhance aerospace alloy surface properties; and built 5-axis flank milling model and code for process optimization of numerous machining applications within UTC business units, which was ultimately licensed externally.

Her many awards and honors include winner of the 2015 Otis Safety Award; and a 2011 Connecticut Women of Innovation Nominee. Key appointments include Associate Professor, University of Alexandria, Egypt; Research Manager, Machining System Laboratory and Adjunct Professor, McMaster University, Canada; and Visiting Professor, Mechanical Engineering Department, Imperial College, United Kingdom. El-Wardany has published more than 100 peer-reviewed journal and conference papers and holds 21 patents and 40 patent applications in additive manufacturing, hybrid and conventional manufacturing, and the science of friction, lubrication and wear. She has been an invited speaker at many advanced manufacturing conferences, including the 2015 and 2018 National Academy of Science workshop on additive manufacturing modeling and online monitoring.

El-Wardany is a member of the Connecticut Academy of Science and Engineering (CASE), Society of Manufacturing Engineers (SEM), American Society of Mechanical Engineers (ASME), The Society of Women Engineers (SWE) . She is editor of the Journal of Applied Mathematics, reviews multiple national and international journals in advanced manufacturing, and is a member of the editorial board of the International Scholarly Research Network Tribology. She holds undergraduate and graduate degrees in production engineering from the University of Alexandria, Egypt, and a Ph.D. in mechanical engineering from the University of Birmingham, UK.

Maureen Fang, *Technical Product Manager – Lockheed Martin*

Dr. Maureen Fang is technical project leader on submarine sensor and sonar team managing capital projects including design, procurement and implementation of new factory cells. She manages a new product project ($70MM). She is responsible for day-to-day manufacturing operations including design work instructions, tools, fixtures, and test equipment. Fang incorporates lean six sigma initiatives on time and cost savings; and trains multiple disciplinary team members on the operation of use new equipment.

Fang is an experienced product manager with a demonstrated history of working in the Aviation & Aerospace, and defense industry. Skilled in product introduction, process development, project management, producibility, design for manufacturing and assembly (DFMA), failure analysis, FMEA, proposal creation, cost reduction, root cause and correct actions, lean manufacturing, six sigma, Geometric Dimensioning & Tolerancing, Project Estimation, Siemens NX, Volunteer Management and Lead Time Reduction. Her research interests are in design for manufacturing (DFM/DFx), digital manufacturing, digital thread, model based definition, and advanced manufacturing.

Prior to joining Lockheed Martin, Maureen was a mechanical design and manufacturing engineer at Pratt and Whitney. She then left Pratt and Whitney to pursue a PhD at Purdue University. In 2015 while pursuing her PhD, Maureen was awarded the 1st ASME Advanced Manufacturing Fellow at America Makes, the National Additive Manufacturing Innovation Institute. She worked for the deputy director of Education and Workforce. In this role, she managed the advisory board and roadmap development aimed in creating long-term strategic plans for advancing the next generation manufacturing workforce.

Maureen holds a BS in Mechanical Engineering from Clarkson University, MS in Mechanical Engineering from Rensselaer Polytechnic Institute, and PhD in Mechanical Engineering Technology from Purdue University.

Victoria Fry, *Technical Solutions Executive – Autodesk, Inc*

Victoria Fry is a Technical Solutions Executive at Autodesk out of Silicon Valley. Victoria works with Autodesk's named account manufacturing customers to deliver business outcomes through technical solutions. Autodesk has over 130 different software titles spanning additive manufacturing and fluid simulation to visual effects for major motion films. Victoria leverages her technical background to understand and solve engineering challenges with her Fortune 5 customers. In 2016, she received one of two 'Excellence in Teamwork' awards for collaboration with R&D and manufacturing.

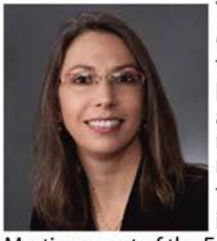
Prior to joining Autodesk, Victoria traveled the world licensing Chevron's hydroprocessing catalyst and technology to other oil majors.

Victoria holds a BS in Chemical Engineering from University of Nebraska. During university, Victoria worked with Exxon Mobil & Goldman Sachs.

Barbara Linke, *Associate Professor – University of California Davis*

Dr.-Ing. Barbara S. Linke is a faculty member of Mechanical and Aerospace Engineering at the University of California, Davis. She completed her Diplom (2002), doctorate (2007), and Habilitation (2015) at the RWTH Aachen University, Germany and worked as post-doc with Professor Fritz Klocke, Werkzeugmaschinenlabor (WZL), RWTH Aachen University and Professor David Dornfeld, University of California Berkeley. Her research interests include sustainable manufacturing, abrasive machining technologies, part quality, smart and data-driven manufacturing, among others. She has published over 70 peer-reviewed papers, authored two books, edited a book and a proceedings, and is an active member of ASME MED and SME.

Barbara S. Linke received several awards, including the F.W. Taylor Medal of the CIRP in 2009, the Outstanding Young Manufacturing Engineer award of the SME in 2013, and the UC Davis College of Engineering Outstanding Junior Faculty Award in 2018.



Teresa Malueg, *Antisubmarine Warfare Sensors (ASW) and Mission Systems Programs Director – Lockheed Martin Corporation*

Teresa Malueg is the Antisubmarine Warfare Sensors (ASW) and Mission Systems Programs Director located in Syracuse, NY. She has responsibility for towed array, hull array, non-propulsion engineering and several additional ASW programs. In her prior role, Teresa was the Underseas Chief Engineer with responsibility for all undersea programs at the Syracuse site including towed arrays, hull arrays, non-propulsion electronics, mine warfare, and mission and unmanned systems.

Teresa holds a BS in Mechanical Engineering from Michigan Technological University as well as an MS in Mechanical Engineering from National Technological University. She started her career at Lockheed Martin as part of the Engineering Leadership Development Program and has moved through positions of increasing responsibility over time.

Additional roles within Lockheed Martin that Teresa recently held include being the RMS representative to the corporate Root Cause and Corrective Action board and technical liaison to Penn State focusing on continued and increased technical engagement with the University.

Crystal Morrison, *Founder & CEO – EverRise*

Dr. Crystal G. Morrison is a highly regarded scientist and leader who is passionate about developing people and organizations to their highest potential. She believes strongly that innovation is an act of leadership not just creativity. With extensive experience across industry, academia and national labs, Dr. Morrison knows what it takes to build and lead successful teams that create lasting value and bring products from concept to reality.

Dr. Morrison holds a Ph.D. in Macromolecular Science and Engineering and a B.S. in Chemistry. Following graduate school at the University of Michigan, Dr. Morrison was a Harold Agnew National Security Postdoctoral Fellow at Los Alamos National Laboratory (LANL) and later became a staff member, team leader and program leader before moving to Pittsburgh, PA. Since LANL, she has held successive leadership roles, including global R&D leader in a Fortune 500 company for 2 business units covering 77 unique market segments with over $2.5B in annual sales. In 2018, Dr. Morrison converted her passion for people, technology and leadership into EverRise. EverRise is focused on uncovering and unleashing hidden potential in technical professionals and organizations to deliver growth and longterm sustainability.

Brigid Mullany, *ENG/CMMI: AM & LEAP HI Program Director – National Science Foundation / Professor – University of North Carolina at Charlotte*

Dr. Brigid Mullany is a Professor in the Department of Mechanical Engineering and Engineering Science at the University of North Carolina at Charlotte. Her undergraduate and graduate degrees are from University College Dublin Ireland. After completing her PhD in 2002 she accepted a two-year Marie Cure post doc position with Carl Zeiss in Germany, after which she took a position at UNC Charlotte in 2004. Her research focuses on surface finishing methods and surface evaluation.

Dr. Mullany is also currently a Program Director at the National Science Foundation in the Advanced Manufacturing Program within the Division of Civil, Mechanical and Manufacturing Innovation.

During the course of her UTRC career, she has overseen development of novel manufacturing

Elisabeth Smith, *President & CEO – Acutec Precision Aerospace, Inc*

Since December 2014, Elisabeth has been the President and CEO of Acutec Precision Aerospace Inc. Acutec has grown over the last 30 years into one of the world's leading privately owned aerospace and power generation components and sub-assembly suppliers with a worldwide customer base, and facilities in Pennsylvania and South Carolina. In 2017, Acutec was ranked #1 in the aerospace industry by Aviation Week for valuing the individual. Ms. Smith is committed to a culture of teamwork, continuous improvement and harnessing technology to improve processes.

In 2015, she cofounded Lojic, a manufacturing software development spin-off specializing in IoT and application integration, reporting and dashboard implementation, as well as mobile app design and development.

Prior to joining Acutec, she was a consultant for the Aerospace and Defense practice of Charles River Associates (now Renaissance Strategic Advisors) and in the Operations Leadership Program (OLP) with United Technologies Corporation (now Collins Aerospace), holding positions at Pratt & Whitney, Hamilton-Sundstrand, and Sikorsky Helicopter, before becoming a manager on the Blackhawk HH-60M Medevac helicopter final assembly line for Sikorsky.

In 2016, Elisabeth was a STEP Ahead award winner, honored in Washington DC by the Manufacturing Institute for outstanding women in science, technology, engineering and production (STEP) careers. In 2018 Elisabeth was the first female winner of the Winslow Award, honoring an individual, group, business or industry that has made a significant contribution to the economic growth of the greater Meadville area.

She has a B.A. in Mathematical Economics from Haverford College, and MBA in Manufacturing Operations from the Tauber Institute for Global Operations at the University of Michigan. She has also completed Defense Policy Analysis coursework at George Washington University and the General Course at the London School of Economics.

Susan M. Smyth, *Chief Scientist for GM Manufacturing and Director, Manufacturing Systems Research – General Motors (retired)*

Susan Smyth, PhD, FSME, NAE, recently retired as the Chief Scientist for global manufacturing at General Motors and the Director of GM R&D Manufacturing Systems Research Labs. In this capacity, she directed the creation of GM's global manufacturing R&D strategies and oversaw innovation and implementation of it's advanced manufacturing technology portfolio.

In this role at General Motors, Susan was responsible for manufacturing technology research and development enabling the production of world class vehicle and propulsion systems and driving innovations to enhance quality, efficiency and flexibility of GM's manufacturing systems. During her career at GM she held a variety of leadership positions in Manufacturing, Engineering, "Big Data" Analytics, and Research and Development.

Susan is recognized as one of the strategic technology leaders inside and outside General Motors. She served as Chair of the U.S. Manufacturing Council, which advises the Secretary of Commerce on government policies and programs that affect United States manufacturing. She was the GM Executive Representative and Chair of the Manufacturing Technology Leadership Council at the United States Council for Automotive Research. She has also served as executive technology advisor to a number of prestigious research institutes (University of Michigan, MIT, Georgia Tech, and Shanghai Jiao-Tong University, …).

Dr. Smyth has been recognized for her technical and business achievements with multiple international awards. She was made a Fellow of the Society of Manufacturing Engineers in 2015, and was elected to the National Academy of Engineering in 2018. She also serves as an advisor to NSF (Directorate for Engineering).

She has a Bachelor of Science degree in Physics, a Master of Science degree in Optoelectronics and Information Technology, and a Doctorate in Physics (Queen's University of Belfast, Northern Ireland).

Gloria Wiens, *Associate Professor – University of Florida*

Gloria Wiens, PhD, is a faculty member of Mechanical and Aerospace Engineering at the University of Florida. Professor Wiens conducts research in the areas of intelligent and autonomous robotic systems, innovative mechanisms and controls for automation, space robotics/small satellites, manufacturing and micro-electro-mechanical systems. Her research projects have involved collaborations with National and International Laboratories (AFRL, SNL, NIST, NASA and CNR-ITIA/STIIMA) and industry (Comau, Fanuc Robotics North America, Ford). Currently funded by NSF/NRI 2.0, she is co-leading a multi-university/industry/multi-country collaboration on intelligent human-robot collaboration for smart factory.

In support of the Nation and the U.S. manufacturing community, Professor Wiens served as an ASME Foundation Swanson Fellow (2013-2015) and Assistant Director for Research Partnerships in the Advanced Manufacturing National Program Office providing coordination for the federal and public-private partnership teams supporting the Advanced Manufacturing Partnership (AMP 2.0), a steering committee under the President's Council of Advisors on Science and Technology (PCAST); and as a member of the Interagency Working Team which provides planning and coordination of federal advanced manufacturing activities, and develops policy documents for the National Network for Manufacturing Innovation Program (NNMI, now publically known as Manufacturing USA Program). In 2016-2017, Professor Wiens served as the FloridaMakes Director of Advanced Manufacturing at BRIDG, an industry-driven consortium in partnership with Florida's NIST/Manufacturing Extension Partnership (MEP). In 2016, she was awarded a United States Department of Commerce, Certificate of Appreciation – from Secretary Penny Pritzker.

She is a fellow of ASME, serving on ASME's Manufacturing Public Policy Task Force; Robotics Public Policy Task Force; Design, Materials and Manufacturing Segment Leadership Team; Technical Events and Content Council; and M. Eugene Merchant Medal of ASME/SME Board of Awards Committee.

She has Bachelor and Master of Science degrees in Mechanical Engineering (Kansas State University), and a Doctorate in Mechanical Engineering (University of Michigan).

Danielle Zeng, *Technical Expert in Materials and Manufacturing – Ford Research and Innovation Center*

Dr. Danielle Zeng is a technical expert in materials and manufacturing at Ford Research & Innovation Center. She specializes in advanced manufacturing processes and materials modeling method development for a variety of material systems such as aluminum, advanced high strength steels, polymers, and fiber reinforced polymer composites.

Dr. Zeng joined Ford Motor Company in 2003 and has co-authored over 50 technical papers. In recent years, she has been leading the effort to intensively develop the Integrated Computational Materials Engineering (ICME) tools for carbon fiber reinforced composites and the additive manufacturing process for lightweight and smart designed vehicles.

Her major awards include the Sydney H. Melbourne Award, the Henry Ford II Distinguished Award from the American Society of Automotive Engineering (SAE), the best paper award from the American Iron and Steel Institute (AISI), and she has received the Henry Ford Technology Award three times, the highest technical honor bestowed at Ford Motor Company.

Dr. Zeng is a member of the American Society of Automotive Engineering (SAE). She holds Master's and Bachelor's degrees in Engineering Mechanics from Tsinghua and Hangzhou University, China and Ph.D degree in mechanical engineering from the Ohio State University.

Lihui Wang

Professor & Chair of Sustainable Manufacturing
Department of Production Egineering
at KTH Royal Institute of Technology

Lihui Wang is a Professor and Chair of Sustainable Manufacturing at KTH Royal Institute of Technology, Sweden. His research interests are focused on brain robotics, human-robot collaborations, cyber-physical systems, real-time monitoring and control, adaptive and sustainable manufacturing systems. Professor Wang is actively engaged in various professional activities. He is the Editor-in-Chief of International Journal of Manufacturing Research, Editor-in-Chief of Robotics and Computer-Integrated Manufacturing, and Editor-in-Chief of Journal of Manufacturing Systems. He has published 8 books and authored in excess of 450 scientific publications. Professor Wang is a Fellow of Canadian Academy of Engineering, CIRP, SME and ASME. He is also a Professional Engineer in Canada, the Secretary of North American Manufacturing Research Institution of SME, and the Chairman of Swedish Production Academy.

Brain Robotics: Making a Daydream Come True

Tuesday, June 11th | 11:00-12:30

Abstract

During the pastdecades, electroencephalography (EEG) has been used to analyse and understand the behaviours of human brains.Despite the challenges in capturingEEG signals accurately and consistently,recent developmentsin analysing brain EEG signals show the potential in using the signals for communication with different manufacturing equipment such as robotsfor human-robot collaboration(HRC).Using humanbrainwaves for communication with a robot offers two major advantages: (1) it allows an operator to control a robot while performing a related task to co-work with the robot, which will have a positive impact on the productivity at the robotic cell level;and (2) it provides an auxiliary channel for multimodal collaborations with the robot in addition to voice, gesture and haptic commands. For example, using mental commands to control the robot can overcome the difficultiesthat often accompany the usage of voice commands in a relatively noisy robotic environment.This talkwill first presenta snapshot of AI historyand the latest advancement of brain robotics. In order to understand the new technologyand itsfuture potential in HRC assembly, examples of brainwave-driven robot control will be explained. This talkwill then projectthefuture growth enabled by brain robotics,withthe challenges to beidentified.

0910-1040 100	**NAMRC- Student Research Competition- Session 1** *Session Chair: Livan Fratini | Session Co-Chair: Hitomi Yamaguchi-Greenslet*	
Paper 54	Dilshan Sooriyaarachchi, Jiaxin Wu, Aixin Feng, Maksud Islam and George Tan	Hybrid Fabrication of Biomimetic Meniscus Scaffold by 3D Printing and Parallel Electrospinning
Paper 56	Baltej Singh Rupal, Khaled G. Mostafa, Yeping Wang and Ahmed Jawad Qureshi	A Reverse CAD Approach for Estimating Geometric and Mechanical Behavior of FDM Printed Parts
Paper 79	Erina Baynojir Joyee and Yayue Pan	Multi-material Additive Manufacturing of Functional Soft robot
0910-1040 120	**NAMRC- TRACK 2 Manufacturing Processes- Forming 1** *Session Chair: Paul Lynch*	
Paper 13	Sergio Rinaldi, Giovanna Rotella and Domenico Umbrello	Experimental and numerical analysis of roller burnishing of Waspaloy
Paper 36	Oksana Baer, Andreas Feuerhack, Herman Voigts and Thomas Bergs	Investigation of the mechanical punch loads during fine blanking of high-strength steels with cemented carbide
Paper 51	Tyler Grimm and Ihab Ragai	An Investigation of Liquid Metal Lubrication during Electrically-Assisted Incremental Forming of Titanium
0910-1040 130A	**NAMRC- TRACK 3 Material Removal- Simulation 1** *Session Chair: Jeff Ma*	
Paper 15	Tony Schmitz, Andrew Honeycutt, Michael Gomez, Michael Stokes and Emma Betters	Multi-point coupling for tool point receptance prediction
Paper 26	Megan Shockly, Nick Duong, Jianfeng Ma, Shuting Lei, Muhammad Jahan and Murali Sundaram	Numerical Investigation of the Effects of Operating Parameters in the Vibration Assisted Nano Impact Machining of Single Crystalline Silicon by Loose Abrasive using Molecular Dynamics Simulation
Paper 32	Chong Liu, Nick Duong, Muhammad Jahan, Jianfeng Ma and Roan Kirwin	Experimental investigation and numerical simulation of micro-EDM of bulk metallic glass with focus on surface finish
0910-1040 130B	**NAMRC- TRACK 4 Additive Manufacturing- Optimization 1** *Session Chair: Guha Manogharan*	
Paper 41	Mallikharjun Marrey, Ehsan Malekipour, Hazim El-Mounayri and Eric J Faierson	A Framework for Optimizing Process Parameters in Powder Bed Fusion (PBF) Process Using Artificial Neural Network (ANN)
Paper 92	Marinela Peto, Erick G. Ramirez-Cedillo, Adriana Hernandez and Hector R. Siller	Structural design optimization of knee replacement implants for Additive Manufacturing
Paper 123	Matthew Hildner, Jeff Plott, Albert Shih and Bizhong Zhu	Design of a static mixer for silicone extrusion additive manufacturing

1100-1230 100	**NAMRC- Student Research Competition- Session 2** *Session Chair: Bryan Dods | Session Co-Chair: Livan Fratini*	
Paper 25	Hyun-Jun Hwang, Jeremy Cleeman and Rajiv Malhotra	Flash Light Sintering of Silver Nanowire Films on Polyester Fabric
Paper 47	Ankush Bansal, Baoyang Jiang and Jun Ni	Die-less fabrication of miniaturized parts through single point incremental micro-forming
Paper 113	Shuaihang Pan, Gongcheng Yao, Jingke Liu and Xiaochun Li	Effect of Hot Rolling on Naval Brass/WC Nanocomposite

1100-1230 110	**NAMRC- TRACK 5 Smart Manufacturing & Cyber- Physical *Systems- What's New for Smart Manufacturing*** *Session Chair: Lee Wells*	
Paper 206	Lihui Wang	Brain Robotics: Making a Daydream Come True (A Keynote)
Paper 111	Ahmad Elhabashy, Lee Wells and Jaime Camelio	Cyber-Physical Security Research Efforts in Manufacturing – A Literature Review

1100-1230 120	**NAMRC- TRACK 1 Manufacturing Systems- Session 1** *Session Chair: Brian Paul*	
Paper 37	Sebastian Groth, Peter Frohn and Bernd Engel	Product planning system for manufacture-oriented modeling of freeform bend tubes produced by three-roll-push-bending
Paper 85	Qi Tian and Weihong Guo	Reconfiguration of manufacturing supply chains considering outsourcing decisions and supply chain risks
Paper 97	Qinan Zhou, Nicholas Toombs and Placid Ferreira	Dynamics Modeling and Verification of a Large-Displacement Precision Preloaded-Flexure Stage

1100-1230 130A	**NAMRC- TRACK 2 Manufacturing Processes- Forming 2** *Session Chair: Chetan Nikhare*	
Paper 53	Harald Schmid and Marion Merklein	Failure behavior of different sheet metals after passing a drawbead
Paper 61	Manfred Vogel and Marion Merklein	Flexible rolling of rotational symmetric tailored blanks with a two-sided thickness profile
Paper 112	Randy Cheng, Nicholas Wiley, Matt Short, Xun Liu and Alan Taub	Applying ultrasonic vibration during single-point and two-point incremental sheet forming

1100-1230 130B	**NAMRC- TRACK 4 Additive Manufacturing- Simulation 1** *Session Chair: Ramesh Singh*	
Paper 2	Omar Fergani, Ole Geisen, David Madeley and Martin Jurisch	Impact of the introduction of process simulation capabilities on the component qualification process for gas turbine applications
Paper 18	Stephan Rosenthal, Marlon Hahn and A. Erman Tekkaya	Simulation approach for three-point plastic bending of additively manufactured Hastelloy X sheets
Paper 106	Alaa Olleak and Zhimin Xi	Simulation of Layer-by-Layer Selective Laser Melting Process with an Efficient Remeshing Technique

1100-1230 130C	**NAMRC- TRACK 6 Industrial Applications & Manufacturing Education- Session 1** *Session Chair: Iqbal Shareef*	
Paper 194	John Agapiou and Jie Gu	Incorporating Local Offset in the Global Offset Method and Optimization Process for Error Compensation in Machine Tools
Paper 205	Charles Caristan, Cerkez Kaya, Christopher Bertez and Maria Stepanova	High efficiency laser-cutting of stainless steel
Paper 157	Rapeepan Promyoo, Shashank Alai and Hazim El-Mounayri	Innovative Digital Manufacturing Curriculum for Industry 4.0

1400-1530 120	**NAMRC- TRACK 2 Manufacturing Processes- Joining 1** *Session Chair: Livan Fratini*	
Paper 8	Hongliang Wang, Xingcheng Xiao, Guoxian Xiao, Hua-Tzu Fan and Jorge Arinez	Laser Joining of CFRP and Metal with High-Strength and Corrosion-Resistance Bonds
Paper 24	Hyun-Jun Hwang and Rajiv Malhotra	Pulsed Light Sintering of Silver Nanowire/ Nanosphere films
Paper 108	Gianluca Buffa, Livan Fratini, Filomena Impero, Attilio Masnata, Fabio Scherillo and Antonino Squillace	Comparison of Stationary and Rotating Shoulder Tool in Friction Stir Welding of lap joints: experimental and numerical approach

1400-1530 130A	**NAMRC- TRACK 3 Material Removal- Grinding** *Session Chair: Laine Mears*	
Paper 1	K. Philip Varghese	Grinding innovations for high performance and quality
Paper 42	Raja Kountanya and Changsheng Guo	Accurate Grain Penetration Prediction using Grinding Wheel Surface Topography Data
Paper 180	Nagaraj Shanbhog and Arunachalam N	Grindability studies and force prediction for TiB2 Ultra High Temperature Ceramics

1400-1530 130B	**NAMRC- TRACK 4 Additive Manufacturing- Simulation 2** *Session Chair: A. Erman Tekkaya*	
Paper 48	Sumair Sunny, Glenn Gleason and Arif Malik	Comparison of Numerical Methods for Fluid-Structure Interaction Simulation of Fused Deposition Modeled Nylon Components
Paper 129	Botao Zhang, Archak Goel, Omkar Ghalsasi and Sam Anand	CAD-Based Design and Pre-processing Tools for Additive Manufacturing
Paper 160	Sachin Alya, Chaitanya Vundru, Bhargavi Ankamreddy and Ramesh Singh	Characterization and Modeling of Deposition Geometry in Directed Energy Deposition over Inclined Surfaces

1400-1530 130C	**NAMRC- TRACK 5 Smart Manufacturing & Cyber- Physical Systems- Neural Networks** *Session Chair: Lee Wells*	
Paper 3	Richard Meyes, Johanna Donauer, Andre Schmeing and Tobias Meisen	A Recurrent Neural Network Architecture for Failure Prediction in Deep Drawing Sensory Time Series Data
Paper 77	Harish Cherukuri, Elena Perez Bernabeu, Miguel Selles and Tony Schmitz	A neural network approach for chatter prediction in turning

0910-1040 130C	**Session 1-1-1 Additive Manufacturing of Ceramics, Concretes, & Composites I** *Session Chair: Dazhong Wu | Session Co-Chair: Wenchao Du*	
MSEC2019-2886	Brooke Mansfield, Sabrina Torres, Tianyu Yu and Dazhong Wu	A Review on Additive Manufacturing of Ceramics
MSEC2019-3001	Wenchao Du, Guanxiong Miao, Lianlian Liu, Zhijian Pei and Chao Ma	Binder Jetting Additive Manufacturing of Ceramics: Feedstock Powder Preparation by Spray Freeze Granulation
MSEC2019-3004	Abhinav Bhardwaj, Negar Kalantar, Elmer Molina, Na Zou and Zhijian Pei	Extrusion-Based 3D Printing of Porcelain: Feasible Regions
0910-1040 140A	**Session 1-2-1 Metal Additive Manufacturing Process 1** *Session Chair: Ho Yeung | Session Co-Chair: Xing Zhang*	
MSEC2019-2891	Bo Cheng and Charles Tuffile	Numerical Study of Porosity Formation With Implementation of Laser Multiple Reflection in Selective Laser Melting
MSEC2019-2872	Sagil James and Cristian Navarro	Molecular Dynamics Simulation of Nanoparticle Infiltration During Binder Jet Printing Additive Manufacturing Process: A Preliminary Study
MSEC2019-2987	Subin Shrestha and Y. Kevin Chou	A Numerical Study on the Keyhole Formation During Laser Powder Bed Fusion Process
0910-1040 140B	**Session 2-1-1 Innovations in Equipment Design, Control and Automation I** *Session Chair: Matthew Krugh | Session Co-Chair: Yingbin Hu*	
MSEC2019-3003	Rishi K. Malhan, Ariyan Kabir, Brual Shah, Timotei Centea and Satyandra Gupta	Determining Feasible Robot Placements in Robotic Cells for Composite Prepreg Sheet Layup
MSEC2019-2966	Zixuan Yang, Huaiyuan Teng, Jeremy Goldhawk, Ilya Kovalenko, Efe C. Balta, Felipe Lopez and Dawn Tilbury	A Vision-Based Framework for Enhanced Quality Control in a Smart Manufacturing System
MSEC2019-2928	Haris Khan and Toyosi Ademujimi	Development of Novel Hybrid Manufacturing Technique for Manufacturing Support Structures Free Complex Parts
0910-1040 140C	**Session 3-1-1 Process Control in Multi-Axis Machining** *Session Chair: Ryuta Sato*	
MSEC2019-2737	Hrishikesh Mane and Sanjay Shriram Pande	Adaptive Tool Path Planning Strategy for 5-Axis CNC Machining of Free Form Surfaces
MSEC2019-2959	Norikazu Suzuki, Rikiya Ishiguro, Tomoki Morita and Eiji Shamoto	Variable Helix Cutter Design to Suppress Regenerative Effect
MSEC2019-2954	Takashi Matsumura	Cutting Process Simulation in Micro Dimple Machining

0910-1040 160A	**Session 3-11-1 Micro and Nano Manufacturing I** *Session Chair: Chandra Nath | Session Co-Chair: Martin Jun*	
MSEC2019-3031	Alwin Varghese, Vinay Kulkarni and Suhas S. Joshi	Effect of Tool Condition on Cutting Mechanism in Micromilling
MSEC2019-3055	Jue-Hyun Lee and Angela A. Sodemann	Simulation of Cutting Edge Wear Model Based on Chip Production Rate in Micro-Endmilling
MSEC2019-2900	Xingyu Fu, Kyeongeun Song, Dongmin Kim, Gyuho Kim, Byung-Kwon Min and Martin Jun	Micro-Scale Fiber Cutting Geometry Predictions During Milling of Carbon Fiber Reinforced Polymers (CFRP) Composites

1100-1230 140A	**Session 1-1-2 Additive Manufacturing of Ceramics, Concretes, & Composites II** *Session Chair: Xuan Song | Session Co-Chair: Weilong (Ben) Cong*	
MSEC2019-2983	Wenchao Du, Guanxiong Miao, Lianlian Liu, Zhijian Pei and Chao Ma	Binder Jetting Additive Manufacturing of Ceramics: Comparison of Flowability and Sinterability Between Raw and Granulated Powders
MSEC2019-2988	Abhinav Bhardwaj, Scott Jones, Negar Kalantar, Zhijian Pei, John Vickers, Timothy Wangler, Pablo Zavattieri and Na Zou	Additive Manufacturing Processes for Infrastructure Construction: A Review

1100-1230 140B	**Session 1-2-3 Metal Additive Manufacturing Process 3** *Session Chair: Wenchao Zhou | Session Co-Chair: Pedram Parandoush*	
MSEC2019-2741	Elham Mirkoohi, Daniel E. Sievers and Steven Liang	Effect of Time Spacing and Hatch Spacing on Thermal Material Properties and Melt Pool Geometry in Additive Manufacturing of S316L
MSEC2019-2996	Shrouq Alelaumi, Yue Zhou, Ali Khoshkhoo and Fuda Ning	Selective Laser Melting of Curved Surface Metal Parts: A Fundamental Study on Surface Finish and Dimensional Accuracy
MSEC2019-2930	Shiming Gao, Wei-Hsin Liao and Ping Guo	Development of a Multi-Directional Metal 3D Printing System Based on Direct Metal Deposition

1100-1230 140C	**Session 2-1-2 Innovations in Equipment Design, Control and Automation II** *Session Chair: Farbod Akhavan Niaki*	
MSEC2019-3027	Vivek Annem, Shantanu Thakar, Pradeep Rajendran and Satyandra Gupta	Towards Remote Teleoperation of a Semi-Autonomous Mobile Manipulator System in Machine Tending Tasks
MSEC2019-3024	Prahar Bhatt, Rishi K. Malhan and Satyandra Gupta	Computational Foundations for Using Three Degrees of Freedom Build Platforms to Enable Supportless Extrusion-Based Additive Manufacturing
MSEC2019-2956	Jing Huang, Qing Chang and Jorge Arinez	Modeling and Analysis of Multi-Product Manufacturing Systems With Two Machines and One Buffer

1100-1230 160A	**Session 3-1-2 Process Evaluation and Planning in Multi-Axis and Multi-Tasking Machining** *Session Chair: Takashi Matsumura*	
MSEC2019-2995	Motoaki Murase, Isamu Nishida, Ryuta Sato and Keiichi Shirase	Automated Measuring Planning for On-Machine Measurement and Re-Machining Process
MSEC2019-2804	Zongze Li, Ryuta Sato, Keiichi Shirase and Yukitoshi Ihara	Sensitivity Analysis Between Error Motions and Machined Shape Errors in Five-Axis Machining Centers: In Case of S-Shaped Machining Test by a Square End Mill
MSEC2019-2848	Bo Mao and Yiliang Liao	Understanding the Laser-Matter Interaction and Plasma Dynamics in Nanosecond Pulsed Laser Shock Processing: A First Principle Study

1400-1530 140A	**Session 1-1-3 Additive Manufacturing of Ceramics, Concretes, & Composites III** *Session Chair: Heng Pan | Session Co-Chair: Guanxiong Miao*	
MSEC2019-2972	Pedram Parandoush, Timothy Deines, Dong Lin, Hao Zhang and Chang Ye	Mechanical Finishing of 3D Printed Continuous Carbon Fiber Reinforced Polymer Composites via CNC Machining
MSEC2019-2925	Guanxiong Miao, Wenchao Du, Zhijian Pei and Chao Ma	Binder Jetting Additive Manufacturing of Ceramics: Analytical and Numerical Models for Powder Spreading Process
MSEC2019-3017	Xiaowei Yu and Heng Pan	Aerosol Jet Printing of Electrodes for Lithium-Ion Batteries

1400-1530 140B	**Session 1-2-2 Metal Additive Manufacturing Process 2** *Session Chair: Ping Guo | Session Co-Chair: Xiayun Zhao*	
MSEC2019-2991	Zongyue Fan, Hao Wang and Bo Li	Powder-Scale Meshfree Simulations of Powder Bed Fusion Based Additive Manufacturing Processes
MSEC2019-2892	Jin Wang, Jing Shi, Yi Wang and Yun Bai	Thermal Analysis and Verification for Direct Metal Deposition of 0Cr18Ni9 Stainless Steel
MSEC2019-2887	Sagil James and Karan Parikh	Study on Selective Electroless Plating of 3D Printed Counter Electrodes for Dye-Sensitized Solar Cells
1400-1530 140C	**Session 2-2-1 Advances in Competitive Manufacturing Engineering** *Session Chair: Mohamed Gadalla | Session Co-Chair: Sampson Gholston*	
MSEC2019-2951	Prince Pal Singh, I. K. Gujral Punjab, Jatinder Madan, Harwinder Singh, Guru Nanak Dev	Performance Metrics for Product Flow Configuration in a Reconfigurable Manufacturing System (RMS)
MSEC2019-2706	Jan Rey, Timm Grünebaum and Daniel Trauth	Highly Iterative Planning of Manufacturing Technologies: Evaluation of Manufacturing Technology Capabilities Considering Information Uncertainties
MSEC2019-2724	Wu DongBo and Wang Hui	Numerical Modeling and Analysis of Positioning Error for Near-Net-Shaped Jet Engine Blades
1400-1530 160A	**Session 3-2-1 Advances in Assisted and Augmented Manufacturing I** *Session Chair: Brandt Ruszkiewicz | Session Co-Chair: Tyler Grimm*	
MSEC2019-2738	Mariam Ali and Hassan El-Hofy	Experimental Investigation of Vibration Assisted Helical Milling of 7075 Aluminum Alloy
MSEC2019-3030	Christy Nguyen, Marshall Laminen and Durul Ulutan	A Review of Assisted / Augmented Manufacturing Processes
MSEC2019-3014	Dongzhe Zhang, Hui Wang, Yingbin Hu, Xiaoxu Chen, Weilong (Ben) Cong and Anthony R. Burks	Rotary Ultrasonic Machining of CFRP Composites: Effects of Carbon Fiber Reinforcement Structure
1400-1530 160B	**Session 3-11-2 Micro and Nano Manufacturing II** *Session Chair: Ping Guo | Session Co-Chair: Rui Liu*	
MSEC2019-2862	Ashwani Pratap and Karali Patra	Analysis of Polycrystalline Diamond Micro-Grinding Tool Topography Using Image Processing
MSEC2019-2723	Talwinder Singh Bedi, Vishwas Grover and Ajay Kumar	A New Permanent Magnet Type Magnetorheological Finishing Tool for External Cylindrical Surfaces Having Different Outer Diameter
MSEC2019-2769	Xiaohong Lu, Furui Wang, Kun Yang, Yixuan Feng and Steven Liang	An Indirect Method for the Measurement of Micro-Milling Forces

0910-1040 | 110 — ASME Student Mfg Design Competition- Session 1

Session Chair: Moneer Helu

9:10-9:20	**Introduction & Welcome**	
9:20-9:40	Elizabeth Labra, Nicholas Azzarito, Nicholas Kilbreath, Vincent Le, John Leitch, and Nicole Maly *(Faculty Advisor: James Wilt)* *University of Texas at Dallas*	Wire Line Start-up Sampler
9:40-10:00	Tyler Moore, Rohan Hattangady, Elise Michell, Madeleine Dwyer, Ben Spooner, Evan McCutcheon, Vijay Gattupalli, JT Kelly, Ben Wooten, Mario Medina, Patrick Castel, and Alex Markle *(Faculty Advisor: Sam Chiappone)* *Rensselaer Polytechnic Institute*	MILL: Digital Manufacturing and Other Industry 4.0 Methods for the Mass Production of Toy Fireboats
10:00-10:20	Bugra Ayan and Adomas Povilianskas *(Faculty Advisor: Ibrahim Ozbolat)* *Penn State University*	Aspiration-Assisted Bioprinter for Tissue Biofabrication
10:20-10:40	Fenfen Wang *(Faculty Advisor: Chris Yuan)* *Case Western University*	Design of a High Capacity Lithium Ion Battery Pack for Electric Vehicle

1100-1230 | 160B — Keynote Papers for ASME Journal of Manufacturing Science and Engineering (JMSE) 100th year anniversary of the Manufacturing Engineering Division (MED) - Session 1

Session Chair: Albert Shih | Session Co-Chair: Laine Mears

11:05-11:25	I.S. Jawahir, Julius Schoop, Tao Lu, Yusuf Kaynak, A.K. Balaji, R. Ghosh	Progress Towards Modeling and Optimization of Sustainable Machining Processes [dedicated to PLB Oxley] *Presenter: IS Jawahir*
11:25-11:45	Ping Guo, Kornel Ehmann, ZJ Pei, Gracious Ngaile, Yong Chen, Wayne Cai	Vibration-assisted Manufacturing Processes: A Review of State of the Field *Presenter: Ping Guo*
11:45-12:05	Joseph Beaman, David Bourell	Additive Manufacturing: Early Past to Current Research *Presenter: David Bourell*
12:05-12:25	Cindy Chang, Cheryl Xu, Jorge Arinez, Dean Bartles	Artificial intelligence Approaches in Manufacturing *Presenter: Cindy Chang*

1400-1530 **110**	**ASME Student Mfg Design Competition- Session 2** *Session Chair: Moneer Helu*	
14:00-14:20	Spencer Sullivan, Elise Baribault, Katelyn Dudley, Lucas Gagnon, Eric Schliemann, Nicholas Wheeler *(Faculty Advisor: Brad Kinsey)* *University of New Hampshire*	Automated Machine Tool Utilizing Mobile Robotics
14:20-14:40	E. Taewan Lee *(Faculty Advisors: Zhaoyan Fan and Burak Sencer)* *Oregon State University*	Real-Time Grinding Wheel Condition Monitoring Using Linear CCD Sensor
14:40-15:00	Keaton Adcock, Jonathan Madera, Stephen Brocious, Monica Dallacasa, Reid Goins, Christian Vieira *(Faculty Advisor: Wooram Park)* *University of Texas at Dallas*	Precision Automated Fluid Dispensing Machine
15:00-15:20	Dustin Harper, Ella Mudry, Connor Wilson, Sriram Manoharan *(Faculty Advisor: Karl Haapala)* *Oregon State University*	Build-Make-Learn: Build Machines to Make Products to Learn Manufacturing
15:20-15:30	***Closing***	

Acutec Precision Aerospace Tour & Dinner

Tuesday, June 11th | 17:30-21:30

Acutec Precision Aerospace

Founded in 1988, Acutec Precision Aerospace is an award-winning family-owned aerospace manufacturer providing critical components for the aviation industry. They have evolved from a small 17-person machining company into a full-service manufacturing and engineering company with almost 500 employees and the largest industrial employer in Crawford County.

Acutec markets include: rotor and vibration damping
engine and power generation
hydraulics, avionics, and actuation systems
landing gear and braking systems

What Attendees Will See: *After outgrowing its still operating 80,000 square foot facility in Saegertown, Acutec moved into a section of this 1930s industrial textile facility and renovated it in 2007. Having undergone continued expansion since then (Acutec added and renovated 40,000 square feet in 2013, 80,000 square feet in 2014, 10,000 square feet in 2015 and 100,000 square feet in 2018) Acutec has grown its footprint in the old facility to cover a climate-controlled 310,000 square feet. It houses all of Acutec's simple turning, EDM, grind, cellular manufacturing, metal joining, assembly and test and post processing including NDT testing, chemical processing and paint. With an in-house software development company, Lojic, Acutec leverages live data to continuously improve processes across a library of 8,500 different parts and assemblies.*

WEDNESDAY **JUNE 12, 2019**

TIME	LOCATION	EVENT
7:00-16:00	E. Pre-Function	Registration
7:00-8:00	N. Point Lobby/ E. Pr-function	Breakfast
8:00-9:00	Grand Ballroom	Keynote-Alan Taub
9:00-11:00	Off Site	Optional Industry Tours
9:10-10:40	120-160B	Technical Session 4
9:10-10:40	100	NAMRC Student Research Competition III
9:10-10:40	170	Blue Sky Competition I
10:00-17:00	E. Pre-Function	Exhibitor Booths Open
10:40-11:00	N. Point Lobby/ E. Pr-function	Morning Break
11:00-12:30	120-160B	Technical Session 5
11:00-12:30	170	Blue Sky Competition II
11:00-12:30	110	ASME MED 100th Year Anniversary 2
11:00-12:30	100	NAMRC Student Research Competition IV
12:30-13:50	Grand Ballroom	ASME/MED Award Luncheon
14:00-15:30	110-160B	Technical Session 6
14:00-15:30	170	Federal Agencies Perspective on Advanced Manufacturing
14:00-16:00	Off Site	Optional Industry Tour
15:00-17:00	S. Great Hall	Poster Session
15:30-15:50	N. Point Lobby/ E. Pr-function	Afternoon Break
15:50-17:20	110-160B	Technical Session 7
15:50-17:20	170	NSF Advanced Manufacturing Program Update
17:30-19:00	N. Point Lobby	SME Journal Reception
18:00-21:00	Grand Ballroom	Early Career Forum

Alan I. Taub, Ph. D.

Professor of Materials Science & Engineering and Mechanical Engineering,
University of Michigan
Senior Technical Advisor, Lightweight Innovations for Tomorrow (LIFT)

Alan I. Taub was born September 10, 1954, in Brooklyn, New York. He received a B.Sc. degree in materials engineering from Brown University in 1975, and an M.S. and Ph.D. degrees in applied physics from Harvard University, in 1975 and 1979 respectively. Dr. Taub joined the faculty of Materials Science and Engineering at the University of Michigan in the Fall of 2012. In this role, he is conducting research in advanced materials and processing while also serving in a leadership role as Senior Technical Advisor of the Manufacturing USA Institute, Lightweight Innovations for Tomorrow (LIFT). LIFT is a public-private partnership to develop and deploy advanced lightweight metals manufacturing technologies, and implement education and training programs to prepare the workforce. Dr. Taub retired from General Motors in April 2012. Prior to his retirement, he was vice president for global research and development, leading GM's advanced technical work activity, seven science laboratories around the world, and seven global science offices. He was promoted to vice president in 2009, after joining GM R&D as executive director in 2001. Before joining GM, he worked at Ford Motor Company from 1993 to 2001 as a manager of the Lincoln vehicle engineering, vehicle crash safety, and materials science department. He also spent 15 years in research and development at General Electric (1979-1993). Dr. Taub has earned 26 patents and authored more than 70 papers and book chapters. Dr. Taub was elected to the NAE in 2006 for his contributions to the development of innovative electrical materials and automotive technologies, and leadership in the globalization of automotive research. He has served as an NAE Councillor since July 2016 and serves on the NAE Audit Committee and Executive Compensation Committee. He served on the NAE Committee on Membership (member, peer committee chair), Materials Engineering Peer Committee (member, vice chair, chair), the Section 9 Executive Committee (peer committee vice chair, chair and immediate past chair); and and the National Academies' Committee on Review of the Research Program of the U.S. DRIVE Partnership, Phase 5. Dr. Taub serves on the boards of the startups CellEra and Brightway Vision and is on advisory committees for Samsung and Bocar. He is a technical advisor for the strategic venture capital fund, Auto Tech Ventures. He also serves on advisory boards for the Massachusetts Institute of Technology, the University of California, Berkeley and SIMTech - Singapore's national laboratory. Dr. Taub is on the ASM Silver Medal committee and previously served as chair for the Visiting Committee on Advanced Technology (VCAT) for the National Institute of Standards and Technology (NIST). He was also a member of The Minerals, Metals & Materials Society (TMS) Energy Materials Blue Ribbon Panel. Dr. Taub was named a TMS fellow in 2019 and received the 2011 Acta Materialia Materials & Society Award. He delivered the 2017 Golick lecture at Missouri University of Science & Technology. He also received the Materials Research Society's Special Recognition Award in 2004 and Woody White Service Award in 2002. He received the Brown University Engineering Alumni Medal in 2002.

Opportunities to Reduce the Weight of Structural Components for Transportation

Wednesday, June 12th | 8:00-9:00

Abstract

The potential for reducing weight in automobiles, ships and aircraft using high-strength steel, aluminum, titanium and magnesium alloys and polymer composites is well established. The challenge is to achieve the weight reduction at the right value to the user. Optimization of the material properties and processes together with robust design tools and joining technologies to enable multi-material structures is required.This has become possible through co-development of the material, the component design and the manufacturing processusing state-of-the-art Integrated Computational Materials Engineering(ICME) models. Examples will be discussed crossing melt, thermomechanical and powder processing.The role of Lightweight Innovations for Tomorrow (LIFT)will also be highlighted. LIFT is one of the Manufacturing USA Institutes and was established to accelerate the adoption of advanced metal structures. It serves as the bridge between basic research and final product commercialization. Our large and small industry partners in collaboration with an extensive network of universities and the national and federal laboratories are developing the next generation of advanced manufacturing processes for lightweight structural components.

Advanced Manufacturing Blue Sky Competition

Wednesday, June 12

Session 1: 9:00-10:30 | **Session 2:** 11:00-12:30

Organizers: Zhijian (ZJ) Pei, Scott Smith, and Brian Paul

This is the third David Dornfeld Manufacturing Vision Award and Blue Sky Competition, with funding from NSF. It aims to identify areas for emphasis in manufacturing research and education, and to catalyze support for a vision of the future of US manufacturing. The selection committee is responsible for choosing 7 finalists (from 26 abstracts) to make presentations at these sessions, and selecting the recipient of the David Dornfeld Manufacturing Vision Award from these presentations.

The following 7 finalists will make presentations (leading author is identified):

An Open Data Network for Manufacturing (Jaydeep Karandikar)
Changing the Face(s) of Manufacturing (Shawn P. Moylan)
Computer Games as a Future of Manufacturing Education (Sudhanshu Nahata)
Computer Integrated Manufacturing 4.0 (Chinedum Okwudire)
Geo Technologies Applied to Manufacturing (John K. Schueller)
Industry H.0 (Harsha Malshe)
Point-of-Care Engineered Tissue Smart "Factories" (Rohan A. Shirwaiker)

The selection committee members are:

AFOSR: Sofi Bin-Salamon(Program Manager, Biophysics)
DARPA: John A. Main (Program Manager, Defense Sciences Office)
DoD: A. Adele Ratcliff (Director, Industrial Base Analysis & SustainmentProgram)
DoE: Rob Ivester (Director, Federal Energy Management Program)
NASA: John Vickers (Principal Technologist)
NIST/AMNPO: Frank Gayle (Deputy Director, Office of Advanced Manufacturing)
AAAS/Science: Phil Szuromi(Deputy Editor for Physical Sciences, Science Magazine)
Boeing: Steve Walls(Technical Fellow, Production Engineering/Building Integration)
DEKA Research and Development: Kristy Pottol (Strategic Development)
GE: Dale Lombardo (Technical Operations Leader, Structural Materials Processes & Analytics, GE Global ResearchCenter)
NCDMM: Ralph Resnick (President and Executive Director) Saint Gobain: Anand Tanikella (Vice President, R&D Abrasives worldwide)

Sofi Bin-Salamon, *Program Manager,Biophysics program*
Air Force Office of Scientific Research (AFOSR)

Sofi Bin-Salamon received his PhD in Chemistry at North Carolina State University in 2005. He then served as a National Research Council Research Associate in the Chemistry Division at US Naval Research Laboratory where he developed nanoelectronic materials. Afterwards, he expanded his work on materials chemistry to include photodynamic therapy. This was initially performed in the Department of Chemistry at Texas A&M University and later continued at the Radiation Oncology Branch within the National Cancer Institute/National Institutes of Health. Sofi has served as an American Associate for the Advancement of Science Fellow and Program Manager at the AFOSR International Office. He currently is the Program Manager of the AFOSR Biophysics program.

Frank W. Gayle, *Deputy Director, Advanced Manufacturing National Program Office (AMNPO)*
Deputy Director, NIST Office of Advanced Manufacturing
National Institute of Standards and Technology (NIST)

Frank W. Gayle is Deputy Director of the interagency Advanced Manufacturing National Program Office, which is headquartered at the National Institute of Standards and Technology (NIST). This office coordinates federal activities in advanced manufacturing, and is the Congressionally-designated National Program Office for Manufacturing USA®. His past roles at NIST include serving as Division Chief of the NIST Metallurgy Division, where he focused on measurement needs for industry. Frank also led the team of technical experts on the forensics of structural steel in the Congressionally mandated NIST investigation of the World Trade Center disaster on September 11, 2001. Prior to joining NIST, Frank spent 11 years in the aerospace industry. He is a Fellow of SME and ASM International, and a Member of the World Economic Forum - Global Future Council on the Future of Manufacturing. Frank earned an Sc.D. in Materials Science from the Massachusetts Institute of Technology, and degrees in Civil and Mechanical Engineering from Duke University.

Rob Ivester, *Director, Federal Energy Management Program*
Office of Energy Efficiency and Renewable Energy
Department of Energy (DoE)

Robert W. Ivester currently serves as the Director of the Federal Energy Management Program (FEMP) in the Office of Energy Efficiency and Renewable Energy. FEMP oversees the implementation of policy and actions that result in energy efficiency implementation, renewable energy adoption, and reduction in energy and water use in federal government operations. Prior to this position, he served in AMO for six years. During that time, AMO launched five Manufacturing USA Institutes, the Critical Materials Hub, and hundreds of small R&D and technical assistance projects across the Nation. He also worked at the National Institute of Standards and Technology for over 16 years, leading and performing research in advanced manufacturing. He has been an instructor for the Johns Hopkins University Engineering for Professionals program for graduate-level studies in manufacturing engineering since 2001. He is a SME Fellow and a Fellow of the American Society of Mechanical Engineers. He received his doctorate in engineering and a Bachelor of Science in Mechanical Engineering and Master of Science in Manufacturing Engineering from the University of Massachusetts at Amherst.

Dale Lombardo, *Manufacturing Technology*
General Electric Research

Dale Lombardo leads a diverse team of manufacturing technologists working across GE's broad product portfolio. His team links materials to design to customers through a variety of processes including machining, joining, and inspection. Dale's team expands the envelope of conventional manufacturing and incorporates novel and non-conventional methods (e.g. electro-thermal, electro-chemical, and lasers) into GE's toolkit of how its parts are or will be made. Dale graduated from Rensselaer Polytechnic Institute with both BS & MSME with a specialization in Mechatronics & Controls. He joined GE Global Research developing control strategies for machining as a special process for GE Aviation. After that, Dale worked for GE Aviation and expanded to more general in-process machining monitoring and led GE's Shot Peening Special Process team globally for GE jet engines and co-chaired the startup of the PRI/Nadcap criteria for peening special process supplier supervision still in use today. Dale was then part of a Manufacturing Technology startup organization within the GE Power business and expanded his surface treatment technologies expertise to include surface finishing and surface measurement. Dale is a member of the ASME B46 committee on Surface Texture. He holds multiple patents in a broad array of manufacturing related disciplines. Dale lives in upstate New York where he is also a volunteer and mentor in the local school district and supports STEM activities through Invention Convention. Dale represents GE for RPI's MILL: Manufacturing Innovation Learning Laboratory and supports their Senior Capstone Design class.

John A. Main, *Program Manager*
Defense Sciences Office
Defense Advanced Research Projects Agency (DARPA)

John Main is currently a Program Manager in the Defense Sciences Office at DARPA where he is responsible for initiating new research programs in the physical sciences and fostering the communities that support those programs. Previously, John worked at technology startup Intific Inc., initially as an Executive Producer developing software products and ultimately as the company's first Chief Operating Officer. His academic credentials include stints as an Associate Professor of Mechanical Engineering at the University of Kentucky and an Assistant Professor at the University of Maine. He also founded Precision Systems and Instrumentation LLC in 2001, which is a company that designs, manufactures, sells, and supports instrument systems used in spinal cord and head trauma injury research. John received his Doctor of Philosophy and Master of Science in mechanical engineering from Vanderbilt University and his Bachelor of Science in physics and mathematics from Western Kentucky University. In 2008, John was awarded the Office of Secretary of Defense Medal for Exceptional Public Service.

Kristy Pottol, *Strategic Development*
DEKA Research and Development

Kristy Pottol works at DEKA Research and Development to speed health security projects for Health and Human Services priorities. Kristy comes to DEKA after a long career serving the Department of Defense. Recent highlights include Regenerative Medicine Project Manager and development of an advanced tissue biofabrication Manufacturing USA program. Kristy is a certified Defense Acquisition Professional Program Management Level 3 and Project Management Professional. She has worked in project management, biotechnology product development, FDA quality systems, business operations, and strategic communications for over 15 years and has an extensive and varied background in product development projects for militarily-relevant medical solutions from vaccines to devices. Kristy is a former US Navy Hospital Corpsman. She holds a MBA from Regis University, a MS in Accounting with emphasis on Information Systems from the UNC Wilmington, and a BS Physics with an emphasis in biophysics from East Carolina University.

A. Adele Ratcliff, *Director, Industrial Base Analysis & Sustainment (IBAS) Program*
Office of the Deputy Assistant Secretary of Defense (ODASD) for Industrial Policy (IndPol)
Department of Defense

Adele Ratcliff is currently the Director of the Industrial Base Analysis & Sustainment (IBAS) Program within the Office of the Deputy Assistant Secretary of Defense (ODASD) for Industrial Policy (IndPol). During her tenure in Office of the Secretary of Defense, she has focused on building strong interagency partnerships to address broad transition of manufacturing issues such as manufacturing readiness and the Advanced Manufacturing Enterprise. Her current position uses the broad authorities of the IBAS program element to enable a modern Industrial Base that integrates traditional and emerging sectors to be able to respond at will to National Security Requirements. Most recently, as the Director of the DoD Manufacturing Technology (ManTech) Program, Adele led the effort in establishing the DoD's national Manufacturing Innovation Institutes (MIIs), now known as Manufacturing USA Institutes, outlined in the President's 2013 State of the Union address. She has a long acquisition career, including Program Manager for the congressionally mandated Defense Acquisition Challenge Program, Deputy Program Manager for the Foreign Comparative Test Program, and more than eleven years in Air Force Test and Evaluation at Eglin Air Force Base in Florida. As Test Manager, she guided the Air Force's Wind Corrected Munitions Dispenser test program (better known as WCMD), from prototype through the production and deployment phase of the Platform, earning her the Air Force Materiel Command Test Engineer of the Year Award. More importantly, her efforts transitioned this Platform to support the Warfighter in the initial phases of Operation Enduring Freedom. She is a proud alumnus of the Mississippi State University Bulldogs, earning a BS in Mechanical Engineering in 1988. In 2011 she graduated from the U.S. Army War College (in-residence) earning a MS in Strategic Art and graduated from the DoD's Defense Senior Leadership Development Program (DSLDP). She received the Secretary of Defense (SECDEF) Award for Excellence for her support of the Pilot Institute for Additive Manufacturing in March 2013.

Ralph Resnick, FSME,
Vice President, Strategy, NCDMM and Founding Director, America Makes

Mr. Resnick joined NCDMM in September 2008 as Vice President, Chief Technology Officer with more than 35 years of manufacturing experience. He assumed President and Chief Executive Officer in May 2011 and led the NCDMM to winning the competitive National Additive Manufacturing Innovation Institute contract. Upon award, he also assumed the role of Acting Director of the Institute, now known as America Makes, until February 2013 upon appointing a new director. In May 2019, Mr. Resnick stepped down as NCDMM President & CEO and assumed a newly created position of Vice President of Strategy.
Prior to joining NCDMM, Mr. Resnick served as Chief Technology Officer for both The ExOne Company and Extrude Hone Corporation where he was a major contributor in establishing both organizations as leaders in advanced manufacturing, including such areas as additive manufacturing, process research, and technology transition to the world's factory floors. He holds several patents in manufacturing processes and metrology.

Mr. Resnick serves on the Board of Directors of SME and is a former member (Chairman) of SME's International Awards and Recognition Committee and the former President of the North American Manufacturing Research Institute (NAMRI/SME). He also serves on the MTConnect Institute Board of Trustees; Advisory Board for CANRIMT and HI-AM Network of the Natural Sciences and Engineering Research Council of Canada, DoD's JDMTP Metals Subpanel; and is a member of the prestigious International Institution for Production Engineering Research (CIRP). He is a former Board member of the Association for Manufacturing Technology (AMT); the National Center for Manufacturing Sciences (NCMS); the Louisiana Center for Manufacturing Sciences (LCMS); former Chairman of the National Defense Industrial Association (NDIA) Manufacturing Division; NIST Smart Machining Consortium; and the Navy Metalworking Center's (NMC) Industry Advisory Board.

Locally, Mr. Resnick is active in the Board of Directors for the Central Allegheny Challenger Learning Center (CACLC) in Indiana County; the Westmoreland-Fayette Workforce Investment Board; and the Westmoreland Heritage Trail.

He is a former Chairman of the National Center for Manufacturing Sciences (NCMS) and was a longtime member of the Board of Directors until January 2013. He also is a former Board member of the Navy's Electro Optic Center (EOC) and a past Chairman of the AMT's Technology Issues Committee.

Mr. Resnick is a Fellow of SME and in 2010, he received the NAMRI/SME "Outstanding Lifetime Service Award."

Phil Szuromi, *Deputy Editor for Physical Sciences, Science Magazine*
AAAS/Science

Phillip Szuromi received his bachelor's degree in chemistry from Harvey Mudd College in 1980 and his PhD in chemistry from Cal Tech in 1985. His research at Cal Tech with Henry Weinberg focused on catalytic reactions of hydrocarbon molecules. He then had a postdoctoral position with Ted Madey at NIST in Gaithersburg, MD, exploring Fischer-Tropsch reactions. He came to Science in 1986, where he is now a Deputy Editor. He currently handles papers in chemistry, physics, and materials science, but over the years he has also covered atmospheric science, biochemistry, and structural biology. He also works in the Insights section of the magazine, where he solicits and edits Perspectives. In 2004, he was made a AAAS Fellow in Chemistry.

Anand Tanikella, *Vice President R&D*
Saint Gobain Abrasives Worldwide

Anand Tanikella is currently the worldwide Vice President of R&D for Saint Gobain Abrasives based in Massachusetts, USA. Prior to this, Anand was the founding Director of Saint Gobain Research India, a newly setup 7th transversal R&D center in Chennai, India. Anand joined Saint-Gobain in 1996 in USA as a Senior Research Engineer in Saint Gobain North American R&D Center in Northborough, MA in Boston area. He held various positions with increasing responsibilities during the past 21 years conducting breakthrough R&D in technologies related to ceramics, abrasives, plastics and various construction materials. He is passionate about Technology management and bringing out profitable Innovations, as well as about influencing the Impact of Engineering Education on Industrial Innovation.
Anand received a Ph.D. in Materials Science & Engineering and Precision Engineering from North Carolina State University in 1996 and a B.S. in Mechanical Engineering from Andhra University, India. He has authored numerous international journal publications and holds over 15 patent families with several in process. Throughout his career, he has been active in technology education and was a part time faculty member at Northeastern University in Boston, Massachusetts.

John Vickers, *Principal Technologist*
Space Technology Mission Directorate
National Aeronautics and Space Administration (NASA)

John Vickers serves as the principal technologist in the area of advanced materials and manufacturing within the Space Technology Mission Directorate at NASA Headquarters. He also serves as the associate director of the Materials and Processes Laboratory at the NASA Marshall Space Flight Center and as the manager of NASA's National Center for Advanced Manufacturing with operations in Huntsville, Alabama and New Orleans, Louisiana. He has over 30 years of experience in materials and manufacturing – research and development, engineering, and production operations for propulsion, spacecraft, and scientific space systems. As principal technologist, he leads the nationwide NASA team to develop advanced manufacturing technology strategies to achieve the goals of NASA's missions. He is the Agency representative to the National Science and Technology Council, Subcommittee on Advanced Manufacturing and the Subcommittee on Critical and Strategic Mineral Supply Chains. He is a founding member of the Manufacturing USA - National Network for Manufacturing Innovation program and the Interagency Advanced Manufacturing National Program Office. His many awards include NASA's Exceptional Achievement Medal, NASA's Outstanding Leadership Medal and the AIAA Holger Toftoy award. He is a fellow of SME. He holds a Bachelor of Science in Engineering from the University of Alabama in Huntsville.

Stephen A. Walls, *Senior Production Engineer and Technical Fellow*
The Boeing Company

Steve Walls provides production engineering build architecture expertise that advances production technologies and supports the long-term vision of the company and the Boeing engineering and scientific communities. In this role he advances design processes to enable advanced product and production system definition and development. For 30 years Steve has provided definition and advances in the specialty field of large scale structural integration of commercial transports (747, 767, 777, and 787) – specifically dimensional engineering and management. Steve's current technical focus is in the application of systems engineering science to the new design of full scope production system architecture for commercial air transport development programs. Specifically this includes adaption of Petri Net modeling for developing and analyzing a worldwide distributed production system, establishment of a multi-doma in production system analytical framework in support of design maturity and trade study efforts, and establishing a baseline system concepts definition for Boeing Production Systems, culminating in a rich validated set of Production System requirements and measures.

LORD
Ask Us How™

LORD Corporation is a diversified technology and manufacturing company developing highly reliable adhesives, coatings, motion management devices, and sensing technologies that significantly reduce risk and improve product performance. For more than 90 years, LORD has worked in collaboration with our customers to provide innovative oil and gas, aerospace, defense, automotive and industrial solutions. With world headquarters in Cary, N.C., LORD has approximately 3,100 employees in 26 countries and operates 19 manufacturing facilities and 10 R&D centers worldwide. LORD actively promotes STEM education and many other community engagement initiatives.

Our Mission is to transform innovative ideas into long-term value for our customers, employees and shareholders. This mission is furthered by our Core Beliefs, values which have been integral to our culture since the company's founding. Firm commitments to employee dignity, safety and well-being; continuous innovation; and integrity and ethical behavior guide our business wherever we operate throughout the world.

With a passion for innovation and collaborative problem solving, we actively work in partnership with our customers to minimize risk and deliver value with highly reliable solutions. To support our strategic priorities and grow sustainably, we focus on investing in people and technology.

Throughout our history, LORD has been first to market with disruptive technologies that render our customers' products safer, more efficient, and higher-performing.

1100-1230 110	**Keynote Papers for ASME Journal of Manufacturing Science and Engineering (JMSE) 100th year anniversary of the Manufacturing Engineering Division (MED) - Session 2** *Session Chair: Albert Shih | Session Co-Chair: Laine Mears*	
11:00-11:18	Yung Shin, Larry Yao, Benxin Wu, Gary Cheng, Frank Phefferkorn, Shuting Lei	Recent Advances in Laser based Manufacturing and Materials Processing *Presenter: Yung Shin*
11:18-11:36	Robert Landers, Kira Barton, Santosh Devasia, Tom Kurfess, Prabhakar Pagilla	A Review of Manufacturing Process Control [Dedicated to Ulsoy and Koren] *Presenter: Robert Landers*
11:36-11:54	Yusuf Altintas, Gabor Stepan, Erhan Budak, Tony Schmitz	Chatter Stability of Machining Operations [dedicated to Tobias and Tlusty] *Presenter: Tony Schmitz*
11:54-12:12	Warren DeVries	A History of Manufacturing *Presenter: Warren DeVries*
12:12-12:30	Jay Lee, Jun Ni, Jaskaran Singh, Xiaodong Jia, Baoyang Jiang	Intelligent Maintenance Systems and Predictive Manufacturing [Dedicated to Prof. S. M. Wu and Dr. Dick Kegg] *Presenter: Jay Lee*

Federal Agencies' Perspectives on Advanced Manufacturing

Wednesday, June 12, 2019 from 14:00-15:30

Organizers: Federal Agencies' Perspectives on Advanced Manufacturing

In this special session, representatives from several federal agencies will share their perspectives on matters related to Advanced Manufacturing. They will also answer questions from the audience.

The panelists at this special session are:

- DoD: A. Adele Ratcliff (Director, Industrial Base Analysis & Sustainment)
- DoE: Rob Ivester (Director, Federal Energy Management Program)
- NASA: John Vickers (Principal Technologist, Space Technology Mission Directorate)
- NIST/AMNPO: Frank Gayle (Deputy Director, Office of Advanced Manufacturing)
- NSF: Brigid Mullany (Program Director, Advanced Manufacturing Cluster)

Frank W. Gayle, *Deputy Director, Advanced Manufacturing National Program Office (AMNPO)*
Deputy Director, NIST Office of Advanced Manufacturing
National Institute of Standards and Technology (NIST)

Frank W. Gayle is Deputy Director of the interagency Advanced Manufacturing National Program Office, which is headquartered at the National Institute of Standards and Technology (NIST). This office coordinates federal activities in advanced manufacturing, and is the Congressionally-designated National Program Office for Manufacturing USA®. His past roles at NIST include serving as Division Chief of the NIST Metallurgy Division, where he focused on measurement needs for industry. Frank also led the team of technical experts on the forensics of structural steel in the Congressionally mandated NIST investigation of the World Trade Center disaster on September 11, 2001. Prior to joining NIST, Frank spent 11 years in the aerospace industry. He is a Fellow of SME and ASM International, and a Member of the World Economic Forum - Global Future Council on the Future of Manufacturing. Frank earned an Sc.D. in Materials Science from the Massachusetts Institute of Technology, and degrees in Civil and Mechanical Engineering from Duke University.

Rob Ivester, *Director, Federal Energy Management Program*
Office of Energy Efficiency and Renewable Energy
Department of Energy (DoE)

Robert W. Ivester currently serves as the Director of the Federal Energy Management Program (FEMP) in the Office of Energy Efficiency and Renewable Energy. FEMP oversees the implementation of policy and actions that result in energy efficiency implementation, renewable energy adoption, and reduction in energy and water use in federal government operations. Prior to this position, he served in AMO for six years. During that time, AMO launched five Manufacturing USA Institutes, the Critical Materials Hub, and hundreds of small R&D and technical assistance projects across the Nation. He also worked at the National Institute of Standards and Technology for over 16 years, leading and performing research in advanced manufacturing. He has been an instructor for the Johns Hopkins University Engineering for Professionals program for graduate-level studies in manufacturing engineering since 2001. He is a SME Fellow and a Fellow of the American Society of Mechanical Engineers. He received his doctorate in engineering and a Bachelor of Science in Mechanical Engineering and Master of Science in Manufacturing Engineering from the University of Massachusetts at Amherst.

A. Adele Ratcliff, *Director, Industrial Base Analysis & Sustainment (IBAS) Program*
Office of the Deputy Assistant Secretary of Defense (ODASD) for Industrial Policy (IndPol)
Department of Defense

Adele Ratcliff is currently the Director of the Industrial Base Analysis & Sustainment (IBAS) Program within the Office of the Deputy Assistant Secretary of Defense (ODASD) for Industrial Policy (IndPol). During her tenure in Office of the Secretary of Defense, she has focused on building strong interagency partnerships to address broad transition of manufacturing issues such as manufacturing readiness and the Advanced Manufacturing Enterprise. Her current position uses the broad authorities of the IBAS program element to enable a modern Industrial Base that integrates traditional and emerging sectors to be able to respond at will to National Security Requirements. Most recently, as the Director of the DoD Manufacturing Technology (ManTech) Program, Adele led the effort in establishing the DoD's national Manufacturing Innovation Institutes (MIIs), now known as Manufacturing USA Institutes, outlined in the President's 2013 State of the Union address. She has a long acquisition career, including Program Manager for the congressionally mandated Defense Acquisition Challenge Program, Deputy Program Manager for the Foreign Comparative Test Program, and more than eleven years in Air Force Test and Evaluation at Eglin Air Force Base in Florida. As Test Manager, she guided the Air Force's Wind Corrected Munitions Dispenser test program (better known as WCMD), from prototype through the production and deployment phase of the Platform, earning her the Air Force Materiel Command Test Engineer of the Year Award. More importantly, her efforts transitioned this Platform to support the Warfighter in the initial phases of Operation Enduring Freedom. She is a proud alumnus of the Mississippi State University Bulldogs, earning a BS in Mechanical Engineering in 1988. In 2011 she graduated from the U.S. Army War College (in-residence) earning a MS in Strategic Art and graduated from the DoD's Defense Senior Leadership Development Program (DSLDP). She received the Secretary of Defense (SECDEF) Award for Excellence for her support of the Pilot Institute for Additive Manufacturing in March 2013.

Brigid Mullany, *ENG/CMMI: AM & LEAP HI Program Director – National Science Foundation / Professor – University of North Carolina at Charlotte*

Dr. Brigid Mullany is a Professor in the Department of Mechanical Engineering and Engineering Science at the University of North Carolina at Charlotte. Her undergraduate and graduate degrees are from University College Dublin Ireland. After completing her PhD in 2002 she accepted a two-year Marie Cure post doc position with Carl Zeiss in Germany, after which she took a position at UNC Charlotte in 2004. Her research focuses on surface finishing methods and surface evaluation.

Dr. Mullany is also currently a Program Director at the National Science Foundation in the Advanced Manufacturing Program within the Division of Civil, Mechanical and Manufacturing Innovation.

During the course of her UTRC career, she has overseen development of novel manufacturing

John Vickers, *Principal Technologist*
Space Technology Mission Directorate
National Aeronautics and Space Administration (NASA)

John Vickers serves as the principal technologist in the area of advanced materials and manufacturing within the Space Technology Mission Directorate at NASA Headquarters. He also serves as the associate director of the Materials and Processes Laboratory at the NASA Marshall Space Flight Center and as the manager of NASA's National Center for Advanced Manufacturing with operations in Huntsville, Alabama and New Orleans, Louisiana. He has over 30 years of experience in materials and manufacturing – research and development, engineering, and production operations for propulsion, spacecraft, and scientific space systems. As principal technologist, he leads the nationwide NASA team to develop advanced manufacturing technology strategies to achieve the goals of NASA's missions. He is the Agency representative to the National Science and Technology Council, Subcommittee on Advanced Manufacturing and the Subcommittee on Critical and Strategic Mineral Supply Chains. He is a founding member of the Manufacturing USA - National Network for Manufacturing Innovation program and the Interagency Advanced Manufacturing National Program Office. His many awards include NASA's Exceptional Achievement Medal, NASA's Outstanding Leadership Medal and the AIAA Holger Toftoy award. He is a fellow of SME. He holds a Bachelor of Science in Engineering from the University of Alabama in Huntsville.

What's New at NSF – Update from NSF Program Directors

Wednesday, June 12, 2019 from 16:00-17:30

Organizers: Scott Smith, Brian Paul, and Zhijian (ZJ) Pei

In this special session, four NSF program directors from the NSF Advanced Manufacturing Cluster will update the audience what is new at NSF, especially regarding advanced manufacturing. They will also answer questions from the audience.

The panelists at this special session are:

- **Khershed Cooper**, Program Director – Responsible for Advanced Manufacturing (AM), Engineering Research Centers (ERCs), and Network for Computational Nanotechnology (NCN).
- **Robert Landers**, Program Director – Responsible for Dynamics, Controls, and System Diagnostics (DCSD) and Cyber-Physical Systems (CPS)
- **Brigid Mullany**, Program Director – Responsible for Advanced Manufacturing (AM) and Leading Engineering for America's Prosperity, Health, and Infrastructure (LEAP HI).
- **Steven R. Schmid**, Program Director

Khershed P Cooper, *Program Director*
National Science Foundation (NSF)

Khershed P. Cooper is NSF representative for the National Science & Technology Council (NSTC)'s Nano Science Engineering & Technology (NSET) Sub-committee, and he is a member of the National Nanotechnology Initiative (NNI)'s Signature Initiative on Sustainable Nanomanufacturing. He contributes to the development of the Manufacturing USA Institutes. Prior to joining NSF, Khershed was a Program Officer at the Office of Naval Research (ONR) and a Senior Research Metallurgist at the Naval Research Laboratory (NRL), where he studied materials processing, additive and nano manufacturing. He also has industrial research experience. He has nearly 150 publications, over 150 invited talks, and 70 contributed presentations. He has sponsored symposia and workshops in additive and nano-manufacturing. He is a Fellow of ASM International and a recipient of its prestigious Burgess Memorial Award. He received his PhD from University of Wisconsin - Madison. Currently he is a Program Director in the Advanced Manufacturing Program at the National Science Foundation.

Robert Landers, *Program Director*
National Science Foundation (NSF)

Robert Landers received his Bachelor of Science degree from the University of Oklahoma in 1990, his Masters of Engineering degree from Carnegie Mellon University in 1992, and his Doctorate of Philosophy degree from the University of Michigan in 1997, all in Mechanical Engineering. Upon graduation he worked as a Research Scientist in the NSF Engineering Research Center for Reconfigurable Machining at the University of Michigan. In 2000 he joined the Department of Mechanical Engineering at the Missouri University of Science and Technology (formerly the University of Missouri Rolla) where he a Curators' Distinguished Professor of Mechanical Engineering working in the areas control of advanced manufacturing processes and electrochemistry. He received the SME Eugene Merchant Outstanding Young Manufacturing Engineer Award in 2004, the Blackall Machine Tool and Gage award in 2014, and was elected ASME Fellow in 2014. Currently he is a Program Director in the Dynamics, Controls, and Cognition Cluster at the National Science Foundation and the Vice Chair of the ASME Dynamic Systems and Control Division.

Brigid Mullany, *Program Director*
National Science Foundation (NSF)

Brigid Mullany received her Bachelor of Engineering Degree and Doctorate in Mechanical Engineering from University College Dublin in Ireland. Upon graduation she received a two-year EU Marie Curie postdoctoral research position at Carl Zeiss in Germany. In 2004 she joined the Department of Mechanical Engineering and Engineering Science at the University of North Carolina at Charlotte where she a Professor working in the area of surface finishing and advanced manufacturing. She received the SME Kuo K Wang Outstanding Young Manufacturing Engineer Award in 2007, and the NSF CAREER award in 2008. Currently she is a Program Director in the Advanced Manufacturing Program at the National Science Foundation. She is active in CIRP, and is the Vice Chair of the Scientific Technical Committee on Surfaces (STC-S).

Steven R. Schmid, *Program Director*
National Science Foundation (NSF)

Steven R. Schmid received his Bachelor of Science Degree in Mechanical Engineering at the Illinois Institute of Technology; Master of Science and Ph.D. degrees at Northwestern University; and is a Professor at the University of Notre Dame. He conducts research and teaches courses in the general fields of manufacturing, metal forming, tribology, and design. Of his textbooks, Manufacturing Engineering and Technology (with S. Kalpakjian) is the world's most popular manufacturing textbook. Manufacturing Processes for Engineering Materials, Fundamentals of Machine Elements and Fundamentals of Fluid Film Lubrication are some of his other books. In 2012-2013, Dr. Schmid was the first Faculty Fellow at the Advanced Manufacturing National Program Office. He has won numerous best paper and teaching awards, and served as President of the North American Manufacturing Research Institute from 2015-2016. He is a Fellow of ASME and SME. He is currently a Program Director in the Advanced Manufacturing Program at the National Science Foundation

Eriez Industrial Tour

Wednesday, June 12th | 9:00-11:00

Eriez

Eriez, a privately held company, is a world leader in the design and manufacturer of separation, material handling and inspection equipment used throughout process industries like food, plastics and chemicals, mining, aggregates, metalworking and recycling. The applications and production methods requiring our equipment are universal around the world. Separation equipment typically uses magnetics to remove unwanted tramp metals or metal contaminants in both dry and liquid process flows. Other applications involve metalworking fluid filtration as well as flotation and magnetic technologies to concentrate minerals. The Material Handling group comprises of feeding, conveying and screening equipment to move dry materials with applications and capacities ranging from metering ounces of flour to moving tons of coal. Our Inspection Systems are designed to safeguard consumer products like foods and pharmaceuticals from metal contaminants and protect valuable downstream processing equipment like crushers from large dangerous tramp metals.

McInnes Industrial Tour

Wednesday, June 12th | 9:00-11:00

McInnes Rolled Rings

Since 1992, we have focused exclusively on producing high quality, seamless rolled rings from 4" (100mm) to 144" (3660mm) outer diameter, weighing up to 8,000 pounds in carbon, alloy, and stainless steel. Our Erie, Pennsylvania facility is the industry standard for productivity, cost control, and speed. Our customers trust that an order at McInnes Rolled Rings will be delivered in the shortest lead times available in the industry, and with the highest quality and reliability. In our 144,470 square-foot facility we operate two Wagner radial axial ring rolling mills (RAW 63/63 and RAW 160/160), a smaller Wagner KFR 630 ring mill, 1,200-ton and 3,500-ton hydraulic preform presses, and full heat treatment capabilities. Our RAW ring mills feature advanced CNC controls which are at the forefront of globally available technology. This enables our seamless ring rolling process to produce rings with accurate and repeatable dimensions to tight tolerances,which allows minimal material allowance and results in very little waste. Seamless rolled rings offer superior integrity for demanding engineering applications, and often provide a cost-effective alternative to fabricating rings from steel plate. We also offer forged discs-using our RAW 160/160 ring mill for consistent size and finish, we produce discs with 5,000 pounds maximum weight, and up to 60" (1524mm) outside diameter and 10" (254mm) height. Final applications of our carbon, alloy, and stainless steel rings and discs include power generation and transmission, valve and flange, general machine shop and fabrication, industrial machinery, bearings, aerospace, and oil field equipment. Our ISO9001and AS9100 compliant quality management system, range of industry approvals and bureau certifications, and process of continual improvement enable us to dependably meet the needs of our customers.To learn more about McInnes Rolled Rings and its offerings, please visitwww.mcinnesrolledrings.com.

Modern Industrial Tour

Wednesday, June 12th | 14:00-16:00

Modern Industries

Modern Industries is a second generation family owned business established in 1946 by a returning WWII veteran who was driven to build a company that would have a positive impact on all those involved with his endeavor. The underlying characteristics of Modern's founder, Herb Sweny, were the foundation of his new venture and help define who we are today. Modern has grown into a four division, vertically integrated provider of manufacturing and industrial support services. Whether looking for turnkey finished products and assemblies or individual services. Modern offers nearly 70 years of engineering experience and technical know-how to a wide variety of commercial, mobile, industrial, aerospace markets. What we do:

***We** make the parts that industry needs to build their products, with Precision Machining Services.*

***We** make metals tougher & stronger through Thermal Processing.*

***We** help you assure product quality with Materials Testing Services.*

***We** make machine operators more efficient with Quick Change Modular Workholding and Toolholding Devices.*

***We** make industrial equipment operate effectively and last longer with customized Motion Control Devices.*

Modern Industries Today:

- Over 200 Employees in Western Pennsylvania
- Sales in more than a dozen countries around the world
- Operations in Erie, Pittsburgh, Meadville and Kersey PA
- Average length of employment is greater than 8 years
- Quality Certifications to AS-9100D, IATF-16949, ISO-17025, ISO-9001, Nadcap

Berry Global Industrial Tour

Wednesday, June 12th | 14:00-16:00

Berry Global

Berry Global is a global leader in healthcare packaging. They develop a variety of products for the medical and healthcare industries that ensure safe and sanitary practices for the home and healthcare facilities.

At Berry Global, we believe we can have the greatest impact on increasing both recycling access and recycling rates through partnerships with trade organizations and initiatives that bring together multiple stakeholders throughout the supply chain.

We produce products that impact lives every day. Optimizing designs, selecting more environmentally responsible materials, and choosing efficient production methods while still meeting functional requirements are part of our product development process.

National Fuel Gas Company

National Fuel Gas Company is a diversified, integrated energy company with a complementary mix of natural gas assets. From the bottom of the wellbore to the customer's burner tip, National Fuel has structured its collective group of businesses in a manner that leverages our vast upstream resources, valuable midstream footprint, and reliable downstream operations.

National Fuel Quick Facts:

- Incorporated in 1902
- Headquarters in Williamsville, N.Y.
- $6.0 billion in assets
- 2,105 full-time employees
- 1,020 union employees
- 2,222 retired employees

* As of Sept. 30, 2018

Visit NationalFuel.com to learn more.

Research Professions in Academia, Industry & National Laboratories: An Early Career Forum

Wednesday, June 12, 2019 from 18:00-21:00

Sponsored by: NSF, Penelec & NAMRI/SME

Organized by: ASME/MED & NAMRI/SME

Hosted by: Penn State Erie, The Behrend College

Purpose: The goal of this forum is to provide current students at all levels of graduate and undergraduate programs as well as recent graduates with better information/knowledge of various research and technical positions in industry, academia, and national laboratories. The forum will further discuss how to be successful professionally in the various settings.

Agenda (Wednesday, June 12th,2019)

18:00 –18:15: Opening Remarks and Welcome, Pizza and beverages served

18:15 –19:00: 5-minute spoken introduction by each panelist

19:00–20:30: Breakout panel discussions

Panel 1: Academia

Panel 2: Government

Panel 3: Industry

20:30 -21:00: Wrap-up discussion, open questions and answers

Forum Format:

1. Each panelist will introduce themselves in approximately 5 minutes each. They have experience in conducting and leading research and engineering projects in academia, government labs, and industrial sectors.
2. Parallel round table discussions will follow: one for academia, one for government and the other for industry. Panelists will discuss topics such as how to search for a job, career management, funding for research, etc.
3. Food and beverages will be served during the forum.
4. Participants are encouraged to engage in conversations/discussions related to their particular/personal interests.

Fee: Free for registered conference participants

Attendance:

Open to all registered conference participants

Mandatory for NSF Travel Grant student applicants

Early Career Forum Chair: Dr. Arif S. MalikAssociate Professor, Department of Mechanical Engineering, 972-883-4550

Tahany El-Wardany, *Fellow, Advanced Manufacturing – United Technologies Research Center*

Tahany El-Wardany, Ph.D., is Fellow, Advanced Manufacturing, at United Technologies Research Center (UTRC). As such, El-Wardany identifies and creates new technology areas in materials and manufacturing with widespread impact across United Technologies Corporation (UTC); develops capabilities in the fields of advanced manufacturing and elevator tribology; engages external networks to identify and support business development opportunities; and guides technical project work in advanced manufacturing. Previously, she served as Principal Engineer and a member of UTRC's Surface Mechanics Group, Physical Sciences Department.

During the course of her UTRC career, she has overseen development of novel manufacturing processes (hybrid/additive manufacturing/deep rolling manufacturing, high-speed machining); contributed to ARPA-E winning project proposals; matured methods to mechanically enhance aerospace alloy surface properties; and built 5-axis flank milling model and code for process optimization of numerous machining applications within UTC business units, which was ultimately licensed externally.

Her many awards and honors include winner of the 2015 Otis Safety Award; and a 2011 Connecticut Women of Innovation Nominee. Key appointments include Associate Professor, University of Alexandria, Egypt; Research Manager, Machining System Laboratory and Adjunct Professor, McMaster University, Canada; and Visiting Professor, Mechanical Engineering Department, Imperial College, United Kingdom. El-Wardany has published more than 100 peer-reviewed journal and conference papers and holds 21 patents and 40 patent applications in additive manufacturing, hybrid and conventional manufacturing, and the science of friction, lubrication and wear. She has been an invited speaker at many advanced manufacturing conferences, including the 2015 and 2018 National Academy of Science workshop on additive manufacturing modeling and online monitoring.

El-Wardany is a member of the Connecticut Academy of Science and Engineering (CASE), Society of Manufacturing Engineers (SEM), American Society of Mechanical Engineers (ASME), The Society of Women Engineers (SWE) . She is editor of the Journal of Applied Mathematics, reviews multiple national and international journals in advanced manufacturing, and is a member of the editorial board of the International Scholarly Research Network Tribology. She holds undergraduate and graduate degrees in production engineering from the University of Alexandria, Egypt, and a Ph.D. in mechanical engineering from the University of Birmingham, UK.

Maureen Fang, *Technical Product Manager – Lockheed Martin*

Dr. Marureen Fang is technical project leader on submarine sensor and sonar team managing capital projects including design, procurement and implementation of new factory cells. She manages a new product project ($70MM). She is responsible for day-to-day manufacturing operations including design work instructions, tools, fixtures, and test equipment. Fang incorporates lean six sigma initiatives on time and cost savings; and trains multiple disciplinary team members on the operation of use new equipment.

Fang is an experienced product manager with a demonstrated history of working in the Aviation & Aerospace, and defense industry. Skilled in product introduction, process development, project management, producibility, design for manufacturing and assembly (DFMA), failure analysis, FMEA, proposal creation, cost reduction, root cause and correct actions, lean manufacturing, six sigma, Geometric Dimensioning & Tolerancing, Project Estimation, Siemens NX, Volunteer Management and Lead Time Reduction. Her research interests are in design for manufacturing (DFM/DFx), digital manufacturing, digital thread, model based definition, and advanced manufacturing.

Prior to joining Lockheed Martin, Maureen was a mechanical design and manufacturing engineer at Pratt and Whitney. She then left Pratt and Whitney to pursue a PhD at Purdue University. In 2015, while pursuing her PhD, Maureen was awarded the 1st ASME Advanced Manufacturing Fellow at America Makes, the National Additive Manufacturing Innovation Institute. She worked for the deputy director of Education and Workforce. In this role, she managed the advisory board and roadmap development aimed in creating long-term strategic plans for advancing the next generation manufacturing workforce.

Maureen holds a BS in Mechanical Engineering from Clarkson University, MS in Mechanical Engineering from Rensselaer Polytechnic Institute, and PhD in Mechanical Engineering Technology from Purdue University.

Dr. Robert Hart, *The University of Texas at Dallas*

Robert Hart is a Clinical Associate Professor in the Mechanical Engineering Department at the University of Texas at Dallas. He received his doctorate in Mechanical Engineering from the University of Texas at Austin. He also holds a Bachelor's and Master's degree in mechanical engineering from the University of Houston. Robert is a licensed professional engineer in Texas. Prior to his time at UT Dallas, he worked for eight years as a research engineer in the Multiphase Flow Section at Southwest Research Institute in San Antonio, Texas. He also spent two years as a project engineer at Caterpillar Compression Systems in Houston, Texas. Upon joining UT Dallas in 2012, he developed the capstone design course sequence in the newly-formed mechanical engineering department and has been responsible for teaching it since. Students who participated in this capstone design sequence have won first place in the MSEC/NAMRC Student Design Competition in four consecutive years (2015-18). In 2017, Hart was a recipient of a University of Texas System Regents' Outstanding Teaching Award. His professional interests are in the areas of engineering education, fluid mechanics, and thermal science. Robert is an active member of ASME and ASEE and has held leadership positions in both organizations. He has also been a member of the Capstone Design Conference organizing committee since 2016.

Peter Jay, *Wenderoth, Lind, and Ponack, LLP*

Peter Jay is a patent attorney at Wenderoth, Lind, and Ponack, LLP, an intellectual property law firm located in Washington, DC. He joined Wenderoth in 2012, after practicing in Wilmington, DE and Washington, DC at another law firm. The primary focus of Peter's practice is the prosecution and drafting of patents, where Peter developed a particular expertise in technologies involving adhesives, resins, and polymer chemistry, and their manufacturing techniques. Nonetheless, Peter also regularly drafts and prosecutes patent applications related to medical devices, films, coatings, batteries, solar technology, catalysts, alloys, chemical processes, cosmetics, optics, semiconductors, food chemistry, pharmaceutical formulations, mechanical devices, and small molecules. Having diverse experiences in patent prosecution and litigation, Peter is also adept at providing due diligence studies and drafting opinions. Peter received his B.S. (2004) and M.E. (2005) from SUNY Buffalo in Chemical Engineering and a J.D. (2008) from the University at Buffalo Law School.

Barbara Linke, *Associate Professor – University of California Davis*

Dr.-Ing. Barbara S. Linke is a faculty member of Mechanical and Aerospace Engineering at the University of California, Davis. She completed her Diploma (2002), doctorate (2007), and Habilitation (2015) at the RWTH Aachen University, Germany and worked as post-doc with Professor Fritz Klocke, Werkzeugmaschinenlabor (WZL), RWTH Aachen University and Professor David Dornfeld, University of California Berkeley. Her research interests include sustainable manufacturing, abrasive machining technologies, part quality, smart and data-driven manufacturing, among others. She has published over 70 peer-reviewed papers, authored two books, edited a book and a proceedings, and is an active member of ASME MED and SME.

Barbara S. Linke received several awards, including the F.W. Taylor Medal of the CIRP in 2009, the Outstanding Young Manufacturing Engineer award of the SME in 2013, and the UC Davis College of Engineering Outstanding Junior Faculty Award in 2018.

Crystal Morrison, *Founder & CEO – EverRise*

Dr. Crystal G. Morrison is a highly regarded scientist and leader who is passionate about developing people and organizations to their highest potential. She believes strongly that innovation is an act of leadership not just creativity. With extensive experience across industry, academia and national labs, Dr. Morrison knows what it takes to build and lead successful teams that create lasting value and bring products from concept to reality.

Dr. Morrison holds a Ph.D. in Macromolecular Science and Engineering and a B.S. in Chemistry. Following graduate school at the University of Michigan, Dr. Morrison was a Harold Agnew National Security Postdoctoral Fellow at Los Alamos National Laboratory (LANL) and later became a staff member, team leader and program leader before moving to Pittsburgh, PA. Since LANL, she has held successive leadership roles, including global R&D leader in a Fortune 500 company for 2 business units covering 77 unique market segments with over $2.5B in annual sales. In 2018, Dr. Morrison converted her passion for people, technology and leadership into EverRise. EverRise is focused on uncovering and unleashing hidden potential in technical professionals and organizations to deliver growth and longterm sustainability.

Dr. Brian A. Weiss , *National Institute of Standards and Technology (NIST)*

Dr. Brian A. Weiss is a mechanical engineer and the project leader of the Prognostics and Health Management for Reliable Operations in Smart Manufacturing (PHM4SM) project within the Engineering Laboratory (EL) at the National Institute of Standards and Technology (NIST). His current research efforts are focused on developing the necessary measurement science to verify and validate emerging monitoring, diagnostic, and prognostic technologies and strategies for smart manufacturing to enable manufacturers to respond to planned and un-planned performance changes. The project is focused on the application domains of machine tools and robot systems. From 2013-2016, Dr. Weiss also served as the Associated Program Manager for the Smart Manufacturing Operations Planning and Control (SMOPAC) program. Prior to his manufacturing research, he spent 15 years conducting performance assessments across numerous military and first response technologies including autonomous unmanned ground vehicles; tactical applications operating on Android™ devices; advanced soldier sensor technologies; free-form, two-way, speech-to-speech translation devices for tactical use; urban search and rescue robots; and bomb disposal robots. He also spent six years developing robotic crane technologies which included the deployment of a prototype system on a military installation. His efforts have earned him numerous awards including the PHM Society's Contributor of the Year – Individual (2018), a GCN for IT Excellence Award (2014), Department of Commerce Gold Medal (2013), Colleague's Choice Award (2013), Silver Medal (2011), Bronze Medals (2004 & 2008), and the Jacob Rabinow Applied Research Award (2006). He has a B.S. in Mechanical Engineering (2000), Professional Masters' in Engineering (2003), and Ph.D. in Mechanical Engineering (2012) from the University of Maryland, College Park, Maryland, USA.

Gloria Wiens, *Associate Professor – University of Florida*

Gloria Wiens, PhD, is a faculty member of Mechanical and Aerospace Engineering at the University of Florida. Professor Wiens conducts research in the areas of intelligent and autonomous robotic systems, innovative mechanisms and controls for automation, space robotics/small satellites, manufacturing and micro-electro-mechanical systems. Her research projects have involved collaborations with National and International Laboratories (AFRL, SNL, NIST, NASA and CNR-ITIA/STIIMA) and industry (Comau, Fanuc Robotics North America, Ford). Currently funded by NSF/NRI 2.0, she is co-leading a multi-university/industry/multi-country collaboration on intelligent human-robot collaboration for smart factory.

In support of the Nation and the U.S. manufacturing community, Professor Wiens served as an ASME Foundation Swanson Fellow (2013-2015) and Assistant Director for Research Partnerships in the Advanced Manufacturing National Program Office providing coordination for the federal and public-private partnership teams supporting the Advanced Manufacturing Partnership (AMP 2.0), a steering committee under the President's Council of Advisors on Science and Technology (PCAST); and as a member of the Interagency Working Team which provides planning and coordination of federal advanced manufacturing activities, and develops policy documents for the National Network for Manufacturing Innovation Program (NNMI, now publically known as Manufacturing USA Program). In 2016-2017, Professor Wiens served as the Florida Makes Director of Advanced Manufacturing at BRIDG, an industry-driven consortium in partnership with Florida's NIST/Manufacturing Extension Partnership (MEP). In 2016, she was awarded a United States Department of Commerce, Certificate of Appreciation – from Secretary Penny Pritzker.

She is a fellow of ASME, serving on ASME's Manufacturing Public Policy Task Force; Robotics Public Policy Task Force; Design, Materials and Manufacturing Segment Leadership Team; Technical Events and Content Council; and M. Eugene Merchant Medal of ASME/SME Board of Awards Committee.

She has Bachelor and Master of Science degrees in Mechanical Engineering (Kansas State University), and a Doctorate in Mechanical Engineering (University of Michigan).

ESSENTRA COMPONENTS

Essentra PLC is a diversified manufacturing company with an impressive history of success that spans over 50 years. Products include a vast array of products, packaging and components that are used in many different industries including healthcare, food and beverage, electronics, and energy. Publicly traded on the London Stock Exchange with over £1 billion in revenue, the organization has grown significantly over the past few years by complimenting steady organic growth with strategic acquisitions that have expanded the product portfolio and strengthened their global presence. With operations in 33 countries around the world, the company is organized into three Strategic Business Units (SBUs): Component Solutions, Health and Personal Care Packaging, and Filtration Products. The Americas Region, which includes approximately 22 manufacturing and distribution locations and 2,200 employees across the US, Canada, and Latin America, accounts for over one third of global sales. The dynamic culture is entrepreneurial, fast paced and results driven. The Company's Key Principles are centered around building a winning engaging team with the freedom to operate in an open, honest and safe environment.

0910-1040 100	**NAMRC- Student Research Competition- Session 3** *Session Chair: Albert Shih | Session Co-Chair: Bryan Dods*	
Paper 191	Qinghua Wang, Avik Samanta, Fatima Toor, Scott Shaw and Hongtao Ding	Colorizing Ti-6Al-4V Surface via High-Throughput Laser Surface Nanostructuring
Paper 49	Timothy No, Michael Gomez, Ryan Copenhaver, Juan Uribe Perez, Christopher Tyler and Tony Schmitz	Scanning and Modeling for Non-Standard Edge Geometry Endmills
Paper 153	Ping-Ju Chen, Boqiang Qian, Shama F. Barna, Glennys Mensing and Placid Ferreira	An Experimental Investigation into Plate-to-Roll Patterning with Solid-State Superionic Stamping

0910-1040 120	**NAMRC- TRACK 2 Manufacturing Processes- Testing & Characterization1** *Session Chair: Brad Kinsey*	
Paper 76	Lise Sandnes, Luca Romere, Filippo Berto, Torgeir Welo and Øystein Grong	Assessment of the Mechanical Integrity of a 2 mm AA6060-T6 Butt Weld Produced Using the Hybrid Metal Extrusion & Bonding (HYB) Process – Part I: Bend Test Results
Paper 35	Enrico Simonetto, Stefania Bruschi and Andrea Ghiotti	Electroplastic effect on AA1050 plastic flow behavior in H24 tempered and fully annealed conditions
Paper 58	Shunyi Zhang and Brad Kinsey	Importance of electrical and physical contact during electromagnetic forming simulations

0910-1040 130A	**NAMRC- TRACK 3 Material Removal- Machining 1** *Session Chair: Jeff Ma*	
Paper 43	Slawomir Swirad and Roman Wdowik	Determining the effect of ball burnishing parameters on surface roughness using the Taguchi method
Paper 45	Craig Hanson, Pratik Hiwase, Xingbang Chen, Muhammad Jahan, Jianfeng Ma and Greg Arbuckle	Experimental investigation and numerical simulation of burr formation in micro-milling of polycarbonates
Paper 135	Jibin G John and Arunachalam N	Surface roughness charaterization by transformed images using machine vision method in grinding

0910-1040 130B	**NAMRC- TRACK 4 Additive Manufacturing- Optimization 2** *Session Chair: Guha Manogharan*	
Paper 126	Suchana Jahan, Tong Wu, Yung Shin, Andres Tovar and Hazim El-Mounayri	Thermo-fluid Topology Optimization and Experimental Study of Conformal Cooling Channels for 3D Printed Plastic Injection Molds
Paper 128	Catherine Tiner, Salil Bapat, Subrata Deb Nath, Sundar V. Atre and Ajay P. Malshe	Exploring Convergence of Snake-Skin-Inspired Texture Designs and Additive Manufacturing for Mechanical Traction
Paper 156	Jiayi Wang, Santosh Reddy Sama, Paul Lynch and Guha Manogharan	Design and Topology Optimization of 3D-Printed Wax Patterns for Rapid Investment Casting

0910-1040 130C	**NAMRC- TRACK 6 Industrial Applications & Manufacturing Education- Session 2** *Session Chair: John Agapiou*	
Paper 136	Alyssa Rumsey, John Morehouse and Charlotte Densmore	Evaluating Manufacturing Workforce Development Initiatives in Georgia
Paper 127	Noah Glick and Iqbal Shareef	Optimization of electrostatic powder coat cure oven process: A capstone senior design research project

1100-1230 100	**NAMRC- Student Research Competition- Session 4** *Session Chair: Hitomi Yamaguchi-Greenslet | Session Co-Chair: Albert Shih*	
Paper 62	Maxwell Praniewicz, Thomas Kurfess and Christopher Saldana	Error qualification for multi-axis BC-type machine tools
Paper 201	Ezgi Pinar Yalcintas, Kadri Bugra Ozutemiz, Toygun Cetinkaya, Livio Dalloro, Carmel Majidi and O. Burak Ozdoganlar	Automated Microcontact Printing of Liquid-phase Metals for Manufacturing of Soft and Stretchable Microelectronics
Paper 155	Sidharth Baskaran, Farbod Akhavan Niaki, Mark Tomaszewski, Jasprit Gill, Yi Chen, Yunyi Jia, Laine Mears and Venkat Krovi	Digital Human and Robot Simulation in Automotive Assembly using Siemens Tecnomatix Process Simulate: A Feasibility Study

1100-1230 120	NAMRC- TRACK 1 Manufacturing Systems- Session 2 *Session Chair: Weihong Guo*	
Paper 103	Jaesung Lee, Chao Wang, Shiyu Zhou and Junhong Chen	Spatial distribution quantification and control of ink flakes in reduced graphene oxide FET inkjet printing
Paper 139	Fei Shen and Joshua Tarbutton	A Voxel Based Automatic Tool Path Planning Approach Using Scanned Data as the Stock
Paper 149	Brian Paul, Steven Kawula and Chuankai Song	A Manufacturing Process Design for Producing a Membrane-based Energy Recovery Ventilator with High Aspect Ratio Support Ribs

1100-1230 130A	NAMRC- TRACK 2 Manufacturing Processes- Testing & Characterization 2 *Session Chair: Chetan Nikhare*	
Paper 71	Chandra Nath, Lili Zheng and Wei Yuan	Investigating the Effect of In-Built Anisotropy of Cylindrical Bar on Machinability while Drilling of Stainless Steel
Paper 12	Sean Flanagan, Jeremy Main, Paul Lynch, Conner Vanderwiel and John Roth	A Mechanical Evaluation of an Overaged Aluminum Metal-Matrix-Composite (2009 Al/ SiC/15p MMC)
Paper 174	Zeyi Guan, Shuaihang Pan, Chase Linsley and Xiaochun Li	Manufacturing and Characterization of Zn-WC as Potential Biodegradable Material

1100-1230 130B	NAMRC- TRACK 6 Material Removal- Simulation 2 *Session Chair: Sagil James*	
Paper 67	Sagil James and Mayur Narkhede	Analytical Modeling and Experimental Study on Machining of CFRP/Ti Stacks with Submerged Abrasive Waterjet Machining
Paper 193	Jaydeep Karandikar	Machine learning classification for tool life modeling using production shop-floor tool wear data
Paper 199	Huan Zhang, Changsheng Guo and Yan Chen	Inverse Material Characterization through Finite Element Simulation of Material Tests and Numerical Optimization

1100-1230 130C	**NAMRC- TRACK 4 Additive Manufacturing- Processes 1** *Session Chair: Hantang Qin*	
Paper 29	Michael Borish, Brian Post, Alex Roschli, Phillip Chesser, Lonnie Love, Katherine Gaul, Matt Sallas and Nikolaos Tsiamis	In-Situ Thermal Imaging for Single Layer Build Time Alteration in Large-Scale Polymer Additive Manufacturing
Paper 33	Jørgen Blindheim, Torgeir Welo and Martin Steinert	Rapid prototyping and physical modelling in the development of a new additive manufacturing process for aluminium alloys
Paper 74	Matteo Strano, Kedarnath Rane, Guillaume Herve and Anna Tosi	Determination of process induced dimensional variations of ceramic parts, 3d printed by extrusion of a powder-binder feedstock

1400-1530 110	**NAMRC- TRACK 2 Material Processes- Joining 2** *Session Chair: Livan Fratini*	
Paper 182	Dario Baffari, Anthony P. Reynolds, Attilio Masnata, Livan Fratini and Giuseppe Ingarao	Friction Stir Extrusion To Recycle Aluminum Alloys Scraps: Energy Efficiency Characterization
Paper 185	Nikhil Gotawala and Amber Shrivastava	Numerical Analysis of Material Movement during Dissimilar Friction Stir Welding of Al 1050 and Copper
Paper 196	Ji Hoon Kim, Lyang Suan Wang, Kaushalya Putta, Payam Haghighi, Jami Shah and Pete Edwards	Knowledge Based Design Advisory System for Multi-Material Joining

1400-1530 120	**NAMRC- TRACK 3 Material Removal- Machining 2** *Session Chair: Mike Vogler*	
Paper 81	Liang Huang, Yan Cao, Feng Jia and Ruiyuan Mu	Research on Cathode Surface Design Method of High Precision Electrolytic Machining for Spur Face Gear based on the Principle of Complex Surface Mesh
Paper 91	Mukesh Tak, Shreeya Singh and Rakesh Mote	Effect of microstructure on electrochemical dissolution characteristics of titanium alloys in electrochemical micromachining
Paper 99	Sepideh Abolghasem Ghazvini and Luis Felipe Hernández Rivera	Optimizing the metastability of high-strength ultrafine grained microstructure from large strain machining

1400-1530 130A	**NAMRC- TRACK 4 Additive Manufacturing- Processes 2** *Session Chair: Matteo Strano*	
Paper 98	Yi Cai and S.H. Choi	Deposition Group-based Toolpath Planning for Additive Manufacturing with Multiple Robotic Actuators
Paper 105	Sriram Manoharan, Kijoon Lee, Lucas Freiberg, Matthew Coblyn, Goran Jovanovic and Brian Paul	Comparing the Economics of Metal Additive Manufacturing Processes for Micro-scale Plate Reactors in the Chemical Process Industry
Paper 125	Kimberly Nagulpelli, Russell King and Donald Warsing	Integrated traditional and additive manufacturing production profitability model

1400-1530 130B	**NAMRC- TRACK 5 Smart Manufacturing & Cyber- Physical Systems- Systems 1** *Session Chair: Chinedum Okwudire*	
Paper 23	Mingtao Wu and Young Moon	Alert Correlation for Cyber-Manufacturing Intrusion Detection
Paper 84	Riddhiman Sherlekar, Paul Cohen and Binil Starly	Provisioned Data Distribution for Intelligent Manufacturing via Fog Computing
Paper 93	Xiang Lu, Giridharan Kumaravelu and Chinedum E. Okwudire	An Evaluation of Data Size Reduction Techniques for Improving the Reliability of Cloud-based CNC for a 3D Printer

1400-1530 130C	**NAMRC- TRACK 4 Additive Manufacturing- Materials & Characterization1** *Session Chair: Ramesh Singh*	
Paper 186	Saptarshee Mitra and Mohamed El. Mansori	Micro-focus X-Ray Computed Tomography (CT) Analysis of functional 3D Printed sand mold
Paper 192	Joseph Kubalak, Alfred Wicks and Christopher Williams	Deposition path planning for material extrusion using specified orientation fields
Paper 204	Jessica Schiltz, Andrew Rosenberger, Todd Render, Bernice Aboud Gatrell, Haibo Qu, Colton Steiner, Paul McGinn and Steven Schmid	Wear of structural oxide ceramics produced through additive manufacturing

1550-1720 110	**NAMRC- TRACK 2 Manufacturing Processes- Tribology 1** *Session Chair: Gonumakulapalle Lodi Samuel*	
Paper 7	S Niketh and Gonumakulapalle Lodi Samuel	Surface texturing of Tribological Interfaces – Numerical Modeling and Experimental Analysis
Paper 14	Christoph Kossack, John Ziegert and Tony Schmitz	The sliding friction contact frequency response function
Paper 161	Srishti Jain, Mike Corliss, Bruce Tai and Wayne Hung	Electrochemical polishing of selective laser melted Inconel 718
1550-1720 120	**NAMRC- TRACK 3 Material Removal- Machining 3** *Session Chair: Sagil James*	
Paper 101	Siddharam Mane, Jay Ramchandani, Deepak Marla and Suhas Joshi	Experimental Investigation of Oil Mist Assisted Cooling on Orthogonal Cutting of Ti6Al4V
Paper 114	Jin Woo Kim, Jungsoo Nam and Sang Won Lee	Experimental Study on Micro-drilling of Unidirectional Carbon Fiber Reinforced Plastic Composite Using Nano-solid Lubrication
Paper 117	Derek Yip-Hoi, David Gill, Jacob Gahan, Gavin Travis and Lukas Mackaay	Material Stiffness and Cutting Parameters for Honeycomb Aluminum Sandwich Panel: a Comparison with Bulk Material
1550-1720 130A	**NAMRC- TRACK 4 Additive Manufacturing- Materials & Chacterization 2** *Session Chair: Hantang Qin*	
Paper 34	Matthew Michaelis	Multi-droplet splat solidification with re-melting during precision droplet manufacturing
Paper 63	Alejandro F. Eufracio Aguilera, Balakrishnan Nagarajan, Brian A. Fleck and Ahmed Jawad Qureshi	Ferromagnetic particle structuring in material jetting - Manufacturing control system and software development
Paper 72	Prashant Polamaplly, Yiliang Cheng, Xiaolei Shi, Karthick Manikandan, Gul E. Kremer and Hantang Qin	3D Printing and Characterization of Hydroxypropyl Methylcellulose and Methylcellulose for Biodegradable Support Structures
1550-1720 130B	**NAMRC- TRACK 5 Smart Manufacturing & Cyber- Physical Systems- Systems 2** *Session Chair: Lee Wells*	
Paper 118	J. Cecil, Hai Huynh and Parmesh Ramanathan	A cloud-based cyber-physical framework for collaborative manufacturing
Paper 132	Hamed Bouzary, F. Frank Chen and Mohammad Shahin	Optimal composition of tasks in cloud manufacturing platform: a novel hybrid GWO-GA approach
Paper 140	Sameer Mittal, Muztoba Khan, David Romero and Thorsten Wuest	Building Blocks for Adopting Smart Manufacturing

0910-1040 140A	**Session 1-2-4 Metal Additive Manufacturing Process 4** *Session Chair: Jing Shi | Session Co-Chair: Haseung Chung*	
MSEC2019-2841	Xing Zhang and Yiliang Liao	Microstructure Evolution During Solid-State Selective Laser Sintering of Metallic Materials: A Phase-Field Simulation
MSEC2019-2989	Vysakh Venugopal, Matthew McConaha and Sam Anand	Topology Optimization for Multi-Material Lattice Structures With Tailorable Material Properties for Additive Manufacturing
MSEC2019-3051	Mingsan Xu, Fuzhou, Fujian, Simo Liu, Mingliang Mei and Bingbing Li	Effect of Cooling Modes on Microstructure and Mechanical Properties of Cr18Ni8Mo2Si Cladding to 40Cr by Laser Cladding Technology
0910-1040 140B	**Session 2-3-1 Inter-Connected Manufacturing Systems** *Session Chair: Hui Wang*	
MSEC2019-2748	Ryan Fisher and Guodong Shao	Testing of the MTCONNECT???OPC UA Companion Specification
MSEC2019-3005	Zhengqian Jiang, Arriana Nwodu, Sean Psulkowski, Hui Wang and Tarik Dickens	Improved Co-Scheduling of Printing Path Scanning for Collaborative Additive Manufacturing
MSEC2019-2749	Ben Amaba and Jeff Daniels	Innovation Interdisciplinary Integrated Engineering
0910-1040 140C	**Session 3-7-1 Resistance Spot Welding of Dissimilar Materials** *Session Chair: Wayne Cai | Session Co-Chair: Xun Liu*	
MSEC2019-2933	Umair Shah and Xun Liu	Ultrasonic Resistance Spot Welding of Transformation Induced Plasticity Steel 780 to Aluminum Alloy Al-6061
MSEC2019-2704	Surender Maddela and Blair Carlson	Corrosion Characterization of Resistance Spot Welded Aluminum and Steel Couple
MSEC2019-2958	Xin Wu, Jingtao Du and Wayne Cai	Significance of Workpiece Conductivity on Resistance Spot Welding Process Map
0910-1040 160A	**Session 3-11-3 Micro and Nano Manufacturing III** *Session Chair: Rajiv Malhotra | Session Co-Chair: Howon Lee*	
MSEC2019-2778	Harish Devaraj and Rajiv Malhotra	Conformal Circuit Fabrication via Flash Light Sintering and Forming
MSEC2019-2871	Shahrima Maharubin, Xiaomei Shu, Manavi Singh, Benildo De los Reyes and George Tan	Cone Electrospinning Polycaprolactone / Collagen Scaffolds With Microstructure Gradient
MSEC2019-2999	Xingjian Wei, Abhinav Bhardwaj, Li Zeng and Zhijian Pei	Experimental Investigation of Stratasys J750 PolyJet Printer: Effects of Finish Type and Shore Hardness on Dimensional Accuracy

0910-1040 160B	**Session 4-1-1 Advances in Processing and Recycling of Polymers and Polymer Composites** *Session Chair: Anasuya Sahoo | Session Co-Chair: Felicia Stan*	
MSEC2019-2929	Felicia Stan, Nicoleta-Violeta Stanciu, Catalin Fetecau and Ionut-Laurentiu Sandu	Mechanical Recycling of Low-Density Polyethylene/Carbon Nanotube Composites and its Effect on Material Properties
MSEC2019-2765	Denise Bellisario, Fabrizio Quadrini, Loredana Santo, Leandro Iorio, Nicola Gallo and Stefano Giuseppe Corvaglia	Out-of-Autoclave Repair of Composite Laminates by Using Shape Memory Polymer Foams
MSEC2019-2745	Fabrizio Quadrini, Denise Bellisario, Giovanni Matteo Tedde and Loredana Santo	Recycling of Printed Circuit Boards by Direct Molding Technology
1100-1230 140A	**Session 2-3-2 Smart Manufacturing Systems- Session 1** *Session Chair: Hui Yang | Session Co-Chair: Hui Wang*	
MSEC2019-3002	Farhad Imani, Ruimin Chen, Evan Diewald, Edward Reutzel and Hui Yang	Image-Guided Variant Geometry Analysis of Layerwise Build Quality in Additive Manufacturing
MSEC2019-3050	Nathan Decker and Qiang Huang	Geometric Accuracy Prediction for Additive Manufacturing Through Machine Learning of Triangular Mesh Data
MSEC2019-3061	Guilong Li, Shichang Du, Delin Huang, Chen Zhao and Yafei Deng	Chatter Prediction for Face Milling Process of Workpieces With Variable Stiffness
1100-1230 140B	**Session 2-8-1 Cloud Manufacturing and Industrial Internet 1** *Session Chair: Lihui Wang | Session Co-Chair: Yujie Chen*	
MSEC2019-2702	Zhao Zhiqiang, Aby Varghese, Chua Wei Quan and Prabhu Vinayak Ashok	Natural-Language Chat and Control HMI for Manufacturing Shopfloor
MSEC2019-2890	Xi (Vincent) Wang, Chen Wang and Lihui Wang	Robots in the Industrial Internet: A Cloud-Based Approach Based on Gateways
MSEC2019-2882	Akshay Bharadwaj, Yang Xu, Atin Angrish, Yong Chen and Binil Starly	Development of a Pilot Manufacturing Cyberinfrastructure With an Information Rich Mechanical CAD 3D Model Repository
1100-1230 140C	**Session 5-2-1 Design, Process, and Systems Advances for Remanufacturing and Recovery** *Session Chair: Jeremy Rickli*	
MSEC2019-3009	Mojahed Alkhateeb, Jeremy Rickli and Nick Christoforou	Error Propagation in Digital Additive Remanufacturing Process Planning
MSEC2019-2903	Jewel Williams, Shelby Warrington and Astrid Layton	Waste Reduction: A Review of Common Options and Alternatives
MSEC2019-2955	Dillip Kumar Panigrahi and Mihir Sarangi	Fabrication of Deterministic Micro-Asperities on Thrust Surfaces Using Photo Chemical Machining

1100-1230 160A	**Session 3-7-2 Solid State Welding of Dissimilar Materials** *Session Chair: Xun Liu | Session Co-Chair: Gaoqiang Chen*	
MSEC2019-2824	Prem Singh, Dharmpal Deepak and Gurinder Singh Brar	Optimization of Friction Crush Welding of Two Dissimilar Metals ??? Aluminium 6061 T-6 and Stainless Steel-AISI 304
MSEC2019-2938	Yuquan Meng, Dingyu Peng, Qasim Nazir, Gowtham Kuntumalla, Manjunath C. Rajagopal, Ho Chan Chang, Hanyang Zhao, Sreenath Sundar, Placid Ferreira, Sanjiv Sinha, Nenad Miljkovic, Srinivasa Salapaka and Chenhui Shao	Ultrasonic Welding of Soft Polymer and Metal: A Preliminary Study
MSEC2019-2855	Gaoqiang Chen, Xun Liu and Qingyu Shi	Numerical Analysis of In-Process Heat Transfer and Material Flow During Dissimilar Friction Stir Welding Process
1100-1230 160B	**Session 4-2-1 Bio-/Nano-Materials** *Session Chair: Mostafa Bedewy | Session Co-Chair: Sameh Tawfick*	
MSEC2019-2992	Kaihao Zhang and Sameh Tawfick	Graphene Synthesis on Ultrathin Metal Catalyst Films
MSEC2019-2932	Moataz Abdulhafez, Se Youn Cho, Golnaz Tomaraei and Mostafa Bedewy	Microwave-Assisted Processing of Regenerated Silk Fibroin Films
MSEC2019-2847	Jaegeun Lee, Moataz Abdulhafez and Mostafa Bedewy	Multizone Rapid Thermal Processing to Overcome Challenges in Carbon Nanotube Manufacturing by Chemical Vapor Deposition
1400-1530 100	**Session 3-9-1 Tribology 1** *Session Chair: Mathew Kuttolamadom | Session Co-Chair: Dinakar Sagapuram*	
MSEC2019-2849	Bo Mao, Arpith Siddaiah, Pradeep Menezes and Yiliang Liao	A Novel Laser Shock Surface Patterning Process Toward Tribological Applications
MSEC2019-2843	Dinh Nguyen, Vadim Vozynyuk, Mohammad Sayem Bin Abdullah, Dave D-W Kim and Patrick Kwon	Tool Wear of Superhard Ceramic Coated Tools in Drilling of CFRP/Ti Stacks
MSEC2019-2832	Abhishek Sharma and Jinu Paul	Development of Friction Based Strategies for the Surface Modification of Aluminium Alloy
1400-1530 140A	**Session 1-3-1 Surrogate Models for Additive Manufacturing** *Session Chair: Prahalad Rao | Session Co-Chair: Hongyue Sun*	
MSEC2019-3034	Reza Yavari, Jordan Severson, Aniruddha Gaikwad, Kevin D. Cole and Prahalad Rao	Predicting Part-Level Thermal History in Metal Additive Manufacturing Using Graph Theory: Experimental Validation With Directed Energy Deposition of Titanium Alloy Parts
MSEC2019-2875	Reza Yavari, Kevin D. Cole, Prahalad Rao	A Graph Theoretic Approach for Near Real-Time Prediction of Part-Level Thermal History in Metal Additive Manufacturing Processes
MSEC2019-2787	Luis Javier Segura, Guanglei Zhao, Hongyue Sun, Chi Zhou	Gaussian Process Tensor Responses Emulation for Droplet Solidification in Freeze Nano 3D Printing of Energy Products

1400-1530 140B	**Session 2-3-3 Smart Manufacturing Systems Session 2** *Session Chair: Qing Chang*	
MSEC2019-2969	Cheng Zhu, Tian Yu, Qing Chang and Jorge Arinez	Corrective Maintenance Scheduling for Stochastic Manufacturing System by Online Task Allocation Method
MSEC2019-2873	Tizian Bucher, Min Zhang, Chang Jun Chen, Ravi Verma,Wayne Li and Y. Lawrence Yao	Laser Forming of Metal Foam Sandwich Panels: Effect of Panel Manufacturing Method
MSEC2019-2719	Maximilian Lachenmaier, Marius Ohlert, Daniel Trauth and Thomas Bergs	Analysis of the Acceleration Transfer in the Unguided Vibratory Finishing Process

1400-1530 140C	**Session 2-8-2 Cloud Manufacturing and Industrial Internet 2** *Session Chair: Lihui Wang | Session Co-Chair: Xi (Vincent) Wang*	
MSEC2019-2919	Bin Liu, Wenjun Xu, Jiayi Liu, Bitao Yao, Zude Zhou and Duc Truong Pham	Human-Robot Collaboration for Disassembly Line Balancing Problem in Remanufacturing
MSEC2019-2920	Lan Li, Wenjun Xu, Zhihao Liu, Bitao Yao, Zude Zhou and Duc Truong Pham	Digital Twin-Based Control Approach for Industrial Cloud Robotics
MSEC2019-2773	Yilin Fang, Hongkai Wei, Quan Liu, Yongliang Li, Zude Zhou and Duc Truong Pham	Minimizing Energy Consumption and Line Length of Mixed-Model Multi-Robotic Disassembly Line Systems Using Multi-Objective Evolutionary Optimization

1400-1530 160A	**Session 2-11-1 Intelligent Maintenance Decision Making of Manufacturing Systems- Session 1** *Session Chair: Dazhong Wu*	
MSEC2019-2869	Chen Zhang, Tao Yang, Wei Gao and Yong Wang	Solar PV Power Generation Forecasting and O&M Management Applications: A Review
MSEC2019-2819	Madhumitha Ramachandran	Friction Torque and Leakage Based Data-Driven Approach for Rotary Seal Prognostics in Manufacturing Industry
MSEC2019-2976	Yupeng Wei, Dazhong Wu and Janis Terpenny	A Decision-Level Data Fusion Approach to Surface Roughness Prediction

1400-1530 160B	**Session 3-7-3 Mechanical Fastening of Dissimilar Materials** *Session Chair: Chenhui Shao | Session Co-Chair: Ming Lou*	
MSEC2019-2857	YunWu Ma, Yongbing Li and Zhongqin Lin	Joint Formation and Mechanical Performance of Friction Self-Piercing Riveted Aluminum Alloy AA7075-T6 Joints
MSEC2019-2927	Brandt Ruszkiewicz, Gene Simpson and Eric Breidenbaugh	Comparison of Commercially Available Thread Forming Profiles on Flow Drill Joining of 6061-T6 Aluminum to Thermoset Carbon Fiber Reinforced Composite
MSEC2019-2984	Ming Lou, YunWu Ma and Yongbing Li	Study on Formation and Performance of Electric-Aided Self-Piercing Riveted Aluminum Alloy and Dual-Phase Steels With Different Strength Grades
1550-1720 130C	**Session 1-3-2 Physics-based Models and Geometric Models for Additive Manufacturing** *Session Chair: Chi Zhou | Session Co-Chair: Bashir Khoda*	
MSEC2019-2815	Tsz Ho Kwok	The Quality of Slicing Technologies for Digital Light Processing 3D Printing
MSEC2019-2766	Andreas Schröffer, Thomas Maciuga, Konstantin Struebig and Tim C. Lueth	A High-Fidelity Thermal Model for a Novel Droplet-Based Additive Manufacturing Process for Polymers
MSEC2019-2897	Mriganka Roy, Reza Yavari, Chi Zhou, Olga Wodo and Prahalad Rao	Modeling and Experimental Validation of Part-Level Thermal Profile in Fused Filament Fabrication
1550-1720 140A	**Session 2-4-1 Advances in Data Analytics and Engineering Modeling for Intelligent & Resilient Manufacturing Systems I** *Session Chair: Xiaoning Jin*	
MSEC2019-2820	Madhumitha Ramachandran, Jon Keegan and Zahed Siddique	Degradation Assessment of Reciprocating Seal Using Support Vector Regression
MSEC2019-2936	Anqi He and Xiaoning Jin	Failure Detection and Remaining Life Estimation for Ion Mill Etching Process Through Deep-Learning Based Multimodal Data Fusion
MSEC2019-2898	Yuhang Yang, Siyuan Chen, Letao Wang, Jingying He, Shang-Ming Wang, Luwen Sun and Chenhui Shao	Influence of Coating Spray on Surface Measurement Using 3D Optical Scanning Systems
1550-1720 140B	**Session 2-8-3 Cloud Manufacturing and Industrial Internet 3** *Session Chair: Yujie Chen | Session Co-Chair: Xi (Vincent) Wang*	
MSEC2019-2783	Thomas Hedberg, Jr., Allison Barnard Feeney, Vijay Srinivasan and Gaithersburg	An Analysis of Recent Standards on Composite Product Models to Enable Digital Transformation of Composite Product Manufacturing

MSEC2019-2793	Qiunan Meng and Xun Xu	A Stochastic Optimization Model for a Joint Pricing and Resource Allocation Problem
MSEC2019-2799	Kunkun Peng, Xinyu Li, Wuhan, Hubei, Liang Gao, Xi (Vincent) Wang and Yiping Gao	A New Joint Data-Model Driven Dynamic Scheduling Architecture for Intelligent Workshop

1550-1720 140C — Session 3-4-1 Advances in Nontraditional Manufacturing Processes 1

Session Chair: Scott Wagner | Session Co-Chair: Muhammad Jahan

MSEC2019-2985	Yingbin Hu, Hui Wang and Weilong (Ben) Cong	Laser Deposition-Additive Manufacturing of Graphene Oxide Reinforced IN718 Alloys: Effects on Surface Quality, Microstructure, and Mechanical Properties
MSEC2019-2952	Vyas Mani Sharma, Vikranth Racherla and Surjya K Pal	Fabrication of Copper Foam Plate Using Friction Sintering
MSEC2019-3025	Asif Tanveer, Shiv G Kapoor and Soham Mujumdar	Modeling of Material Removal in Atomized Dielectric-Based Electrical Discharge Machining (EDM)

1550-1720 160A — Session 3-7-4 Brazing of Dissimilar Materials

Session Chair: Wenda TAN | Session Co-Chair: Anming Hu

MSEC2019-2973	Denzel Bridges, Anming Hu and Raymond Xu	Transient Liquid Phase Bonding of Inconel 718 With Ni and BNi-2 Nano-Braze Materials
MSEC2019-2950	Saeed Mousa, Jazan University, Jazan, Saudi Arabia, Mahmoud Atta, Zagazig University, Jazan, Egypt, Amro Abd-Elhady, Ahmed Abu-Sinna and Omar Bafakeeh	Mechanical and Bond Behavior of an Advanced Quranic Metal-Matrix Composite Material (QMMC)
MSEC2019-2836	Zhehao Zhang, Yi Zhang, Feng Luo, Jie Li, Cheng Lu, Yuze Zhao, Hang Zhang and Ange Lu	Convolutional Neural Network Using Bayesian Optimization for Laser Welding Tailor Rolled Blanks Penetration Detection

1550-1720 160B — Session 4-1-2 Advances in Processing and Design of Polymers and Polymer Composites

Session Chair: Nestor Vasquez | Session Co-Chair: Fabrizio Quadrini

MSEC2019-2752	Zonghuan Wang and Jun Yin	Experimental and Numerical Analyses on the Poly(Lactide-Co-Glycolide) Hollow Fiber Membranes
MSEC2019-2776	Felicia Stan, Nicoleta-Violeta Stanciu and Catalin Fetecau	On the 3D Printability of Multi-Walled Carbon Nanotube/High Density Polyethylene Composites
MSEC2019-2998	Xingjian Wei, Abhinav Bhardwaj, Li Zeng and Zhijian Pei	Experimental Investigation of Stratasys J750 PolyJet Printer: Effects of Finish Type and Shore Hardness on Surface Roughness

ACUTEC
Precision Aerospace, Inc.

Founded in 1988, Acutec Precision Aerospace is an award-winning family-owned aerospace manufacturer providing critical components for the aviation industry. They have evolved from a small 17-person machining company into a full-service manufacturing and engineering company with almost 500 employees and the largest industrial employer in Crawford County.

Their end markets include:

- rotor and vibration damping
- engine and power generation
- hydraulics, avionics, and actuation systems
- landing gear and braking systems

After outgrowing its still operating 80,000 square foot facility in Saegertown, Acutec moved into a section of this 1930s industrial textile facility and renovated it in 2007. Having undergone continued expansion since then (Acutec added and renovated 40,000 square feet in 2013, 80,000 square feet in 2014, 10,000 square feet in 2015 and 100,000 square feet in 2018) Acutec has grown its footprint in the old facility to cover a climate-controlled 310,000 square feet. It houses all of Acutec's simple turning, EDM, grind, cellular manufacturing, metal joining, assembly and test and post processing including NDT testing, chemical processing and paint. With an in-house software development company, Lojic, Acutec leverages live data to continuously improve processes across a library of 8,500 different parts and assemblies.

THURSDAY **JUNE 13, 2019**

TIME	LOCATION	EVENT
7:00-16:00	E. Pre-Function	Registration
7:00-8:00	N. Point Lobby/ E. Pr-function	Breakfast
8:00-9:00	Grand Ballroom	Keynote-Mike Molnar
9:00-11:00	Off Site	Optional Industry Tour
9:10-10:40	110-160B	Technical Session 8
9:10-10:40	170	RAMP Competition- Session 1
10:00-17:00	E. Pre-Function	Exhibitor Booths Open
10:40-11:00	N. Point Lobby/ E. Pr-function	Morning Break
11:00-12:30	110-160B	Technical Session 9
11:00-12:30	170	RAMP Competition- Session 2
12:30-13:50	Grand Ballroom	SME Award Luncheon & NAMRI Founders Lecture
14:00-16:00	Off Site	Optional Industry Tour
14:00-15:30	10-160B	Technical Session 10
14:00-15:30	100	ASME MED 100th Year Anniversary 3
14:00-16:00	170	Advanced Polymer Composites & Manufacturing for the Circular Economy
15:00-17:00	S. Great Hall	Poster Session
15:30-15:50	N. Point Lobby/ E. Pr-function	Afternoon Break
15:50-17:20	110-160B	Technical Session 11
15:30-17:20	100	ASME MED 100th Year Anniversary 4
17:00-17:20	E. Pre-Function	Exhibitor Booth Move Out
17:30-20:30	Off Site	Behrend Night

Michael F. Molnar, P.E. SES

Director, Office of Advanced Manufacturing
National Institute of Standards and Technology

Mike Molnar is the founding director of the Office of Advanced Manufacturing at the National Institute of Standards and Technology, and the Advanced Manufacturing National Program Office, an interagency team which serves as the Congressionally designated program office for Manufacturing USA. Mike also serves as the principal Commerce representative and co-Chair of the National Science and Technology Council, Subcommittee on Advanced Manufacturing. Prior to joining federal service in 2011 Mike had a nearly 30-year industry career in advanced manufacturing, with leadership roles in manufacturing technology development, corporate manufacturing engineering, capital planning, metrology, quality systems, robotics and flexible automation, and computer integrated manufacturing systems.

Manufacturing: A Bright, Innovative Future

Thursday, June 13th | 8:00-9:00

Abstract

As manufacturing engineers we often are focused on addressing that next challenge, resolving a design issue, or researching a solution to that vexing process problem. While there is much technical talk about the fourth manufacturing revolution a general perception still pervades that manufacturing is either problematic - or worse – part of the "old economy". This plenary address takes the larger view, arguing that the "golden age of manufacturing" is now – manufacturing output has never been greater, while manufacturers are adopting sustainable practices as a business imperative. Progress is underpinned by exceptional productivity gains driven through manufacturing innovation and collaborative engineering. Topics will include the status and future of the Manufacturing USA program, the National Strategic Plan for Advanced Manufacturing, and the Technology Transfer/ROI initiative.

Manufacturing USA®

Manufacturing USA is an initiative focused on coordinating public and private investment in emerging advanced manufacturing technologies. Manufacturing USA brings together industry, academia, and government partners to leverage existing resources, collaborate, and co-invest to advance manufacturing innovation and accelerate commercialization. This network creates a competitive, effective, and sustainable research-to-manufacturing infrastructure for U.S. industry and academia. The network consists of multiple linked Manufacturing Innovation Institutes (MIIs) with common goals but unique technological concentrations.

Each institute accelerates U.S. advanced manufacturing by catalyzing the development of new technologies, educational competencies, production processes, and products via shared contributions from the public and private sectors and academia. The institutes provide shared facilities to local start-ups and small manufacturers to help them scale up new technologies, accelerate technology transfer to the marketplace, and facilitate the adoption of innovation developments across supply chains. Each institute acts as a 'teaching factory' to build workforce skills at multiple levels and to strengthen business capabilities in large and small companies.

Individual institutes serve as technology hubs, benefiting both regional and national interests. By bridging the gap between applied research and product development with a focus on key technology areas. While the institutes each carry a particular regional focus, the network is truly national, integrated, and dynamic, aiming to foster innovation and deliver new capabilities that can stimulate the U.S. manufacturing sector on a large scale.

NIST RAMP Competition

Sponsored by: NIST, SME, & ASTM International

Introduction to the competition

This competition focuses on the modeling of manufacturing processes for system-level sustainability assessment. Models can span from traditional scale down to nanoscale processes and be based on mechanical, electrical, chemical, biochemical, and bio technologies. Any process type - including batch, continuous, and discrete event - is acceptable. Since sustainability is a balance of competing objectives including cost and time as well as environmental considerations, many different types of process performance metrics may be considered. In addition, the use of the models for system-level sustainability performance is encouraged.

Objective

The purpose of the competition is create a venue to foster interest in characterizing manufacturing processes – leading to a common set of descriptive models and performance metrics that support effective and consistent system level analysis and comparisons spanning various manufacturing processes and resources. This year's Theme is Model Reusability.Similar to the 2018 competition, the building blocks of each submission are the Unit Manufacturing Process (UMP) models, which represent Reusable Abstractions of Manufacturing Processes (RAMP). Possible approaches that participants could take to address this year's theme include (but are not limited to) the following:

- Demonstrating the use of a single UMP model to conduct analysis for multiple scenarios
- Linking a UMP model to traditional workflows (e.g., discrete event simulation, Life Cycle Assessment, Optimization, or other systems-level analysis)
- Formally describing the use bounds and feasibility constraints of the UMP model
- Identifying and quantifying sources of model uncertainties

Awards:

Cash prizes and awards, listed below (subject to the quality of the entries), will be presented at the live judging event at MSEC.

First Prize – $1,000
Second Prize – $600
Third Prize – $400

2019 RAMP Competition Finalists:

Efe Balta, ***Ilya Kovalenko***, Kira Barton, "Developing Unit Manufacturing Process Models for Management of an Additive Manufacturing Fleet."

Nathan Decker, Qiang Huang, "Reuse of a UMP Model for Geometric Accuracy Prediction Across Multiple Additive Manufacturing Processes."

Yuquan Meng, Chenhui Shao, "Manufacturing of an Innovative Hybrid Heat Exchanger."

Eriez Industrial Tour

Thursday, June 13th | 9:00-11:00

Eriez

Eriez, a privately held company, is a world leader in the design and manufacturer of separation, material handling and inspection equipment used throughout process industries like food, plastics and chemicals, mining, aggregates, metalworking and recycling. The applications and production methods requiring our equipment are universal around the world. Separation equipment typically uses magnetics to remove unwanted tramp metals or metal contaminants in both dry and liquid process flows. Other applications involve metalworking fluid filtration as well as flotation and magnetic technologies to concentrate minerals. The Material Handling group comprises of feeding, conveying and screening equipment to move dry materials with applications and capacities ranging from metering ounces of flour to moving tons of coal. Our Inspection Systems are designed to safeguard consumer products like foods and pharmaceuticals from metal contaminants and protect valuable downstream processing equipment like crushers from large dangerous tramp metals.

McInnes Industrial Tour

Thursday, June 13th | 9:00-11:00

McInnes Rolled Rings

Since 1992, we have focused exclusively on producing high quality, seamless rolled rings from 4" (100mm) to 144" (3660mm) outer diameter, weighing up to 8,000 pounds in carbon, alloy, and stainless steel. Our Erie, Pennsylvania facility is the industry standard for productivity, cost control, and speed. Our customers trust that an order at McInnes Rolled Rings will be delivered in the shortest lead times available in the industry, and with the highest quality and reliability. In our 144,470 square-foot facility we operate two Wagner radial axial ring rolling mills (RAW 63/63 and RAW 160/160), a smaller Wagner KFR 630 ring mill, 1,200-ton and 3,500-ton hydraulic preform presses, and full heat treatment capabilities. Our RAW ring mills feature advanced CNC controls which are at the forefront of globally available technology. This enables our seamless ring rolling process to produce rings with accurate and repeatable dimensions to tight tolerances,which allows minimal material allowance and results in very little waste. Seamless rolled rings offer superior integrity for demanding engineering applications, and often provide a cost-effective alternative to fabricating rings from steel plate. We also offer forged discs-using our RAW 160/160 ring mill for consistent size and finish, we produce discs with 5,000 pounds maximum weight, and up to 60" (1524mm) outside diameter and 10" (254mm) height. Final applications of our carbon, alloy, and stainless steel rings and discs include power generation and transmission, valve and flange, general machine shop and fabrication, industrial machinery, bearings, aerospace, and oil field equipment. Our ISO9001and AS9100 compliant quality management system, range of industry approvals and bureau certifications, and process of continual improvement enable us to dependably meet the needs of our customers.To learn more about McInnes Rolled Rings and its offerings, please visitwww.mcinnesrolledrings.com.

Modern Industrial Tour

Thursday, June 13th | 14:00-16:00

Modern Industries

Modern Industries is a second generation family owned business established in 1946 by a returning WWII veteran who was driven to build a company that would have a positive impact on all those involved with his endeavor. The underlying characteristics of Modern's founder, Herb Sweny, were the foundation of his new venture and help define who we are today. Modern has grown into a four division, vertically integrated provider of manufacturing and industrial support services. Whether looking for turnkey finished products and assemblies or individual services. Modern offers nearly 70 years of engineering experience and technical know-how to a wide variety of commercial, mobile, industrial, aerospace markets. What we do:

***We** make the parts that industry needs to build their products, with Precision Machining Services.*

***We** make metals tougher & stronger through Thermal Processing.*

***We** help you assure product quality with Materials Testing Services.*

***We** make machine operators more efficient with Quick Change Modular Workholding and Toolholding Devices.*

***We** make industrial equipment operate effectively and last longer with customized Motion Control Devices.*

Modern Industries Today:

- Over 200 Employees in Western Pennsylvania
- Sales in more than a dozen countries around the world
- Operations in Erie, Pittsburgh, Meadville and Kersey PA
- Average length of employment is greater than 8 years
- Quality Certifications to AS-9100D, IATF-16949, ISO-17025, ISO-9001, Nadcap

Penn State Behrend Night Out

Thursday, June 13th | 17:30-20:30

Penn State Behrend

Come and enjoy Behrend's night out and lab tours. As part of one of the country's foremost public research institutions, Penn State Behrend has the state-of-the-art laboratory facilities you would expect, and they're available to our industry partners as part of our OpenLab Environment where industry innovateside-by-side with academic researchers.Our School of Engineering has the largest academic plastics lab in the United States and the faculty and students able to make the most of its capabilities. Industry partners are often surprised by the variety and amount of equipment utilized by students and available to industry. Our material testing and characterization is one of Penn State Behrend Engineering's core competencies. Our lab capabilities, faculty, and students are sought after world-wide. Focusing on industrial R&D is unique enough, but being able to leverage the world class basic research capabilities of University Park gives us an advantage unparalleled. You will also get a chance to visit HERO BX Research & Development Laboratory located at Knowledge Park in the Advanced Manufacturing and Innovation Center (AMIC).The laboratory advances the company's efforts to diversify and develop biodiesel products for new markets while utilizing the skills of Penn State Behrend students in industry-driven research.

0910-1040 110	NAMRC - TRACK 2 MANUFACTURING PROCESSES - Tribology 2 *Session Chair: Gonumakulapalle Lodi Samuel*	
Paper 138	Faez Qahtani and Pranav Shrotriya	Study the Effect of Changing the Surface Roughness and the Laser Focus Distance to the Aluminum Appearance using Picosecond Laser.
Paper 90	Qianting Wang, Xianbin Zeng, Changrong Chen, Guofu Lian and Xu Huang	Profile characterisation and response surface modelling of laser surface hardened Cr12 mould steel
Paper 203	Evgueni Bordatchev, Srdjan Cvijanovic and Ovidiu-Remus Tutunea-Fatan	Effect of initial surface topography during laser polishing process: Statistical analysis

0910-1040 120	NAMRC - TRACK 3 MATERIAL REMOVAL - Advanced Processes 1 *Session Chair: Tony Schmitz*	
Paper 55	Sandeep Ravi-Kumar, Benjamin Lies, Hao Lyu and Hantang Qin	Laser Ablation of Polymers: A Review
Paper 78	Julfekar Arab, Pratik Adhale, Dileep Kumar Mishra and Pradeep Dixit	Micro array hole formation in glass using electro-chemical discharge machining
Paper 89	Aruna Thakur, Mukesh Tak and Rakesh Mote	Electrochemical micromachining behavior on 17-4 PH stainless steel using different electrolytes

0910-1040 130A	NAMRC - TRACK 4 ADDITIVE MANUFACTURING - Materials & Characterization 3 *Session Chair: Kevin Chou*	
Paper 95	Shanshan Zhang, Santosh Rauniyar, Subin Shrestha, Aaron Ward and Kevin Chou	An Experimental Study of Tensile Property Variability in Selective Laser Melting
Paper 100	Michael Sealy, Haitham Hadidi, Brady Mailand, Tayler Sundermann, Ethan Johnson, Mehrdad Negahban, Laurent Delbreilh and Gurucharan Madireddy	Low velocity impact of ABS after shot peening predefined layers during additive manufacturing
Paper 131	Archak Goel and Sam Anand	Design of Functionally Graded Lattice Structures using B-splines for Additive Manufacturing

0910-1040 130B	**NAMRC - TRACK 5 SMART MANUFACTURING & CYBER-PHYSICAL SYSTEMS - Monitoring & Control 1** *Session Chair: Shreyes Melkote*	
Paper 6	Pablo Martinez, Rafiq Ahmad and Mohamed Al-Hussein	Real-time visual detection and correction of automatic screw operations in dimpled light-gauge steel framing with pre-drilled pilot holes
Paper 19	Vinh Nguyen and Shreyes Melkote	Modeling of flange-mounted force sensor frequency response function for inverse filtering of forces in robotic milling
Paper 22	Hasan Latif, Guodong Shao and Binil Starly	Integrating A Dynamic Simulator and Advanced Process Control using the OPC-UA Standard

1100-1230 110	**NAMRC - TRACK 2 MANUFACTURING PROCESSES - Advanced Processes 1** *Session Chair: Murali Sundaram*	
Paper 10	Shamraiz Ahmad, Kuan Yew Wong and Riaz Ahmad	Life cycle assessment for food production and manufacturing: recent trends, global applications and future prospects
Paper 40	Rachele Bertolini, Andrea Ghiotti, Luca Pezzato and Stefania Bruschi	Ultrasonic Vibration Turning to Increase the Deposition Efficiency of a silica-based Sol-Gel Coating
Paper 176	Shao-Wei Tsai, Arkadeep Kumar, Bavisha Kalyan, Chia Hung Hou, Pen-Chi Chiang and Ashok Gadgil	Additive Manufacturing of Electrodes for Desalination

1100-1230 120	**NAMRC - TRACK 3 MATERIAL REMOVAL - Advanced Processes 2** *Session Chair: Frank Pfefferkorn*	
Paper 104	Sarathkumar Loganathan, Soundarapandian Santhanakrishnan, Ravi Bathe and Muthukumaraswamy Arunachalam	Prediction of femtosecond laser ablation parameter on Human teeth using chemical compositional analysis
Paper 145	Suman Bhandari, Mahantesh Murnal, Jian Cao and Kornel Ehmann	Comparative Experimental Investigation of Micro-channel Fabrication in Ti Alloys by Laser Ablation and Laser-induced Plasma Micro-machining
Paper 177	Rakesh Chaudhari, Jay J. Vora and D.M. Parikh	Multi-response Optimization of WEDM Parameters Using an Integrated Approach of RSM-GRA Analysis for Pure Titanium

1100-1230 130A	**NAMRC - TRACK 4 ADDITIVE MANUFACTURING - Processes 3** *Session Chair: Matteo Strano*	
Paper 130	Li He, Fan Fei, Wenbo Wang and Xuan Song	Layerless Additive Manufacturing of Metal Alloy Lattices Using Immiscible-Interface Assisted Direct Metal Drawing
Paper 137	Mohammadrafi Marandi and Joshua Tarbutton	Additive manufacturing of single- and double-layer piezoelectric PVDF-TrFE copolymer sensors
Paper 164	Chaitanya Vundru, Ramesh Singh, Wenyi Yan and Shyamprasad Karagadde	Non-dimensional process maps for normalized dilution limits in laser direct metal deposition
1100-1230 130B	**NAMRC - TRACK 5 SMART MANUFACTURING & CYBER-PHYSICAL SYSTEMS - Monitoring & Control 2** *Session Chair: Niechen Chen*	
Paper 28	Carlos Escobar and Ruben Morales-Menendez	Process-Monitoring-for-Quality — A Model Selection Criterion for L1 -Regularized Logistic Regression
Paper 38	Moslem Azamfar, Xiaodong Jia, Vibhor Pandhare, Jaskaran Singh, Hoseein Davari and Jay Lee	Detection and diagnosis of bottle capping failures based on motor current signature analysis
Paper 50	Florian Hoppe, Johannes Hohmann, Maximilian Knoll, Christian Kubik and Peter Groche	Feature-based Supervision of Shear Cutting Processes on the Basis of Force Measurements: Evaluation of Feature Engineering and Feature Extraction
1400-1530 110	**NAMRC - TRACK 2 MANUFACTURING PROCESSES - Advanced Processes 2** *Session Chair: Jia Deng*	
Paper 44	Yingge Zhou, Shahrima Maharubin, Dilshan Sooriyaarachchi and George Tan	The Effect of Nanoclays on Nanofiber Density Gradient in 3D Scaffolds Fabricated By Divergence Electrospinning
Paper 83	Myong Joon Kim, Maxwell Praniewicz, Thomas Kurfess and Christopher Saldana	Adaptive repair and digitization for hybrid manufacturing
Paper 87	Xianli Liu, Zhan Chen, Wei Ji and Lihui Wang	Iteration-based error compensation for a worn grinding wheel in solid cutting tool flute grinding
1400-1530 120	**NAMRC - TRACK 3 MATERIAL REMOVAL - Machining 4** *Session Chair: Mike Vogler*	
Paper 121	Aditya Nagaraj, Suk Bum Kwon, Hae-Sung Yoon and Sangkee Min	Crack removal behavior in ultra-precision machining of sapphire
Paper 141	Hui Wang, Yingbin Hu, Weilong Cong and Anthony Burks	Rotary ultrasonic surface machining of CFRP composites: Effects of horizontal ultrasonic vibration
Paper 143	Sagil James and Sagar Panchal	Parametric Study of Micro Ultrasonic Machining Process of Hybrid Composite Stacks using Finite Element Analysis

11400-1530 130A	**NAMRC - TRACK 4 ADDITIVE MANUFACTURING - Materials & Characterization 4** *Session Chair: Sam Anand*	
Paper 142	Pu Han, Alireza Tofangchi, Anagh Deshpande, Sihan Zhang and Keng Hsu	An approach to improve interface healing in FFF-3D printed Ultem 1010 using laser pre-deposition heating
Paper 147	Anagh Deshpande, Alireza Tofangchi and Keng Hsu	In-process Microstructure Tuning in Solid-State Ambient Condition Metal Direct Manufacturing
Paper 162	Gabriel Carrillo, Devin Keck and Rodrigo Martinez-Duarte	Mechanical Properties and Process Improvement of Tungsten Carbide Additively Manufactured with Renewable Biopolymers
1400-1530 130B	**NAMRC - TRACK 5 SMART MANUFACTURING & CYBER-PHYSICAL SYSTEMS - Monitoring & Control 3** *Session Chair: Tony Schmitz*	
Paper 52	Yun Chen, Shijie Su, Qiao Li and Hui Yang	Multi-sensor Data Fusion for Online Quality Assurance in Flash Welding Processes
Paper 57	Michael Gomez and Tony Schmitz	Displacement-based dynamometer for milling force measurement
Paper 73	Ethan Wescoat, Matthew Krugh, Andy Henderson, Josh Goodnough and Laine Mears	Vibration Analysis Utilizing Unsupervised Learning
1550-1720 110	**NAMRC - TRACK 2 MANUFACTURING PROCESSES - Advanced Processes 3** *Session Chair: Murali Sundaram*	
Paper 96	Saheem Absar, Sai Amruth Venkatesh Ganduri and Hongseok Choi	Study of the Geometrical Effects of Impeller on the Flow Field in Hybrid Mixing Process for Manufacturing Nanocomposites
Paper 115	Narek Manukyan, Abishek B. Kamaraj and Murali Sundaram	Localized Electrochemical Deposition Using Ultra-High Frequency Pulsed Power
1550-1720 120	**NAMRC - TRACK 3 MATERIAL REMOVAL - Machining** *Session Chair: Farbod Akhavan Niaki*	
Paper 165	Gouthaman Nithyanand, Abram Pleta, Farbod Akhavan Niaki and Laine Mears	Identification of machining parameters for trochoidal milling of Inconel 718 for minimum force and tool wear using the Taguchi method
Paper 169	Kamran Khan, Alwin Varghese, Pradeep Dixit and Suhas Joshi	Effect of Tool Path Complexity on Top Burrs in Micromilling
Paper 175	Delfim Joao, Nicolas Milliken, Evgueni V. Bordatchev and O. Remus Tutunea-Fatan	Axial strategy for ultraprecise single point cutting of V-grooves; Case 1: constant chip thickness

1550-1720 130A	**NAMRC - TRACK 4 ADDITIVE MANUFACTURING - Materials & Characterization 5** *Session Chair: Keng Hsu*	
Paper 171	Pavan Bhavsar, Homar Lopez-Hawa, Rajesh Ananda-Kumar, Viswanathan Madhavan and Wilfredo Moscoso-Kingsley	Adiabatic shear banding behavior of additively manufactured superalloy IN 625
Paper 184	Damian Beasock, T. Michael Stokes, Ahmed El-Ghannam and Tony Schmitz	Effect of processing parameters on the microstructure and mechanical behavior of a silicon carbide-silica composite
Paper 198	Sudhanshu Nahata and O. Burak Ozdoganlar	Feasibility of Metal Additive Manufacturing for Fabricating Custom Surgical Instrumentation for Hip and Knee Implants

1550-1720 130B	**NAMRC - TRACK 5 SMART MANUFACTURING & CYBER-PHYSICAL SYSTEMS - Monitoring & Control 3** *Session Chair: Robert Landers*	
Paper 109	Peng Wang and Robert Gao	Prognostic Modeling of Performance Degradation in Energy Storage by Lithium-ion Batteries
Paper 120	Joseph Fischer, Mitchell Woodside, Mercedes Gonzalez, Nathan Lutes, Douglas Bristow and Robert Landers	Iterative learning control of single point incremental sheet forming process using digital image correlation
Paper 122	Mercedes Gonzalez, Nathan Lutes, Joseph Fischer, Mitchell Woodside, Douglas Bristow and Robert Landers	Analysis of geometric accuracy and thickness reduction in multistage incremental sheet forming using digital image correlation

0910-1040 130C	**Session 1-3-3 Establishing Process- Property Relationships** *Session Chair: Hongyue Sun | Session Co-Chair: Olga Wodo*	
MSEC2019-2717	Xingjian Wei, Abhinav Bhardwaj, Chin-Cheng Shih, Li Zeng, Bruce Tai and Zhijian Pei	Experimental Investigation of Stratasys J750 PolyJet Printer: Effects of Orientation and Layer Thickness on Mechanical Properties
MSEC2019-2788	Sahand Hajifar, Ramanarayanan Purnanandam, Hongyue Sun and Chi Zhou	Exploring the Multi-Stage Effects of Material Preparation and Printing on 3D Printing Product Quality
MSEC2019-3035	Aniruddha Gaikwad, Farhad Imani, Prahalad Rao, Hui Yang and Edward Reutzel	Design Rules and In-Situ Quality Monitoring of Thin-Wall Features Made Using Laser Powder Bed Fusion

0910-1040 140A	**Session 2-4-2 Advances in Data Analytics and Engineering Modeling for Intelligent & Resilient Manufacturing Systems II** *Session Chair: Xiaowei Yue | Session Co-Chair: Chenhui Shao*	
MSEC2019-2945	Xiaowei Yue	Data Decomposition for Analytics of Engineering Systems: Literature Review, Methodology Formulation, and Future Trends
MSEC2019-2812	Jorge D. Camba, Manuel Contero, David Pérez-López and Pedro Company	A Database Framework for the Characterization and Classification of Parametric Models Based on Complexity Metrics to Support Data Analytics
MSEC2019-2753	Yifan Dong, Tangbin Xia, Lei Xiao, Ershun Pan and Lifeng Xi	Real-Time Prognostic and Dynamic Maintenance Window Scheme for Reconfigurable Manufacturing Systems

0910-1040 140B	**Session 3-3-1 Machining - I** *Session Chair: Jianfeng Ma | Session Co-Chair: Jay Raval*	
MSEC2019-2712	Greg Pasken, Jianfeng Ma, Muhammad Jahan and Shuting Lei	Numerical Simulation of Pure Water Jet Machining of Al 6061-T6 With Experimental Validation
MSEC2019-2786	Yixuan Feng, Tsung-Pin Hung, Cheng Shiu and Steven Liang	Prediction of Surface Hardness in Laser-Assisted Milling
MSEC2019-2758	Sagil James and Aakash Patil	Preliminary Study on Multiscale Modeling and Simulation of Liquid-Assisted Laser Beam Machining

0910-1040 140C	**Session 3-4-2 Advances in Nontraditional Manufacturing Processes 2** *Session Chair: Anant Kumar Singh*	
MSEC2019-2971	William Emblom, Ayotunde Olayinka and Scott Wagner	The Development of a Microscale Tube Hydroforming Test Bed and Novel Sealing System: A Work in Progress
MSEC2019-2828	Yang Lian, Hong Lu, Mingtian Ma, Jianying He, Qiong Liu, Qian Cheng and Yu Qiao	Straightening Process of Straight Metal Pipe Considering the Flattening Effect
MSEC2019-3019	Xiaoxu Chen, Hui Wang, Yingbin Hu, Dongzhe Zhang, Weilong (Ben) Cong and Anthony R. Burks	Rotary Ultrasonic Machining of CFRP Composites: Effects of Machining Variables on Workpiece Delamination

0910-1040 160A	**Session 3-7-5 Fusing Welding of Dissimilar Materials** *Session Chair: Yi Zhang*	
MSEC2019-3048	Bret Curtis, Cody Lough, Robert Landers, Douglas Bristow and Edward Kinzel	Fabrication of Glass to Metal Connections Using a Laser Heated Additive Approach
MSEC2019-2722	Ashish K. Nath and Muvvala Gopinath	Assessment of Microstructure and Mechanical Properties in Laser Cladding, Welding and Surface Polishing Through Online Monitoring of Thermal History

0910-1040 160B	**Session 3-10-1 Machining I** *Session Chair: Dinakar Sagapuram*	
MSEC2019-3022	Shwetabh Yadav and Dinakar Sagapuram	Nucleation and Boundary Layer Growth of Shear Bands in Machining
MSEC2019-3013	Juan Sandoval, Dinh Nguyen, Patrick Kwon and Yang Guo	An Experimental Study of Modulation-Assisted Turning of Ti6Al4V
MSEC2019-2922	Anirudh Udupa, Tatsuya Sugihara and James Mann	Glues Make Gummy Metals Easy to Cut

1100-1230 130C	**Session 1-3-4 Assessing Product Quality in Additive Manufacturing** *Session Chair: Olga Wodo | Session Co-Chair: Bashir Khoda*	
MSEC2019-2874	Xiao Zhang, Vignesh Suresh, Yi Zheng, Shaodong Wang, Qing Li, Hao Lyu, Beiwen Li and Hantang Qin	Surface Roughness Measurement of Additive Manufactured Parts Using Focus Variation Microscopy and Structured Light System
MSEC2019-2863	Chabum Lee, Jaemin Han and Gyu-Ha Kim	Additive Manufacturing-Based Adaptive Dynamic Parameter Characterization by Using Pressure-Fed Flexure Mechanisms
MSEC2019-3008	Roozbeh Ross Salary, Jack P. Lombardi III, Darshana L. Weerawarne, Prahalad Rao and Mark D. Poliks	A State-of-the-Art Review on Aerosol Jet Printing (AJP) Additive Manufacturing Process

1100-1230 140A	**Session 2-5-1 Measurement Methods for Process Health Monitoring** *Session Chair: Michael Brundage | Session Co-Chair: Brian Weiss*	
MSEC2019-2755	Thomas A. Feldhausen, Asimm H. Hirani, Walter E. King, Roby Lynn and Thomas Kurfess	Conceptualization and Design of a Low-Cost MTConnect-Enabled Refractometer for Coolant Health Monitoring
MSEC2019-2785	Baoqing Ding, Ruqiang Yan, Shibin Wang, Chaowei Tong and Xuefeng Chen	Singular Vector-Inspired Dictionary Learning for Sparse Decomposition of Vibration Signal
MSEC2019-2911	Gregory Vogl, Brian C. Galfond and N. Jordan Jameson	Bearing Metrics for Health Monitoring of Machine Tool Linear Axes

1100-1230 140B	**Session 3-4-3 Advances in Nontraditional Manufacturing Processes 3** *Session Chair: William Emblom*	
MSEC2019-2943	Sanjib Jaypuria, Debalay Chakrabarti, Dilip K. Pratihar and Mahanand Jha	Effect of Beam Oscillations on Formation of Defects in Electron Beam Welding of Copper Plate
MSEC2019-2894	Xiuping Zhang, Lei Li, Yaozhao Mu, Yanxiang Xie, Jun Dai and Jing Shi	Enhancing Conductivity and Corrosion Resistance by Organic Coatings on AZ31 Magnesium Alloy Treated by Micro-Arc Oxidation
MSEC2019-2963	Ebrahim Seidi and Scott F. Miller	Friction Surfacing Using Consumable Tools: A Review

1100-1230 140C	**Session 3-6-1 Application of Ultrafast Laser in Manufacturing** *Session Chair: Chang Ye | Session Co-Chair: Yiliang Liao*	
MSEC2019-3023	Kewei Li and Xin Zhao	Formation of Micro-/Nano-Surface Structures on Stainless Steel by Ultrafast Lasers
MSEC2019-2968	Shuting Lei, Xin Zhao, Xiaoming Yu, Anming Hu, Sinisa Vukelic, Martin Jun, Hang-Eun Joe, Y. Lawrence Yao and Yung Shin	Ultrafast Laser Applications in Manufacturing Processes: A State of the Art Review

1100-1230 160A	**Session 3-3-2 Manufacturing Process - I** *Session Chair: Hao Wang | Session Co-Chair: Christian Sommerfeld*	
MSEC2019-2782	Thorsten Helmig, Bingxiao Peng, Claas Ehrenpreis, Thorsten Augspurger, Yona Frekers, Reinhold Kneer and Thomas Bergs	A Coupling Approach Combining CFD and FEM Methods to Predict Cutting Fluid Effects on the Tool Temperature in Cutting Processes
MSEC2019-2833	Christian Sommerfeld, Eckart Uhlmann and Anton Hoyer	Modelling of Brushing Processes
MSEC2019-2977	Hao Wang, Bo Li, Zongyue Fan, and Xiaobai Li	Numerical Modeling of the Hot Forming Process of Composite Materials

1100-1230 160B	**Session 3-10-2 Machining II** *Session Chair: Tatsuya Sugihara*	
MSEC2019-2909	Tatsuya Sugihara, Mojib Saei, Koushik Viswanathan and Anirudh Udupa	Some Observations on How Mechanochemical Effect Determines Deformation Mode and Chip Morphology in Cutting of Metals
MSEC2019-2957	Vandana A Salilkumar and Narayan Sundaram	On the Application of Arbitrary Lagrangian-Eulerian and Remeshing Techniques to Simulate Certain Machining and Deformation Processing Operations
MSEC2019-2970	Yang Guo, Jisheng Chen and Amr Saleh	In Situ Analysis of Deformation Mechanics of Constrained Cutting Towards Enhanced Material Removal

1400-1530 130C	**Session 1-3-5 Process Planning and Parameter Optimization** *Session Chair: Bashir Khoda | Session Co-Chair: Prahalad Rao*	
MSEC2019-2739	Jasgurpreet Singh Chohan, Rupinder Singh and Kamaljit Singh Boparai	Multi Response Optimization and Process Capability Analysis of Fused Filament Fabrication and Chemical Vapor Smoothing Operations for Rapid Casting of Biomedical Implants
MSEC2019-2701	Kamaljit Singh Boparai, Gurpartap Singh, Rupinder Singh and Sarabjit Singh	Investigations for Wax Coated 3D Printed Hybrid Patterns for Partial Dentures
MSEC2019-3010	Amm Nazmul Ahsan and Triston Ihrke and Bashir Khoda	Novel Honeycomb Infill Fabrication Pattern for Additive Manufacturing

1400-1530 140A	**Session 2-5-2 Improving Maintainability in Manufacturing Systems** *Session Chair: Brian Weiss | Session Co-Chair: Michael Brundage*	
MSEC2019-2902	Brian Weiss	Developing Measurement Science to Verify and Validate the Identification of Robot Workcell Degradation
MSEC2019-2921	Michael Brundage, Thurston Sexton, Melinda Hodkiewicz, KC Morris, Jorge Arinez, Farhad Ameri and Guoxian Xiao	Where Do We Start? Guidance for Technology Implementation in Maintenance Management for Manufacturing
1400-1530 140B	**Session 3-3-3 Machining- II** *Session Chair: Wolfgang Lortz | Session Co-Chair: Yixuan Feng*	
MSEC2019-2807	Kaining Shi, Ning Liu, Sibao Wang, Chi Ma, Bo Yang, Lili Yi and Ling Kang	Study of Effect of Teeth Number on Cutting Force for Cutter Selection in the End Milling of TC4
MSEC2019-2818	Wolfgang Lortz and Radu Pavel	The Realities of Friction in Metal Plastic Flow With Corresponding Results During Metal Cutting
MSEC2019-2926	Jay Raval, Wayne Hung and Bruce Tai	Multiphase Flow Distribution in MQL Drilling Using Optical Intensity Distribution Based Approach
1400-1530 140C	**Session 3-4-4 Advances in Nontraditional Manufacturing Processes-4** *Session Chair: Jing Shi*	
MSEC2019-2851	Arpit Thomas and Anant Kumar Singh	Magnetorheological Nano-Surface-Finishing of Tapered Cavity of Chrome Steel Punch
MSEC2019-2852	Lijo Paul and J Babu	Grey Relation Approach in Abrasive Jet Machining Process
MSEC2019-2914	Gourhari Ghosh, Ajay M Sidpara and P P Bandyopadhyay	Preliminary Results on Finishing of WC-Co Coating by Magnetorheological Finishing Process
1400-1530 160A	**Session 3-6-2 Application of Laser Peening in Additive Manufacturing** *Session Chair: Xin Zhao | Session Co-Chair: Chang Ye*	
MSEC2019-2979	Hao Zhang, Jun Liu, Yalin Dong and Chang Ye	The Effects of Laser-Assisted Ultrasonic Nanocrystal Surface Modification on 3D-Printed Ti-6Al-4V Alloy
MSEC2019-2731	Yongxiang Hu, Mengqi Lai and Zhenqiang Yao	Experimental Investigation on Laser Peening of Additively Manufactured Ti6Al4V Alloy
MSEC2019-2893	Kuldeep Sidhu, Yachao Wang, Jing Shi, Vijay Vasudevan and Seetha R. Mannava	Effect of Post Laser Shock Peening on Microstructure and Mechanical Properties of Inconel 718 by Selective Laser Melting

1400-1530 160B	**Session 5-3-1 Biomedical Machining** *Session Chair: Yong Lei | Session Co-Chair: Yihao Zheng*	
MSEC2019-2822	Yue Zhang, Chengyong Wang, Zhihua Chen, Na Tang and Bin Chen	Effect of Cutting Parameters on Cutting Force and Surface Quality in Cutting of Articular Cartilage
MSEC2019-2990	JuEun Lee, Zachary Matsumoto and Serena Y. Chu	Forces in Deep-Hole Bone Drilling
MSEC2019-2953	Murong Li and Yong Lei	A Novel Material Point Method Based Needle-Tissue Interaction Model
1500-1720 130C	**Session 1-3-6 Quantifying Deformation and Surface Finish in Additive Manufacturing** *Session Chair: Chi Zhou | Session Co-Chair: Shing I. Chang*	
MSEC2019-3006	Jida Huang, Hongyue Sun, Tsz Ho Kwok, Chi Zhou and Wenyao Xu	Geometric Deep Learning for Shape Correspondence in Mass Customization
MSEC2019-2845	Konstantin Struebig, Andreas Schröffer and Tim C. Lueth	Experimental Study on the Warpage and Tensile Strength of Additively Manufactured Semi-Crystalline Polyamide 6
MSEC2019-2899	Yanglong Lu and Yan Wang	An Improvement of Physics Based Compressive Sensing With Domain Decomposition to Monitor Temperature in Fused Filament Fabrication Process
1500-1720 140A	**Session 3-4-5 Advances in Nontraditional Manufacturing Processes 5** *Session Chair: Meng Zhang*	
MSEC2019-2826	Zexing Guo, Hong Lu, Jinglin Zhang, Yue Zang, Weixin Zhang, Jianying He and Qiong Liu	Improvement on Straightness of Micro-Motor Shaft Considering Stress Concentration Caused by the Grooves
MSEC2019-2791	Zhikang Yang, Jiyu Liu, Zhuji Jin, Guansong Wang, Chuanchuan Wang, Jing Sun and Xin Liu	Research on Ultrasonic Assisted Polyurethane Rubber Punching
MSEC2019-2768	Palamandadige Fernando, Meng Zhang, Zhijian Pei and Adam Owens	Rotary Ultrasonic Machining of Basalt Rock Using Compressed Air As Coolant: A Study on Edge Chipping and Surface Roughness
1550-1720 140B	**Session 3-3-4 Manufacturing Process II** *Session Chair: Anupam Agrawal | Session Co-Chair: Maximilian Lachenmaier*	
MSEC2019-3052	Ala Qattawi, Durul Ulutan and Ala'Aldin	Prediction of Mechanical Properties of Direct Metal Laser Sintered 15-5PH Steel Parts Using Bayesian Inference: A Preliminary Study
MSEC2019-3062	Yanzhong Wang, Kai Yang and Wen Tang	Design and Analysis of the Transmission System in Geared Turbofan Engine
MSEC2019-2716	Sagil James and Karan Shah	Investigation on Residual Stress Development During Multiple Impacts in Cold Spray Process

1550-1720 140C	**Session 3-5-1 Hard Machining and Grinding** *Session Chair: Rahul Chaudhari | Session Co-Chair: Hitomi Yamaguchi*	
MSEC2019-2763	Serafino Caruso, Giovanna Rotella and Luigino Filice	Finite Element Modeling of Microstructural Changes in Hard Machining of SAE 8620
MSEC2019-2777	Benjamin Kirsch, Hendrik Hotz, Jörg Hartig, Sebastian Greco, Marco Zimmermann and Jan C. Aurich	Surface Morphology of Additively Manufactured AISI 316L When Grinding
MSEC2019-3012	Ashutosh Khatri, Muhammad Jahan, Xingbang Chen and Jianfeng Ma	Investigating Microstructural Changes and Phase Transformation During Slot Milling of Ti-6Al-4V in Dry, Flood Coolant and MQL Conditions

1550-1720 160A	**Session 5-4-1 Advances in 3D Bioprinting of Tissue Scaffolds and Organs 1** *Session Chair: Changxue Xu | Session Co-Chair: Heqi Xu*	
MSEC2019-3011	Md Habib and Bashir Khoda	Effect of Process Parameters on Cellulose Fiber Alignment in Bio-Printing
MSEC2019-2816	Parth Chansoria and Rohan Shirwaiker	Ultrasonically-Induced Patterning of Viable Cells in Viscous Bioinks During 3D Biofabrication
MSEC2019-2747	Heqi Xu, Changxue Xu and Zhengyi Zhang	Sedimentation Study of Bioink Containing Living Cells

1550-1720 160B	**Session 3-10-3 Deformation I** *Session Chair: Yang Guo*	
MSEC2019-2980	Haipeng Qiao, Tejas Murthy and Christopher Saldana	Structure and Deformation of Gradient Metal Foams Produced by Machining
MSEC2019-2905	Chetan Nikhare	Bending and Springback Analysis on Sheet Metal Material Discontinuity
MSEC2019-2877	Elizabeth M Mamros and Chetan Nikhare	Springback Analysis of Hybrid Materials Created Through Alternative Layup Processes

1400-1530 **100**	**Keynote Papers for ASME Journal of Manufacturing Science and Engineering (JMSE) 100th year anniversary of the Manufacturing Engineering Division (MED) - Session 3** *Session Chair: Albert Shih | Session Co-Chair: Laine Mears*	
14:00-14:18	Shreyes Melkote, Steven Liang, Tugrul Ozel, I.S. Jawahir	Advances in Machining Process Modeling: From Merchant to the Present Day [Dedicated to Merchant] *Presenter: Shreyes Melkote*
14:18-14:36	YuMing Zhang, Zhili Feng, Jyoti Mazumder, Sindo Kou, Kevin Moore, George Cook	Advanced Welding – A Review of Emerging State-of-Arts Advanced Welding Methods *Presenter: Yuming Zhang*
14:36-14:54	Sagapuram, K. Viswanathan, C. Saldana, J. B. Mann, S. Chandrasekar	On the Cutting of Metals: A Materials Viewpoint [Dedicate to Milton Shaw] *Presenter: S. Chandrasekar*
14:54-15:12	Steven Schmid, Pradip Saha, Tony Schmitz, Jyhwen E. Wang	Developments in Tribology of Manufacturing Processes *Presenter: Steven Schmid*
15:12-15:30	Moneer Helu, William Sobel, Saigopal Nelaturi, Scott Hibbard	Perspectives on Decentralized and Distributed Production in Industry [Dedicated to Dave Dornfeld] *Presenter: Moneer Helu*

1550-1720 **100**	**Keynote Papers for ASME Journal of Manufacturing Science and Engineering (JMSE) 100th year anniversary of the Manufacturing Engineering Division (MED) - Session 4** *Session Chair: Albert Shih | Session Co-Chair: Laine Mears*	
16:00-16:18	John W. Sutherland, Steven J. Skerlos, Fu Zhao, Karl R. Haapala, Daniel R. Cooper	Industrial Sustainability: Research Progress and Future Directions *Presenter: Karl Kaapala*
16:18-16:36	Jian Cao, Delcie Durham, Miki Banu	Forming Processes *Presenter: Miki Banu*
6:36-16:54	Robert Chang, Roland Chen, Yong Huang, Albert Shih, Bruce Tai	Biomedical Manufacturing: A Review of the Emerging Research and Future Outlook *Presenter: Roland Chen*
16:54-17:12	Thomas R. Kurfess, Christopher Saldana, Roby Lynn, Kyle Saleeby, Mahmoud Parto Dezfouli	Internet of Things for Manufacturing *Presenter: Tom Kurfess*
17:12-17:30	Changshen Guo, Zhongde Shi, Brigid Mullany, Barbara Linke, Hitomi Yamaguchi, Rahul Chaudhari, Albert Shih	Advancements in Abrasive Machining [Dedicated to Steve Malkin] *Presenter: Albert Shih*

Advanced Polymer Composites & Manufacturing for the Circular Economy (A Planning Session for GEN 4 – ERC)

Thursday, June 13 14:00-16:30

Organizer: Penn State University TENAS ERC Team

Sponsored by: National Science Foundations & Penn State University

Purpose: Engaging potential industrial and academic partners for development of the next generation of highly-recyclable composites

Description: Penn State University has been invited to submit a second-round proposal for the creation of a Gen-4 NSF Engineering Research Center (ERC). The ERC is entitled **TENAS: Translating & Evolving Nanoscale Assembly for Society**.

This ERC group is dedicated to developing new polymer and composite systems, designed with scale-up and end-of-life strategies that enable integration with the circular economy. TENAS technologies are intended to change the paradigm of industrial polymer and composite waste by accelerating the implementation of advanced materials that can be reused with 95% or greater property retention. Our goal is to work with the automotive and construction industries to develop new technologies that can be quickly adopted into commercial applications.

TENAS is seeking partners of many types, including industrial, non-profit, and policymakers, to build a strong, convergent approach to rapid technology adoption. We intend to build a new type of university-industry collaboration. Benefits for partners include:

1. **Graduate student internship/externship exchange**
2. **On-site research opportunities for industrial scientists or professionals (at Penn State or at our partner universities of UPenn, Columbia, Northwestern)**
3. **Opportunity to influence research strategy**
4. **First access to center-developed intellectual property; start-up company options**
5. **Access to private/federal funding through collaborative TENAS workgroups**
6. **Networking with partners across the value chain**

Agenda

2:00 – 2:30: Introduction to the TENAS ERC model, driving science, and research resources
2:30 – 3:15: Panel discussion – Brainstorm key industrial application and implementation areas
3:15 – 4:00: ERC Engagement Options

Fee: Free for registered conference participants

Attendance: Open to all registered conference participants

Session Chair: *Dr. Alicyn M. Rhoades, Associate Professor, Dept. of Plastics Engineering Technology Penn State Behrend*

For more information, please contact alicyn@psu.edu

TIME	LOCATION	EVENT
7:30-8:30	N. Point Lobby/ E. Pr-function	Breakfast
8:40-10:10	110-160B	Technical Session 12
10:10-10:30	N. Point Lobby/ E. Pr-function	Morning Break
10:30-12:00	110-160B	Technical Session 13
12:00-13:00	E. Pre-function	Boxed Lunch

0840-1010 110	**NAMRC - TRACK 2 Manufacturing Processes- Advanced Processes 4** *Session Chair: Weilong Cong*	
Paper 124	Niechen Chen and Matthew Frank	Process planning for hybrid additive and subtractive manufacturing to integrate machining and directed energy deposition
Paper 148	Jessie Jingxuan Lyu, Yihao Zheng, Albert Shih, Xiang Wu, Yao Liu, Yang Liu and Annie Dian-Ru Li	A miniature nickel-diamond electroplated wheel for grinding of the arterial calcified plaque
Paper 154	Jia Deng, Huimin Zhou, Jingyan Dong and Paul Cohen	Three-Dimensional Nanomolds Fabrication for Nanoimprint Lithography
0840-1010 120	**NAMRC - TRACK 4 Additive Manufacturing- Processes 4** *Session Chair: Edward De Meter*	
Paper 11	Edward De Meter, Kok Hwang Chow and Eric Marsh	Methodology of using PAAW and the Underlying Support Network of an L-PBF Part to Facilitate Machining
Paper 183	Paolo Parenti, Salvatore Cataldo, Alberto Grigis, Marco Covelli and Massimiliano Annoni	Implementation of hybrid additive manufacturing based on extrusion of feedstock and milling
0840-1010 130A	**NAMRC - TRACK 5 Smart Manufacturing & Cyber- Physical Systems- Monitoring & Control 5** *Session Chair: Carlos Escobar*	
Paper 163	Achyuth Kothuru, Sai Prasad Nooka and Rui Liu	Application of deep visualization in CNN-based tool condition monitoring for end milling
Paper 179	Rishabh Mulesh Vedant, Matthew Krugh and Laine Mears	Measuring finger engagement during manual assembly operations in automotive assembly
Paper 197	Carlos Escobar and Ruben Morales-Menendez	Process-Monitoring-for-Quality — A Model Selection Criterion for Support Vector Machine
1030-1200 110	**NAMRC - TRACK 2 Manufacturing Processes- Advanced Processes 5** *Session Chair: Jia Deng*	
Paper 159	Guofu Lian, Mingpu Yao, Zhichao Liu, Su Yang, Changrong Chen, Hui Wang, Yisha Xiang and Weilong Cong	Near-Net Shaping Control of Triangular Stacking in Laser Cladding Process
Paper 190	Avik Samanta, Qinghua Wang, Gurjap Singh, Scott Shaw, Fatima Toor, Albert Ratner and Hongtao Ding	Nanosecond Pulsed Laser Processing Turns Engineering Metal Alloys Antireflective and Superwicking

1030-1200 120	**NAMRC - TRACK 3 Material Removal** *Session Chair: David Stephenson*	
Paper 68	David Stephenson, Ethan Hughey and Aleem Hasham	Air flow and chip removal in minimum quantity lubrication drilling
Paper 69	Ethan Hughey and David Stephenson	Oil delivery balancing and priming for multi-diameter minimum quantity lubrication tooling assemblies

1030-1200 130A	**NAMRC - TRACK 4 Additive Manufacturing- Processes 5** *Session Chair: Edward De Meter*	
Paper 178	Shahriar Safaee and Roland Chen	Investigation of a Magnetic Field-Assisted Digital-Light-Processing Stereolithography Process for Functionally Graded Materials
Paper 195	Angshuman Deka and Sara Behdad	Part Separation Technique for Assembly Based Design in Additive Manufacturing using Genetic Algorithm

0840-1010 130B	**Session 1-3-7 Reviews Papers in Additive Manufacturing** *Session Chair: Shing I. Chang | Session Co-Chair: Prahalad Rao*	
MSEC2019-2913	Mohammadhossein Amini, Shing I. Chang and Prahalad Rao	A Cybermanufacturing Framework for Addressing Quality Issues in Laser Powder Bed Fusion (LPBF) Additive Manufacturing Process
MSEC2019-3018	Ketan Thakare, Xingjian Wei and Zhijian Pei	Dimensional Accuracy in PolyJet Printing: A Literature Review
MSEC2019-2994	Ming Li, Wenchao Du, Alaa Elwany, Zhijian Pei and Chao Ma	Binder Jetting Additive Manufacturing of Metals: A Literature Review

0840-1010 130C	**Session 2-6-1 Advances in Manufacturing Execution - I** *Session Chair: Herman Tang | Session Co-Chair: Cary Zhang*	
MSEC2019-2912	Jad Imseitif and Herman Tang	Effects Analysis of Internal Buffers in Serial Manufacturing Systems for Optimal Throughout
MSEC2019-2856	Jialiang Liu, Qiong Liu, Chenxin Xu, Zhaorui Dong and Mengbang Zou	Scheduling of Cellular Manufacturing With Flexible Routes Intercell Moves for Carbon Reduction in a Network Environment
MSEC2019-2823	Hong Seok Park and Khash Ochir Namjil	Design of Flexible Membrane Fixture for Automobile Door-Trim Infra Stake Welding Machine

0840-1010 140A	**Session 3-3-5 Machining - III** *Session Chair: Sagil James | Session Co-Chair: Liming Li*	
MSEC2019-2754	Liming Li and Imin Kao	Modeling and Experimental Study of the Impact on Free Abrasive Machining (FAM) due to Vibration of a Thin Wire Subject to an Oscillating Boundary Condition
MSEC2019-3049	Zaoyang Zhou, Xueping Zhang, Kunlun Lv, Jun Wu, Zhenqiang Yao and Lifeng Xi	Simulating the Sequential Honing Process of Engine Cylinder Bore by Modeling Abrasives in Honing Stone
MSEC2019-2707	Nick Duong, Jianfeng Ma, Shuting Lei, Murali Sundaram and Muhammad Jahan	FEM Investigation of Damage Evolution at Elevated Temperatures With Multiple Impact Hits in Vibration Assisted Nano Impact Machining by Loose Abrasives

0840-1010 140B	**Session 3-6-3 Laser Shock Peening and Forming** *Session Chair: Yongxiang Hu | Session Co-Chair: Yiliang Liao*	
MSEC2019-2850	Bo Mao, Yiliang Liao and Bin Li	Twinning Behavior in Magnesium Alloys Processed by Laser Shock Peening
MSEC2019-2910	Bo Mao, Xing Zhang, Yiliang Liao and Bin Li	Improving Room Temperature-Stretch Formability of Magnesium Alloys by Laser Shock Peening
0840-1010 140C	**Session 3-10-4 Deformation II** *Session Chair: Chetan Nikhare*	
MSEC2019-2906	Chetan Nikhare, Paul McMahon and Faisal Aqlan	An Experimental Study on Direct Current Dieless Drawing of 4130 Steel Tubes
MSEC2019-2714	Rajiv Selvam and Shanmuga Sundaram	Experimental Investigation of Electromagnetic Compression Forming of Aluminum Alloy Tubes
MSEC2019-2949	Soumya Ranjan Guru and Mihir Sarangi	Evaluation of Mechanical Properties of Poly-Ether-Ether-Ketone by Using Multi-Cycle Indentation Method
0840-1010 160A	**Session 5-3-2 Biomedical Manufacturing** *Session Chair: Roland Chen | Session Co-Chair: Yancheng Wang*	
MSEC2019-3033	Xiaoran Li, Che-Hao Yang, Roland Chen and Wei Li	Dynamic Impedance Monitoring of Large Diameter-Vessel Sealing in Bipolar Electrosurgeries
MSEC2019-2946	Che-Hao Yang, Maher Amer, Wei Li and Roland Chen	A New Concept of Electrosurgical Tissue Joining Process Using Sequential Compression for Minimal Thermal Damage
MSEC2019-2870	Shahrima Maharubin, Xiaomei Shu, Manavi Singh, Benildo De los Reyes and George Tan	Surface Modifications of Titanium With Covalently-Bonded Silver Nanoparticles for Antimicrobial Applications
0840-1010 160B	**Session 3-8-1 SYMP 3-8 Advances in Manufacturing Processes for Energy Applications** *Session Chair: Nikhil Churi*	
MSEC2019-2916	Yang Yang, Mingman Sun, Timothy Deines, Meng Zhang, Jun Li and Donghai Wang	Effects of Particle Size on Biomass Pretreatment for Biofuel Production
MSEC2019-3032	Arvind Shankar Raman, Dustin Harper, Karl R. Haapala, William Bernstein and KC Morris	Challenges in Representing Manufacturing Processes for Systematic Sustainability Assessments: Workshop on June 21, 2018
MSEC2019-2901	Sagil James, Shubham Birar, Riken Parekh, Kushal Jain and Kiran George	Preliminary Study on Fractal-Based Monopole Antenna Fabricated Using 3D Polymer Printing and Selective Electrodeposition Process

1030-1200 130B	**Session 2-10-1 CPS, Stochastic Modeling, and Sensor Networks in Advanced Manufacturing** *Session Chair: Parikshit Mehta*	
MSEC2019-2703	Zhao Zhiqian, Chua Wei Quan, Xiaoming Ding and Prabhu Vinayak Ashok	Smart Factory of Industry 4.0: Connection Infrastructure, Data Acquisition, Data Processing, and Applications
MSEC2019-2896	Mohamed Kashef, Richard Candell and Sebti Foufou	On the Impact of Wireless Communications on Controlling a Two-Dimensional Gantry System
MSEC2019-2844	Xing Zhang, Bo Mao,Rebecca Histed and Yiliang Liao	Modeling for Chemical-Etching Enhanced Pulsed Laser Ablation
1030-1200 130C	**Session 2-6-2 Advances in Manufacturing Execution II** *Session Chair: Herman Tang | Session Co-Chair: George (Mike) Smith*	
MSEC2019-2825	Liu Bao, Hong Lu, Minghui Yang, Xinbao Zhang, Lu Yu, Bowen Wang and Lingyan Wang	Influence of Form Defects on the Load Bearing Characteristics of Interference Fits of Shaft and Bush
MSEC2019-2840	Romina Dastoorian, Lee Wells and Wenmeng Tian	A Hybrid Approach for Heterogeneous High-Density Data for Surface Topology Classification: A Case Study
MSEC2019-2757	Chi Ma, Jialan Liu, Penghai Zhang, Hu Shi, Sibao Wang, Bo Yang, Ling Kang and Lili Yi	Correction of Thermal Boundary Conditions of High-Speed Spindle System
1030-1200 140A	**Session 3-3-6 Manufacturing Process III** *Session Chair: Dazhu Li | Session Co-Chair: Jianfeng Ma*	
MSEC2019-2729	Jiang Han, Dazhu Li, Lian Xia and Xiaoqing Tian	Analytical Study on Tooth Profile of Non-Circular Gear Based on Hobbing Process Simulation
MSEC2019-3026	Saurabh Rai, Rakesh Kumar, Harish K. Nirala, KecinFrancis and Anupam Agrawal	Experimental and Simulation Study of Single Point Incremental Forming of Polycarbonate
1030-1200 140B	**Session 3-10-5 Simulation** *Session Chair: Rohit Voothaluru*	
MSEC2019-2904	Chetan Nikhare	Pressurization and Annealing Effect Analysis Through Hole Expansion
MSEC2019-2885	Dhanooj Bobba, Praveen Ramaprabhu and Harish Cherukuri	An Integrated DEM-FEM Model for Shot Peening Applications
MSEC2019-3043	Rohit Voothaluru, Vikram Bedekar and Praveen Pauskar	A New Micromechanical Model to Study Transformation Plasticity in High-Carbon Steels

1030-1200 140C	**Session 5-3-3 Biomedical Devices** *Session Chair: Yancheng Wang | Session Co-Chair: Lei Chen*	
MSEC2019-2879	Yancheng Wang, Chenyang Han, Deqing Mei and Chengyao Xu	Localized Microstructures Fabrication Through Standing Surface Acoustic Wave and User-Defined Waveguides
MSEC2019-2967	Lei Chen, Jeremiah Hartner, David Van Dyke, Tianshu Dong, Brendon Watson and Albert Shih	Custom Skull Cap With Precision Guides for Deep Insertion of Cellular-Scale Microwire Into Rat Brain
MSEC2019-2915	Changxue Xu, Zhengyi Zhang, Yong Huang and Heqi Xu	Phase Diagram of Pinch-Off Behaviors During Drop-on-Demand Inkjetting of Alginate Solutions

1030-1200 160A	**Session 3-6-4 Laser based Additive Manufacturing** *Session Chair: Xin Zhao Session Co-Chair: Chang Ye*	
MSEC2019-2917	Sagil James and Thilakraj Shivakumar	Preliminary Study on Effects of the Process Parameters on Mechanical Properties in Liquid Holographic Volumetric Additive Manufacturing Process
MSEC2019-2751	Han Wang and Hong Shen	Fabrication of a Nearly Square Micro Channel on the Fused Silica Substrate by Ultrafast Laser Direct Writing
MSEC2019-2779	Alessandro Ascari, Alessandro Fortunato, Erica Liverani and Adrian Hugh Alexander Lutey	Laser Direct Energy Deposition Welding of AISI 316 Stainless Steel Sheets

SESSION **SUMMARY**

		Session 1 Room 100	Session 2 Room 110	Session 3 Room 120	Session 4 Room 130A	Session 5 Room 130B	Session 6 Room 130C
Tuesday, 6/11	Tech Session 1 9:10 - 10:40	NAMRC Student Research Competition - Session 1 NAMRC 54 NAMRC 56 NAMRC 79	ASME Student Mfg Design Competition - Session 1	Track 2: Forming 1 NAMRC 13 NAMRC 36 NAMRC 51	Track 3: Simulation 1 NAMRC 15 NAMRC 26 NAMRC 32	Track 4: Optimization 1 NAMRC 41 NAMRC 92 NAMRC 123	1-1-1 Additive Manufacturing of Ceramics, Concretes, and Composites I MSEC2019-2886 MSEC2019-3001 MSEC2019-3004
	Tech Session 2 11:00 - 12:30	NAMRC Student Research Competition - Session 2 NAMRC 25 NAMRC 47 NAMRC 113	Track 5: What's Next for Smart Manufacturing NAMRC 206 (P) KEYNOTE NAMRC 111	Track 1: MS 1 NAMRC 37 NAMRC 85 NAMRC 97	Track 2: Forming 2 NAMRC 53 NAMRC 61 NAMRC 112	Track 4: Simulation 1 NAMRC 2 (P) NAMRC 18 NAMRC 106	Track 6: IA&ME 1 NAMRC 194 NAMRC 205 (P) NAMRC 157
	Tech Session 3 14:00 - 15:30		ASME Student Mfg Design Competition - Session 2	Track 2: Joining 1 NAMRC 8 NAMRC 24 NAMRC 108 (P)	Track 3: Grinding NAMRC 1 (P) NAMRC 42 (P) NAMRC 180	Track 4: Simulation 2 NAMRC 48 NAMRC 129 NAMRC 160	Track 5: Neural Networks NAMRC 3 NAMRC 77
	15:50 - 17:20						
	Buses Leave at 17:30 for Dinner and Tour at Acutec						
Wednesday, 6/12	Tech Session 4 9:10 - 10:40	NAMRC Student Research Competition - Session 3 NAMRC 191 NAMRC 49 NAMRC 153		Track 2: Testing & Char 1 NAMRC 35 NAMRC 58 NAMRC 76	Track 3: Machining 1 NAMRC 43 NAMRC 45 NAMRC 135	Track 4: Optimization 2 NAMRC 126 NAMRC 128 NAMRC 156	Track 6: IA&ME 2 NAMRC 136 NAMRC 127
	Tech Session 5 11:00 - 12:30	NAMRC Student Research Competition - Session 4 NAMRC 62 NAMRC 201 NAMRC 155	ASME MED 100th Year Anniversary - Session 2	Track 1: MS 2 NAMRC 103 NAMRC 139 NAMRC 149	Track 2: Testing & Char 2 NAMRC 71 (P) NAMRC 174 NAMRC 12	Track 3: Simulation 2 NAMRC 67 NAMRC 193 NAMRC 199	Track 4: Processes 1 NAMRC 29 NAMRC 33 NAMRC 74
	Tech Session 6 14:00 - 15:30	3-9-1 Tribology 1 MSEC2019-2849 MSEC2019-2843 MSEC2019-2832	Track 2: Joining 2 NAMRC 182 NAMRC 185 NAMRC 196	Track 3: Machining 2 NAMRC 81 NAMRC 91 NAMRC 99	Track 4: Processes 2 NAMRC 98 NAMRC 105 NAMRC 125	Track 5: Cyber-Physical Systems 1 NAMRC 23 NAMRC 84 NAMRC 93	Track 4: Mat & Characterization 1 NAMRC 186 NAMRC 192 NAMRC 204
	Tech Session 7 15:50 - 17:20		Track 2: Tribology 1 NAMRC 7 NAMRC 14 NAMRC 161	Track 3: Machining 3 NAMRC 101 NAMRC 114 NAMRC 117	Track 4: Mat & Char 2 NAMRC 34 NAMRC 63 NAMRC 72	Track 5: Cyber-Physical Systems 2 NAMRC 118 NAMRC 132 NAMRC 140	1-3-2 Physics-based Models and Geometric Models for Additive Manufacturing MSEC2019-2815 MSEC2019-2766 MSEC2019-2897
	18:00-21:00 Early Career Forum						

	Session 7 Room 140A	Session 8 Room 140B	Session 9 Room 140C	Session 10 Room 160A	Session 11 Room 160B	Session 12 Room 170
Tech Session 1 9:10 - 10:40	1-2-1 Metal Additive Manufacturing Process 1 MSEC2019-2891 MSEC2019-2872 MSEC2019-2987	2-1-1 Innovations in Equipment Design, Control and Automation I MSEC2019-3003 MSEC2019-2966 MSEC2019-2928	3-1-1 Process Control in Multi-axis Machining MSEC2019-2737 MSEC2019-2959 MSEC2019-2954	3-11-1 Micro and Nano Manufacturing I MSEC2019-3031 MSEC2019-3055 MSEC2019-2900		
Tech Session 2 11:00 - 12:30	1-1-2 Additive Manufacturing of Ceramics, Concretes, and Composites II MSEC2019-2983 MSEC2019-2988 (SOA)	1-2-2 Metal Additive Manufacturing Process 2 MSEC2019-2741 MSEC2019-2996 MSEC2019-2930	2-1-2 Innovations in Equipment Design, Control and Automation II MSEC2019-3027 MSEC2019-3024 MSEC2019-2956	3-1-2 Process Evaluation and Planning in Multi-axis and Multi-taking Machining MSEC2019-2995 MSEC2019-2804 MSEC2019-2848	ASME MED 100th Year Anniversary - Session 1	
Tech Session 3 14:00 - 15:30	1-1-3 Additive Manufacturing of Ceramics, Concretes, and Composites III MSEC2019-2972 MSEC2019-2925 MSEC2019-3017	1-2-3 Metal Additive Manufacturing Process 3 MSEC2019-2991 MSEC2019-2892 MSEC2019-2887	2-2-1 Advances in Competitive Manufacturing Engineering MSEC2019-2706 MSEC2019-2724	3-2-1 Advances in Assisted and Augmented Manufacturing I MSEC2019-2738 MSEC2019-3030 MSEC2019-3014	3-11-2 Micro and Nano Manufacturing II MSEC2019-2862 MSEC2019-2723 MSEC2019-2769	
15:50 - 17:20						Women in Advanced Manufacturing Forum
Buses Leave Acutec by 20:30						
Tech Session 4 9:10 - 10:40	1-2-4 Metal Additive Manufacturing Process 4 MSEC2019-2841 MSEC2019-2989 MSEC2019-3051	2-3-1 Inter-connected manufacturing systems MSEC2019-2748 MSEC2019-3005 MSEC2019-2749	3-7-1 Resistance Spot Welding of Dissimilar Materials MSEC2019-2933 MSEC2019-2704 MSEC2019-2958	3-11-3 Micro and Nano Manufacturing III MSEC2019-2778 MSEC2019-2871 MSEC2019-2999	4-1-1 Advances in Processing and Recycling of Polymers and Polymer Composites MSEC2019-2929 MSEC2019-2765 MSEC2019-2745	Blue Sky Competition (Session I)
Tech Session 5 11:00 - 12:30	2-3-2 Smart manufacturing systems: Session 1 MSEC2019-3002 MSEC2019-3050 MSEC2019-3061	2-8-1 Cloud Manufacturing and Industrial Internet - 1 MSEC2019-2702 MSEC2019-2890 MSEC2019-2882	5-2-1 Design, Process, and Systems Advances for Remanufacturing and Recovery MSEC2019-3009 MSEC2019-2903 MSEC2019-2955	3-7-2 Solid State Welding of Dissimilar Materials MSEC2019-2824 MSEC2019-2938 MSEC2019-2855	4-2-1 Bio-/Nano-Materials MSEC2019-2992 MSEC2019-2932 MSEC2019-2847	Blue Sky Competition (Session II)
Tech Session 6 14:00 - 15:30	1-3-1 Surrogate Models for Additive Manufacturing MSEC2019-3034 MSEC2019-2875 MSEC2019-2787	2-3-3 Smart manufacturing systems Session 2 MSEC2019-2969 MSEC2019-2873 MSEC2019-2719	2-8-2 Cloud Manufacturing and Industrial Internet - 2 MSEC2019-2919 MSEC2019-2920 MSEC2019-2773	2-11-1 Intelligent Maintenance Decision Making of Manufacturing Systems: Session 1 MSEC2019-2869 MSEC2019-2819 MSEC2019-2976	3-7-3 Mechanical Fastening of Dissimilar Materials MSEC2019-2857 MSEC2019-2927 MSEC2019-2984	Special Session: Federal Agencies' Perspectives on Advanced Manufacturing
Tech Session 7 15:50 - 17:20	2-4-1 Advances in Data Analytics-I MSEC2019-2820 MSEC2019-2936 MSEC2019-2898	2-8-3 Cloud Manufacturing and Industrial Internet - 3 MSEC2019-2783 MSEC2019-2793 MSEC2019-2799	3-4-1 Advances in Nontraditional Manufacturing Processes-1 MSEC2019-2985 MSEC2019-2952 MSEC2019-3025	3-7-4 Brazing of Dissimilar Materials MSEC2019-2973 MSEC2019-2950 MSEC2019-2836	4-1-2 Advances in Processing and Design of Polymers and Polymer Composites MSEC2019-2752 MSEC2019-2776 MSEC2019-2998	Special Session: What's New at NSF – Update from NSF Program Directors
18:00-21:00 Early Career Forum						

		Session 1 Room 100	Session 2 Room 110	Session 3 Room 120	Session 4 Room 130A	Session 5 Room 130B	Session 6 Room 130C
Thursday, 6/13	Tech Session 8 9:10 - 10:40		Track 2: Tribology 2 NAMRC 138 NAMRC 203 NAMRC 90	Track 3: Advanced Processes 1 NAMRC 55 NAMRC 78 NAMRC 89	Track 4: Mat & Char 3 NAMRC 95 NAMRC 100 NAMRC 131	Track 5: Process Monitoring and Control 1 NAMRC 6 NAMRC 19 NAMRC 22	1-3-3 Establishing Process-Property Relationships MSEC2019-2717 MSEC2019-2788 MSEC2019-3035
	Tech Session 9 11:00 - 12:30		Track 2: Adv. Processes 1 NAMRC 10 NAMRC 40 NAMRC 176	Track 3: Advanced Processes 2 NAMRC 104 NAMRC 145 NAMRC 177	Track 4: Processes 3 NAMRC 130 NAMRC 137 NAMRC 164	Track 5: Process Monitoring and Control 2 NAMRC 28 NAMRC 38 NAMRC 50	1-3-4 Assessing Product Quality in Additive Manufacturing MSEC2019-2874 MSEC2019-2863 MSEC2019-3008
	Tech Session 10 14:00 - 15:30	ASME MED 100th Year Anniversary - Session 3	Track 2: Adv. Processes 2 NAMRC 44 NAMRC 83 NAMRC 87	Track 3: Machining 4 NAMRC 121 NAMRC 141 NAMRC 143	Track 4: Mat & Char 4 NAMRC 142 NAMRC 147 NAMRC 162	Track 5: Process Monitoring and Control 3 NAMRC 52 NAMRC 57 NAMRC 73	1-3-5 Process Planning and Parameter Optimization MSEC2019-2739 MSEC2019-2701 MSEC2019-3010
	Tech Session 11 15:50 - 17:20	ASME MED 100th Year Anniversary - Session 4	Track 2: Adv. Processes 3 NAMRC 96 NAMRC 115	Track 3: Machining 5 NAMRC 165 NAMRC 169 NAMRC 175	Track 4: Mat & Char 5 NAMRC 171 NAMRC 184 NAMRC 198	Track 5: Process Monitoring and Control 4 NAMRC 109 NAMRC 120 NAMRC 122	1-3-6 Quantifying Deformation and Surface Finish in Additive Manufacturing MSEC2019-3006 MSEC2019-2845 MSEC2019-2899
	Buses leave by 17:30 for Dinner and Campus/Lab tours at Penn State Behrend						
Friday, 6/14	Tech Session 12 8:40 - 10:10		Track 2: Adv. Processes 4 NAMRC 124 NAMRC 148 NAMRC 154	Track 4: Processes 4 NAMRC 11 NAMRC 183	Track 5: Process Monitoring and Control 5 NAMRC 163 NAMRC 179 NAMRC 197	1-3-7 Reviews Papers in Additive Manufacturing MSEC2019-2913 MSEC2019-3018 MSEC2019-2994	2-6-1 Advances in Manufacturing Execution - I MSEC2019-2912 MSEC2019-2856 MSEC2019-2823
	Tech Session 13 10:30 - 12:00		Track 2: Adv. Processes 5 NAMRC 159 NAMRC 190	Track 3: Tribology NAMRC 68 NAMRC 69	Track 4: Processes 5 NAMRC 178 NAMRC 195	2-10-1 CPS, Stochastic Modeling, and Sensor Networks in Advanced Manufacturing MSEC2019-2703 MSEC2019-2896 MSEC2019-2844	2-6-2 Advances in Manufacturing Execution - II MSEC2019-2825 MSEC2019-2840 MSEC2019-2757

	Session 7	Session 8	Session 9	Session 10	Session 11	Session 12
	Room 140A	Room 140B	Room 140C	Room 160A	Room 160B	Room 170
Tech Session 8 9:10 - 10:40	2-4-2 Advances in Data Analytics - II MSEC2019-2945 MSEC2019-2812 MSEC2019-2753	3-3-1 Machining - I MSEC2019-2712 MSEC2019-2786 MSEC2019-2758	3-4-2 Advances in Nontraditional Manufacturing Processes 2 MSEC2019-2971 MSEC2019-2828 MSEC2019-3019	3-7-5 Fusing Welding of Dissimilar Materials MSEC2019-3048 MSEC2019-2722 MSEC2019-2944	3-10-1 Machining I MSEC2019-3022 MSEC2019-3013 MSEC2019-2922	NIST RAMP Competition (Session I)
Tech Session 9 11:00 - 12:30	2-5-1 Measurement Methods for Process Health Monitoring MSEC2019-2755 MSEC2019-2785 MSEC2019-2911	3-4-3 Advances in Nontraditional Manufacturing Processes 3 MSEC2019-2943 MSEC2019-2894 MSEC2019-2963	3-6-1 Application of Ultrafast Laser in Manufacturing MSEC2019-3023 MSEC2019-2968 (SOA)	3-3-2 Manufacturing Process - I MSEC2019-2782 MSEC2019-2833 MSEC2019-2977	3-10-2 Machining II MSEC2019-2909 MSEC2019-2957 MSEC2019-2970	NIST RAMP Competition (Session II)
Tech Session 10 14:00 - 15:30	2-5-2 Improving Maintainability in Manufacturing Systems MSEC2019-2902 MSEC2019-2921 (SOA)	3-3-3 Machining - II MSEC2019-2807 MSEC2019-2818 MSEC2019-2926	3-4-4 Advances in Nontraditional Manufacturing Processes 4 MSEC2019-2851 MSEC2019-2852 MSEC2019-2914	3-6-2 Application of Laser Peening in Additive Manufacturing MSEC2019-2979 MSEC2019-2731 MSEC2019-2893	5-3-1 Biomedical Machining MSEC2019-2822 MSEC2019-2990 MSEC2019-2953	Advanced Polymer Composites & Manufacturing for the Circular Economy
Tech Session 11 15:50 - 17:20	3-4-5 Advances in Nontraditional Manufacturing Processes 5 MSEC2019-2826 MSEC2019-2791 MSEC2019-2768	3-3-4 Manufacturing Process - II MSEC2019-3052 MSEC2019-3062 MSEC2019-2716	3-5-1 Hard Machining and Grinding MSEC2019-2763 MSEC2019-2777 MSEC2019-3012	5-4-1 Advances in 3D Bioprinting of Tissue Scaffolds and Organs 1 MSEC2019-3011 MSEC2019-2816 MSEC2019-2747	3-10-3 Deformation I MSEC2019-2980 MSEC2019-2905 MSEC2019-2877	
Buses leave Behrend by 20:30						
Tech Session 12 8:40 - 10:10	3-3-5 Machining - III MSEC2019-2754 MSEC2019-3049 MSEC2019-2707	3-6-3 Laser Shock Peening and Forming MSEC2019-2850 MSEC2019-2910	3-10-4 Deformation II MSEC2019-2906 MSEC2019-2714 MSEC2019-2949	5-3-2 Biomedical Manufacturing MSEC2019-3033 MSEC2019-2946 MSEC2019-2870	3-8-1 SYMP 3-8 Advances in Manufacturing Processes for Energy Applications MSEC2019-2916 MSEC2019-3032 MSEC2019-2901	
Tech Session 13 10:30 - 12:00	3-3-6 Manufacturing Process - III MSEC2019-2729 MSEC2019-3026	3-10-5 Simulation MSEC2019-2904 MSEC2019-2885 MSEC2019-3043	5-3-3 Biomedical Devices MSEC2019-2879 MSEC2019-2967 MSEC2019-2915	3-6-4 Laser based Additive Manufacturing MSEC2019-2917 MSEC2019-2751 MSEC2019-2779		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