

1st International Workshop on Smart Manufacturing Modeling and Analysis [SM²N]

April 15th, 2019 | Montreal, Quebec, Canada | <https://synercys.github.io/sm2n/>
colocated with CPS-IoT week 2019

Organizers

- Kira Barton, University of Michigan Ann Arbor
- Sibin Mohan, University of Illinois at Urbana-Champaign
- Seta Bogosyan, Virginia Tech/Istanbul Technical University

Technical Program Committee

- Abhijit Chakraborty, UTRC
- Arvind Easwaran, Nanyang Technological University
- Binil Starly, North Carolina State University
- James Moyne, Applied Materials/Univ. of Michigan
- Mu Zhang, Cornell University
- Prahlada Rao, University of Nebraska-Lincoln
- Qiang Huang, University of Southern California
- Raheem Beyah, Georgia Tech
- Saman Zonouz, Rutgers University
- Yan Lu, NIST
- Ye Sun, Michigan Technological University
- Miguel Saez, General Motors
- Saumuy Puchala, Ford Motor Company
- Dawn Tilbury, NSF and University of Michigan
- Frankie King, Vanderbilt University

Web Chair

- Bin-Chou Kao, Univ. of Illinois at Urbana-Champaign

Workshop Overview

Today's manufacturing paradigm is in the midst of a transformation towards smart manufacturing, driven by the generation and analysis of high-volume data coming from interconnected cyber-physical components. This has necessitated an advancement in a number of the tenets of smart manufacturing such as Industrial Internet of Things (IIoT), Artificial Intelligence (AI), anomaly detection, security of industrial plants, novel communication infrastructures, etc. Among the many Smart Manufacturing tenets, a "digital twin" (DT) represents an opportunity to leverage existing and emerging technologies in modeling, simulation and emulation – to improve quality, productivity, and the ability to customize, and reduce energy consumption and waste. DTs might help address many key performance and effectiveness metrics in manufacturing, however the science needs to be better understood in terms of definitions, capabilities, metrics, technical challenges and potential solutions. There exist some academic and industry efforts that aim to tackle this problem, but more is required. In addition, digital twins are just one way to model these type of systems; to improve the overall design, efficiency and even security of future manufacturing systems, there is a need for new science that can capture/explain their behavior and new tools for modeling them.

In this workshop, we intend to bring together multidisciplinary researchers and engineers (from academia, industry, as well as standards organizations) from a broad range of fields (manufacturing, control, cyber-security, networking) to provide an overview of the latest advances in the modeling and analysis of smart manufacturing systems. This area (smart manufacturing and especially modeling/analysis) has not received much focus but is an important area, not just from the research perspective but also from societal impact. It includes all the elements of a classic cyber-physical systems domain, in addition to IoT (industrial IoT).

Program

07:00-08:30 Registration | Breakfast (ends at 08:00)

Session 1 (90 mins)

08:30-09:00 Introduction/Welcome Remarks

09:00-10:00 Keynote - Dawn Tilbury (NSF)

10:00-10:30 Coffee Break

Session 2 (100 mins)

10:30-10:55 The Digital Twin in the Manufacturing Ecosystem of the Future
James Moyne, Efe Balta, Ilya Kovalenko, Yassine Qamsane and Kira Barton (Mechanical Engineering Department, University of Michigan)

10:55-11:20 Towards Resilient and Reliable Distributed Automation for Smart Manufacturing Systems
Vuk Lesi (Duke University), Zivana Jakovljevic (University of Belgrade), Miroslav Pajic (Duke University)

11:20-11:45 Digital Twin for Manufacturing Systems
Annie Zeng (Ford Motor Company)

11:45-12:10 Digitally Threaded Automated Manufacturing
Abhijit Chakraborty (United Technologies Research Center)

12:10-13:30 Lunch

Session 3 (90 mins)

13:30-15:00 Panel Discussion: "The Future of Work in Manufacturing"
Panelists:
Chris Saldana (Georgia Tech)
Sridhar Kota (University of Michigan and MForeSight)
Stefanie Mueller (MIT)
Dawn Tilbury (NSF)

15:00-15:30 Coffee Break

Topics of Interest

The areas of focus for the workshop are (broadly defined but not limited to these):

- What is a digital twin? What are the minimum requirements of any DT? Other than other modeling techniques/technologies that can be used?
- What is the role of such modeling frameworks in cyber-physical manufacturing systems?
- What are the metrics, if any, to evaluate the quality and the results produced from DTs and other modeling frameworks?
- Can the DTs and/or other modeling frameworks be integrated with each other? Is there a need for more than one such solution in a system? Can we create frameworks where more than one can co-exist?
- What are example case studies and success of the use of DTs and other such technologies?
- How can security-specific applications such as anomaly detection be enabled by such modeling and analysis efforts? What other security problems exist?
- Do areas such as machine learning better enable the development/use of DTs and other modeling/analysis frameworks?



Efe Balta currently works at the Department of Mechanical Engineering, University of Michigan. He does research in Cyber-Physical Production Systems, Industrial Automation, Controls Systems and Artificial Intelligence.



Kira Barton is an associate professor in the Mechanical Engineering Department at the University of Michigan at Ann Arbor. Her primary research focus is on precision coordination and motion control for emerging applications, with a specialization in iterative learning control. Barton's work intersects controls and manufacturing and combines innovative manufacturing processes with enhanced engineering capabilities.



Seta Bogosyan is a professor of Electrical and Control Engineering at ITU and research professor at Virginia Tech and UAF. Between 2015-2019, she worked as Program Director at NSF OISE, and then as Expert at NSF CISE in the CPS Program. Her research interests are in CPS unmanned vehicles, connected vehicles, high efficiency control of HEVs and EVs, motion control, and bilateral robot control. She has served as officer and VP at the IEEE Industrial Electronics Society for several years, where she currently also serves as Associate Editor.



Abhijit Chakraborty is a Staff Research Scientist at UTRC. At UTRC, he is a technical contributor to projects related to manufacturing automation leveraging industrial robots and rapid certification of additive manufacturing processes. He serves as a PI for projects in areas related to (i) in-situ process monitoring and control for additive manufacturing, (ii) Robotics for manufacturing capability development, and (iii) validation and verification of safety critical systems.



Zivana Jakovljevic is currently Associate Professor and Head of Laboratory for Manufacturing Automation at Faculty of Mechanical Engineering, University of Belgrade, Serbia. Her research interests include intelligent manufacturing systems, cyber physical systems, industrial internet of things, distributed control, 3D vision systems in manufacturing automation, as well as machine learning and non-stationary signal processing.



Sridhar Kota is the Herrick Professor of Engineering, Professor of Mechanical Engineering at the University of Michigan, and the founding Executive Director of MFOresight: Alliance for Manufacturing Foresight - a national consortium on emerging technologies and advanced manufacturing. Between 2009-2012 Prof. Kota served as the Assistant Director for Advanced Manufacturing at the White House Office of Science and Technology Policy.



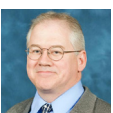
Ilya Kovalenko is a PhD student at the Department of Mechanical Engineering, University of Michigan. His research focuses on manufacturing, specifically multi-agent control of smart manufacturing systems.



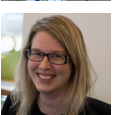
Vuk Lesi is currently a PhD candidate at Pratt School of Engineering, Duke University, where he has been a research assistant in the Cyber-Physical Systems Lab since 2015. His research interests span reconfigurable manufacturing systems, distributed industrial automation, and security-aware embedded and real-time systems in automotive and industrial applications.



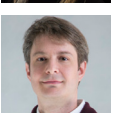
Sibin Mohan is a Research Assistant Professor in the Dept. of Computer Science and the Information Trust Institute at the University of Illinois at Urbana Champaign (UIUC). His research interests are primarily in the Computer Systems area. Much of his research aims to improve the resiliency of cyber-physical systems, real-time and embedded systems as well as the Internet-of-Things domains. To improve resiliency, his research group has worked on novel security mechanisms for these domains as well as robust networking and platform architectures.



James Moyne served as a Standards and Technology Specialist for the Applied Global Services Group at Applied Materials. He received his PhD from the University of Michigan where he is an Associate Research Professor.



Stefanie Mueller is an assistant professor in the MIT EECS department and a member of the Computer Science and Artificial Intelligence Laboratory. In her research, she develops novel hardware and software systems that advance personal fabrication technologies. Stefanie also directs the HCI Engineering group at CSAIL.



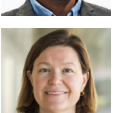
Miroslav Pajic is the Nortel Networks Assistant Professor in the Departments of Electrical and Computer Engineering and Computer Science and the director of the Cyber-Physical Systems Lab (CPSL) at Duke University. His research interests focus on design and analysis of cyber-physical systems and in particular, embedded and distributed/networked control, real-time and embedded systems, and high-confidence medical devices and systems.



Yassine Qamsane is currently a postdoctoral research fellow with the department of Mechanical Engineering at the University of Michigan, Ann Arbor. His research interests include modeling, control, diagnosis, verification and validation of modular/distributed discrete-event systems with the focus on automated manufacturing systems. His current main research interest is smart manufacturing.



Christopher Saldana began working at Georgia Tech in the Fall of 2014. Dr. Saldana's current research interests are centered on establishing the processing science needed to realize next generation material systems (alloys, composites, bio-inspired) and manufacturing processes.



Dawn Tilbury is the Assistant Director of the NSF Engineering Directorate and a professor in the Mechanical Engineering department at the University of Michigan in Ann Arbor. Her research interests lie in the area of control systems, and she is a member of the Robotics Group and the Controls Group in the College of Engineering.



Annie Zeng is currently a Technical Expert in Digital Twin and Artificial Intelligence in Ford Motor Company. Her goal is to digitize and modernize manufacturing engineering and operation leveraging advanced technologies such as PLM, Digital Factory, IIOT and Machine Learning. Previously she was a Digital Manufacturing Supervisor where she oversaw development and implementation of digital tools to improve Manufacturing Engineering efficiency and effectiveness.