

2024 1ST INDUSTRIAL DATA ANALYTICS AND DIGITAL MANUFACTURING (IDADM) WORKSHOP

Theme: Data-driven Intelligent Decision Making For
Better Manufacturing

会议手册

Dec 20, 2024 — Dec 22, 2024

香港科技大学(广州), 南沙, 广州, 广东。





目录

会议日程	01/02
嘉宾简介与实验室报告	03/08
交通&食宿指南	09/10
实验室&学校介绍	11/12



MEETING SCHEDULE

Date: December 20-22, 2024

December 20th, Friday		
Time	Content	Remarks
	Registration	
December 21st, Saturday		
9.00-9.30	Opening Remarks Prof. Ricky Lee, Dean of Systems Hub at HKUST (GZ) Prof. Lei Chen, Dean of Information Hub at HKUST (GZ) Prof. Kai Tang, Head of Smart Manufacturing Thrust at HKUST (GZ)	Chair: Prof. Fugee Tsung, Chair Professor at HKUST (GZ), Director of Triple-i
9.30-9.40	Group photo session	
9.40-10.10	Keynote Speech I Prof. Judy Jin, Professor at the University of Michigan Title: Machine Learning to Empower In-Situ Quality Control for Smart Manufacturing	
10.10-10.40	Keynote Speech II Prof. Jingshan Li, full professor at Tsinghua University Title: Sustainable Manufacturing Systems: Smart Planning and Operation for Green Manufacturing	
10.40-11.00	Coffee/Tea Break	
11.00-11.30	Keynote Speech III Prof. Hui Yang, Professor at Penn State Title: Sensor-based Modeling and Optimization of Additive Manufacturing	Chair: Prof. Fugee Tsung, Chair Professor at HKUST (GZ), Director of Triple-i
11.30-12.00	Keynote Speech IV Prof. Andrea Matta (online), Full Professor at Politecnico di Milano Title: Data-driven Approaches Towards Autonomous Digital Twins	
12.00-14.00	Lunch	

Time	Content	Remarks
14.00-15.10	IDADM Report I Prof. Juan Du, Assistant Professor at HKUST (GZ) Title: Introduction and Recent Advances of IDADM Lab Peng Ye, MPhil student in Smart Manufacturing Thrust, HKUST (GZ) Title: Sequential Actuator Placement Selection and Optimization for Aircraft Fuselage Assembly via Reinforcement Learning Xuanming Cao, PhD student in Smart Manufacturing Thrust, HKUST (GZ) Title: Deep Subspace Learning for Surface Anomaly Classification Based on 3D Point Cloud Data	Chair: Prof. Juan Du, Assistant Professor at HKUST (GZ), Associate Director of Industrial Intelligence and Data Analytics Lab
15.10-15.30	Coffee/Tea Break	
15.30-16.30	IDADM Report II Letian Bai, PhD student in Smart Manufacturing Thrust, HKUST (GZ) Title: Key Variable Identification and Quality Prediction in Nonlinear Multistage Manufacturing Processes of Ceramic Firing Process Mingze Gong, PhD student in Smart Manufacturing Thrust, HKUST (GZ) Title: Gradual Degradation Modeling in UAV Systems for Anomaly Detection Jiaping Cao, PhD student in Smart Manufacturing Thrust, HKUST (GZ) Title: FIT3D: Real-time Flatness Inspection Algorithm for Ceramic Tiles using the Structured Light 3D Scanner	Chair: Prof. Juan Du, Assistant Professor at HKUST (GZ), Associate Director of Industrial Intelligence and Data Analytics Lab
16.00-16.40	Closing Remarks Prof. Kai Tang, Prof. Fugee Tsung	
17.00	Dinner	
December 22nd, Sunday		
10.00-12.00	Campus and Lab Visit	



GUEST INTRODUCTION

Title: Machine Learning to Empower In-Situ Quality Control for Smart Manufacturing



Prof. Jionghua Judy Jin is the A. Galip Ulsoy Collegiate Professor of Engineering and a professor in the Department of Industrial and Operations Engineering at the University of Michigan. Her research focuses on the intersection of data science and quality engineering with an emphasis on integrating process design and operational data to enhance quality control decision-making. Her research results have been widely implemented in various industrial production systems and have received numerous awards, including 17 Best Paper Awards, the Forging Achievement Award, the NSF CAREER Award, and the prestigious NSF PECASE Award. Dr. Jin currently serves as the Focus Issue Editor for IISE Transactions on Data Science, Quality and Reliability and is the Editor-in-Chief elect of IISE Transactions. Dr. Jin also previously served as Vice President of INFORMS, Chairperson of Quality, Statistics and Reliability Section of INFORMS, and President of Quality Control and Reliability Engineering Division of IISE. She is a Fellow of ASME, IISE, and INFORMS.

Abstract: The convergence of advanced sensor technologies and the Internet of Things has created unprecedented opportunities for smart manufacturing. However, the abundance of data also presents significant challenges, particularly in analyzing massive, high-dimensional streaming data characterized by spatial and temporal heterogeneity with complex functional dependencies. This talk will explore how the rapid evolution of machine learning techniques can address these challenges to enhance in-situ quality control decision-making for smart manufacturing. The presentation will begin with an overview of the opportunities and challenges in quality engineering for smart manufacturing. Illustrative examples will be provided to demonstrate the critical role of machine learning in handling the complexities of online sensing data for automatic defect detection and enabling continuous learning for in-situ quality control.

Title: Sustainable Manufacturing Systems: Smart Planning and Operation for Green Manufacturing



Prof. Jingshan Li is the Head and the Gavriel Salvendy Chair Professor in Department of Industrial Engineering, Tsinghua University, Beijing, China. He received BS, MS, and PhD degrees from Tsinghua University, Chinese Academy of Sciences, and University of Michigan, in 1989, 1992 and 2000, respectively. Before joining Tsinghua University in 2021, he was with General Motors R&D Center, University of Kentucky, and University of Wisconsin-Madison.

Dr. Li has published 2 textbooks, 7 book volumes, and close to 300 refereed journal articles, book chapters, and conference proceedings. He has been the Department Editor of IISE Transactions and Flexible Service and Manufacturing Journal, the Senior Editor of IEEE Transactions on Automation Science and Engineering and IEEE Robotics and Automation Letter, Associate Editor of International Journal of Production Research, etc. He was the Editor-in-Chief of IEEE International Conference on Automation Science and Engineering, and the Chairs of many flagship conferences. He has been the Chairs of IEEE Technical Committees on Sustainable Production Automation, and Healthcare Management Society.

Dr. Li is an IEEE Fellow, IISE Fellow, and IEEE Distinguished Lecturer in robotics and automation. He received NSF CAREER Award, IEEE Robotics and Automation Early Career Award, and multiple Best Paper Awards from flagship journals and conferences. His primary research interests are in design, analysis, and control of production and healthcare systems.

Abstract: In order to respond to climate change, carbon peak and carbon neutral become the strategic goals worldwide. Manufacturing is ranked the third in both energy consumption and greenhouse gas emissions, and the first in toxic releases. Therefore, manufacturing must be sustainable, i.e., green.

Sustainable manufacturing systems are of significant importance to the worldwide economy, supply chain, and societal benefits. It typically includes two parts: The first is manufacturing systems of green technology or renewable energy products; While the second is related to scheduling, control, and optimization of manufacturing processes to reduce energy consumption and emissions.

In this talk, we will review the recent progresses in sustainable manufacturing systems, and focus on analysis, design and optimization of sustainable manufacturing systems. Specifically, through examples in battery manufacturing, energy-intensive production, and system redesign, we introduce smart planning and scheduling methods to redesign and reorganize processes and operations, to achieve energy-efficient and environment-friendly manufacturing.



Title: Sensor-based Modeling and Optimization of Additive Manufacturing



Prof. Hui Yang is a Fellow of IISE, a Professor of Industrial and Manufacturing Engineering, Biomedical Engineering at Penn State, and is affiliated with Penn State Cancer Institute (PSCI), Clinical and Translational Science Institute (CTSI), Institute for Computational and Data Sciences (ICDS), CIMP-3D. Currently, he serves as the director of NSF Center for Health Organization Transformation (CHOT). Prior to joining Penn State in 2015, he was an Assistant Professor in the Department of Industrial and Management Systems Engineering at the University of South Florida from 2009 to 2015.

Dr. Yang was the president (2017-2018) of IISE Data Analytics and Information Systems Society, the president (2015-2016) of INFORMS Quality, Statistics and Reliability (QSR) society, and the program chair of 2016 IISE Annual Conference. He is also the Editor-in-Chief (EIC) for IISE Transactions Healthcare Systems Engineering, as well as an Associate Editor (AE) for IISE Transactions, IEEE Journal of Biomedical and Health Informatics (JBHI), ASME Journal of Computing and Information Science in Engineering (JCISE), IEEE Transactions on Automation Science and Engineering (TASE), IEEE Robotics and Automation Letters (RA-L), Quality Technology & Quantitative Management, and an Associate Editor for the Proceedings of IEEE CASE, IEEE EMBC, and IEEE BHI.

Abstract: Additive manufacturing (AM) provides a greater level of flexibility to produce a 3D part with complex geometries directly from the design. However, the widespread application of AM is currently hampered by technical challenges in process repeatability and quality control. To enhance the in-process information visibility, advanced sensing is increasingly invested for real-time AM process monitoring. The proliferation of in-situ sensing data calls for the development of analytical methods for the extraction of features sensitive to layerwise defects, and the exploitation of pertinent knowledge about defects for in-process quality control of AM builds. As a result, there are increasing interests and rapid development of sensor-based models for the characterization and estimation of layerwise defects in the past few years. However, very little has been done to go from sensor-based modeling of defects to the suggestion of in-situ corrective actions for quality control of AM builds. In this talk, we present a new sequential decision-making framework for in-situ control of AM processes through the constrained Markov decision process (CMDP), which jointly considers the conflicting objectives of both total cost (i.e., energy or time) and build quality. Experimental results show that the CMDP formulation provides an effective policy for executing corrective actions to repair and counteract incipient defects in AM before completion of the build.

Title: Data-driven Approaches Towards Autonomous Digital Twins



Prof. Andrea Matta is Full Professor of Manufacturing and Production Systems at Department of Mechanical Engineering of Politecnico di Milano and Guest Professor at Shanghai Jiao Tong University. He graduated in Industrial Engineering at Politecnico di Milano where he develops his teaching and research activities since 1998. He was Distinguished Professor at the School of Mechanical Engineering of Shanghai Jiao Tong University from 2014 to 2016. He has been visiting professor at Ecole Centrale Paris (France), University of California at Berkeley (USA), and Tongji University (China). He is scientific responsible of the Research Area Design and Management of Manufacturing Systems at MUSP (Laboratory for Machine Tools and Production Systems). His research area includes analysis, design and management of manufacturing and health care systems. He has published 130+ scientific papers on international and national journals/conference proceedings.

He is Editor in Chief of Flexible Services and Manufacturing Journal since 2017, editorial board member of OR Spectrum journal and IEEE Robotics and Automation Letters journal. He is Co-Chair of the technical committee IEE RAS Sustainable Production Automation. He is member of scientific committee in several international conferences. He was awarded with the Shanghai One Thousand Talent and Eastern Scholar in 2013. He has been cited among the Leading Scholars in Production Research by International Journal of Production Research journal.

Abstract: With the coming of the Industry 4.0 wave, digital representations of production systems have been promoted from marginal to central. Digital twins are not simply conceived as simulation models of their physical counterparts for offline what-if analysis, differently they are developed as self-adaptable and empowered decision-makers timely aligned with the dynamics of the real system. Enriched by these new features, digital twins are widely recognized as the key enablers for the implementation of the smart manufacturing paradigm. Despite this new role, there are significant barriers to the adoption of the digital twin concept in industrial applications. The creation and continuous update of digital twin models is still a challenge because of the high skills required to use the simulation applications available in the market, the long development times, and their difficult integration with optimization and artificial intelligence packages. The frequent changes manufacturing systems encounter in their life cycle boost these issues. This talk describes data-driven approaches for generating, synchronizing, and validating multi-perspective models for digital twins of discrete event systems from sensor data.



Title: Introduction and Recent Advances of IDADM Lab

IDADM Report



Prof. Juan Du is currently an Assistant Professor with the Smart Manufacturing Thrust and Data Science and Analytics Thrust, and Associate Director of Industrial Intelligence and Data Analytics Lab at The Hong Kong University of Science and Technology (Guangzhou). She is also an affiliate assistant professor at The Hong Kong University of Science and Technology. Her research focuses on industrial data analytics, machine learning and AI for quality improvements in complex manufacturing systems. She is a recipient of multiple international awards from

INFORMS, ASA, IISE, and CSIE, including the Best Paper or Best Student Paper Finalist Awards 10 times. She is also a recipient of the 2024 SME Susan Smyth Outstanding Young Manufacturing Engineer (OYME) Award from SME. Since 1980, the OYME award has recognized manufacturing engineers, age 35 or younger, who have made exceptional contributions and accomplishments in the manufacturing industry. She is also a recipient of 2024 CSAMSE Annual Conference Best Practice Award, which recognizes and celebrates an outstanding contribution in applying the principles of Management Science and Engineering to address a real-world challenge. Her research is supported by national, provincial, industry and other funding agencies of China. She is a senior member of IEEE and IISE.

Abstract: With the development of sensing technology, sensors widely deployed in modern manufacturing systems have significantly enhanced the capability to collect real-time data during production processes, providing a data-rich environments for process monitoring and fault diagnosis. However, these data often exhibit characteristics such as high dimensionality, heterogeneity, imbalance, asynchrony, and low signal-to-noise ratio, posing challenges to smart monitoring and quality improvement based on complex sensing data. This talk will share recent topics and advances from IDADM lab on machine learning for quality control to address these real-world challenges. More information can be found via IDADM Lab website <https://personal.hkust-gz.edu.cn/juandu/IDADM-Lab/>.

IDADM 工作报告

Juan Du, Assistant Professor at HKUST (GZ)

Title: Introduction and Recent Advances of IDADM Lab

Peng Ye, MPhil student in Smart Manufacturing Thrust, HKUST (GZ)

Title: Sequential Actuator Placement Selection and Optimization for Aircraft Fuselage Assembly via Reinforcement Learning

Xuanming Cao, PhD student in Smart Manufacturing Thrust, HKUST (GZ)

Title: Deep Subspace Learning for Surface Anomaly Classification Based on 3D Point Cloud Data

Letian Bai, PhD student in Smart Manufacturing Thrust, HKUST (GZ)

Title: Key Variable Identification and Quality Prediction in Nonlinear Multistage Manufacturing Processes of Ceramic Firing Process

Mingze Gong, PhD student in Smart Manufacturing Thrust, HKUST (GZ)

Title: Degradation Modeling in UAV Systems for Anomaly Detection

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Title: FIT3D: Real-time Flatness Inspection Algorithm for Ceramic Tiles using the Structured Light 3D Scanner