INDUSTRIAL AND SYSTEMS ENGINEERING

Industrial Data Science for Quality Improvement in Complex Systems

Dr. Kaibo Liu

Tuesday, January 16, 2024
11:00am – 12:00pm

This seminar will be both in person in JEC 3117 and via Webex

WebEx link: Dr. Kaibo Liu’s Seminar Link
Meeting number (access code) 2631 594 6521  Password: ISEROCKS

Abstract:
The rapid advancements in Internet of Things (IoT) technology and cyber-physical infrastructure have resulted in a temporally and spatially dense, data-rich environment. This environment provides unprecedented opportunities for quality improvement in various complex systems. However, it also presents new research challenges in industrial data analysis and decision-making, such as dealing with heterogeneous data formats, high-dimensional and big data structures, the inherent complexity of target systems, and the potential lack of complete a priori knowledge. In this talk, I will provide an overview of three research thrusts conducted by my lab. These thrusts include sensor measurement and monitoring strategy, system degradation analysis and prognostics, and spatiotemporal field modeling and prediction. Several research projects will be discussed in detail to illustrate the need for developing multidisciplinary data fusion and analytics methods. These methods are essential for effective quality improvement in industrial applications by harnessing the power of data science. Finally, I will highlight future research topics and applications.

Bio:
Dr. Kaibo Liu is currently a professor in the Department of Industrial and Systems Engineering at the University of Wisconsin-Madison and serves as the Associate Director of the UW-Madison IoT Systems Research Center. He earned his B.S. degree in industrial engineering and engineering management from the Hong Kong University of Science and Technology, an M.S. degree in statistics, and a Ph.D. degree in industrial engineering from the Georgia Institute of Technology. Dr. Kaibo Liu’s research focuses on system informatics and big data analytics, emphasizing the data fusion approach for system modeling, monitoring, diagnosis, prognostics, and decision-making. His research has received funding from NSF, ONR, AFOSR, ERDC, DOE, NIH, and Industry. Dr. Liu is the recipient of three prestigious early career awards: the 2019 Outstanding Young Manufacturing Engineer Award by SME, the 2019 Feigenbaum Medal Award by ASQ, and the 2019 Dr. Hamed K. Eldin Outstanding Early Career IE in Academia Award by IIE. Additionally, he received the Innovations in Education Award from IIE in 2020 and the Award for Technical Innovation in Industrial Engineering from IIE in 2021. He was honored in 2023 as one of the Georgia Tech Alumni Association’s 40 Under 40. Currently, Dr. Kaibo Liu serves as a senior editor of IEEE Transactions on Automation Science and Engineering and as the department editor of IIE Transactions on Data Science, Quality, and Reliability.
Biotechnology and medicine continue to be transformed by improvements to our ability to read, write, and modify genomic DNA. In this talk, I will discuss two new developments at the interface of biotechnology and nanofabricated systems aimed at improving DNA detection and therapeutic gene editing in the context of cancer medicine. First, I will describe a nanophotonic biosensing approach for detecting single biomolecules without enzymatic amplification, towards addressing the challenge of assaying a large number of cancer associated DNA mutations with high sensitivity. Then, the main part of my talk will focus on our ongoing work to improve the efficiency of high throughput gene delivery for chimeric antigen receptor (CAR) T therapy production. We recently developed a microfluidic system that leverages the nonlinear stress behavior of viscoelastic fluids to apply sub-millisecond pulses of mechanical tension to the plasma membrane of cells without surface contact. This creates reversible pores in the membrane, allowing mRNA and CRISPR-Cas9 ribonucleoproteins to diffuse into the cytosol within seconds. This uniquely fast and effective delivery technology will have several exciting applications in cell and gene therapy manufacturing, particularly in T cell editing for CAR T production.

Derin Sevenler is an Instructor in the Center for Engineering in Medicine and Surgery (CEMS) at Massachusetts General Hospital and Harvard Medical School. He conducted postdoctoral training in the laboratory of Mehmet Toner at the CEMS from 2018 to 2022. He received a BS in Mechanical and Aerospace Engineering from Cornell in 2011, and his PhD in Biomedical Engineering from Boston University in 2017. He received the NIH K99/R00 Pathway to Independence Award in 2022. His research is focused on developing microscale and nanoscale systems to improve human health.