Department of Biomedical Engineering

Graduate Seminar

April 22nd (Friday)
11:30am – 1:00 pm
WebEx (Click here)

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Department of Mechanical Engineering
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Intelligent Multi-fidelity Surrogate-based Optimization Framework for Microfluidic Concentration Gradient Generator Design

Abstract

The concentration gradients (CG) of biomolecules play an important role in biological processes. Numerous microfluidic concentration gradient generator (μCGG) platforms for biochemical applications are developed to generate CG of various profiles. Nonetheless, the process to determine the operational and design parameter values for the μCGG is still a challenge, when specific CGs are needed. This talk will present a computation-aware multi-fidelity surrogate-based optimization (MFSBO) framework for intelligent design optimization of μCGGs. The framework judiciously combines computational data from two (or multiple) sources with different fidelities, computation costs, and availability in order to achieve rapid and accurate design while minimizing computation burder. A new sequential and adaptive sampling strategy based on expected improvement reduction (EIR) is proposed to determine the data source and sampling locations for enhanced data utilization. A new data sparsification technique based on the reduced design space and data filtering (RDS&DF) is also developed to eliminate redundant data and reduce the modeling time for improved optimization efficiency, hence addressing the long-lasting “big data” issues associated with MFSBO. RDS&DF is also combined with EIR-based infill technique, enabling both parsimony and computational awareness for MFSBO. The excellent results demonstrate the unprecedented accuracy and efficiency of the proposed framework for microfluidic and biomedical device design.

About the Speaker

Yi Wang is an associate Professor in mechanical engineering at the University of South Carolina (UofSC). He completed his PhD at Carnegie Mellon University in 2005 and obtained his B.S. and M.S. from Shanghai Jiaotong University in China in 1998 and 2000, respectively. In the period from 2005 to 2017, he has held several positions of increasing responsibility at the CFD Research Corporation (CFDRC), Huntsville, Alabama. In 2017, he joined the University of South Carolina to start his academic career. His research interests focus on computational and data-enabled science and engineering (CDS&E), including reduced order modeling, large-scale and/or real-time data analytics, system-level simulation, computer vision, and cyberphysical system and autonomy with applications in biomedical devices, aerospace, unmanned systems, and manufacturing. He has been a PI or an institutional PI of over 55 projects sponsored by DoD, NIH, MDA, NASA, DOT, and industries, and has published over 120 papers in archival journals and conference proceedings. He is also the recipient of the 2021 Research Breakthrough Star Award of UofSC.