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HIGH-DIMENSIONAL DATA ANALYTICS FOR SYSTEM CONDITION MONITORING AND PERFORMANCE IMPROVEMENT

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ABSTRACT

Many capital-intensive assets used in the energy, manufacturing, and service sectors (such as gas turbines, steel mills, and aircraft jet engines) are equipped with numerous sensors that generate large amounts of high-dimensional data streams related to their physical performance. If modeled properly, these data can be very useful for defect/anomaly detection, root cause diagnosis, failure time prognostics, and system performance improvement. In this talk, two topics in this area are presented. The first topic focuses on developing a supervised dimension reduction method for the failure time prediction of assets with incomplete image-based condition monitoring data. Unlike many existing models that rely on unsupervised dimension reduction for feature extraction and subsequent failure time prediction, this topic introduces an innovative supervised dimension reduction approach. It utilizes historical failure times to guide feature extraction, resulting in more effective features and improved prognostic performance. The second topic discusses a federated learning method and its applications in industrial prognostics. Specifically, we develop a federated multilinear principal component analysis (MPCA, also known as tensor PCA) method that allows multiple geographically distributed users to jointly conduct MPCA using their high-dimensional tensor data while keeping each participant's data local and confidential.

SPEAKER BIO

Xiaolei Fang is an assistant professor in the Edward P. Fitts Department of Industrial and Systems Engineering at North Carolina State University. He received his B.S. in Mechanical Engineering from the University of Science and Technology Beijing, China, and his M.S. in Statistics and Ph.D. in Industrial Engineering from the Georgia Institute of Technology, Atlanta, Georgia. His research interests lie in the field of industrial data analytics for High-Dimensional and Big Data applications in the energy, manufacturing, and service sectors. Specifically, he focuses on addressing analytical, computational, scalability, and data privacy-protection challenges associated with the development of statistical and optimization methodologies for analyzing massive amounts of complex data structures for real-time industrial asset management. Dr. Fang's research has garnered considerable recognition, including five best paper awards from IISE or INFORMS, one best doctoral dissertation award, and two featured articles in the ISE magazine.

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