جلسه ارائه علمی دانشکده مهندسی صنایع

High-Dimensional Functional Data Analysis for System Performance Improvement

ارائه دهنده: دکتر کامران پی نبر

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Abstract

Nowadays most manufacturing processes are instrumented with sensing systems comprised of hundreds of sensors. The low implementation cost, high acquisition rate, and high variety of such systems lead to rich functional data that provide distinctive opportunities for performance improvement not heretofore possible. However, complex characteristics of such functional data including the high dimensionality, spatio-temporal correlation structure, and non-stationarity pose significant analytical challenges yet to be addressed. In the first part of talk, a novel process monitoring methodology for high-dimensional functional data streams including profiles, images and videos will be presented. I introduce spatio-temporal smooth sparse decomposition (ST-SSD), which serves as a dimension reduction and denoising technique by decomposing functional data into a functional mean, sparse anomalies, and random noises. ST-SSD is followed by a sequential likelihood ratio test on extracted anomalies for process monitoring. The second topic of this talk is concerned with a new adaptive sampling methodology that helps reduce the measurement time in point-based sensing systems such as guided wave test and laser ultrasonic. The proposed methodology named Adaptive Kernelized Max-Min Distance (AKM^{2}D) is designed based on systematic exploration and exploitation. AKM^{2}D aims to find a balance between space-filling sampling and focused sampling near anomalous regions. Finally, I will discuss some potential topics for future research in the area of high-dimensional functional data analysis.

Biography

Kamran Paynabar is an Assistant Professor in the H. Milton Stewart School of Industrial & Systems Eng. at the Georgia Institute of Technology. He received B.Sc. and M.Sc. in Industrial Eng. from Iran University of Science and Technology and Azad University in 2002 and 2004, respectively, and Ph.D. in Industrial and Operations Eng. from The University of Michigan in 2012. He holds an M.A. in Statistics from The University of Michigan. His research interests include high-dimensional data analysis for systems monitoring, diagnostics and prognostics, and statistical and machine learning for complex-structured streaming data including multi-stream signals, images, videos, point clouds and network data with applications ranging from manufacturing to healthcare. Paynabar is the recipient of QSR Best Paper Award, POMS Best Paper Award, Best Application Paper Award from IIE Transactions, INFORMS Data Mining Best Student Paper Award, and Georgia Tech Junior Faculty Teaching Excellence Award. He is the President-Elect of Quality Control and Reliability Engineering Division of Institute of Industrial and Systems Engineering.