EPSTEIN INSTITUTE SEMINAR ▪ ISE 651

Big Data Analytics for Real-time Complex System Monitoring and Prognostics

ABSTRACT - The rapid advancements of internet of things (IoT) technology and cyber-physical infrastructure have resulted in a temporally and spatially dense data-rich environment, which provides unprecedented opportunities for performance improvement in various complex systems. Meanwhile, it also raises new research challenges on data analysis and decision making, such as heterogeneous data formats, high-dimensional and big data structures, inherent complexity of the target systems, and potential lack of complete a priori knowledge. In this talk, two research topics will be discussed in detail to elaborate the needs of developing multidisciplinary data fusion and analytics methods for effective online monitoring and prognostics by harnessing the power of Big Data. The first topic introduces a generic data-level fusion methodology, which is capable of integrating multiple sensor signals to effectively visualize and continuously model the evolution of a unit's health status for degradation modeling and prognostic analysis. To the best of our knowledge, this is the first work that provides the theoretical analysis of the data fusion method for degradation modeling and prognostics. The methodology will be tested and validated through a degradation dataset of aircraft gas turbine engines. In the second topic, a dynamic and adaptive sampling algorithm will be introduced to actively decide which data streams should be observed to maximize the anomaly detection capability subject to the practical resources constraint. Two theoretical properties on the sampling layout of the proposed algorithm are investigated when the process is in control and out of control. Comprehensive simulations and real case studies will be provided to illustrate the effectiveness of the proposed method over existing techniques. In addition, various other examples will be demonstrated by using the proposed methods if time allows.

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SPEAKER BIO - Dr. Kaibo Liu is an Assistant Professor at the Department of Industrial and Systems Engineering, University of Wisconsin-Madison. He received the B.S. degree in Industrial Engineering and Engineering Management from the Hong Kong University of Science and Technology, Hong Kong, China, the M.S. degree in statistics and the Ph.D. degree in Industrial Engineering from the Georgia Institute of Technology, Atlanta, respectively. Dr. Kaibo Liu's research is in the area of system informatics and data analytics, with an emphasis on the data fusion approach for system modeling, monitoring, diagnosis, prognostics and decision making. The significance of his research has been evidenced by the wide recognition in a broad of research communities in Quality, Statistics, Reliability and Data Mining, including several best paper awards from INFORMS and ISERC and several featured articles from IIE and INFORMS magazines. His research has been successfully funded by NSF, ONR, AFOSR, DOE, and Industry. He is the receipt of the Outstanding Young Manufacturing Engineer Award by SME and the Feigenbaum Medal Award by ASQ in 2019. He is currently serving as an Associate Editor of IEEE Transactions on Automation Science and Engineering and IEEE CASE. More information can be found in his website: http://kaibo.ie.wisc.edu/index.html.

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