Sensor based Online Quality Assurance in Advanced Manufacturing and Service Systems using Compressive Sensing

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Abstract
Sensor technologies have been widely used for quality monitoring and assurance in manufacturing and service systems. However, due to the ever increasing system complexity, online quality monitoring and diagnosis become more and more challenging. Essentially, the underlying model that connects sensor data with the process variables is ill-posed in many real-world applications; thus, a unique solution becomes infeasible. This research primarily focuses on compressive sensing (CS) and sparse estimation based approaches to tackle the above challenges, for effective quality assurance of manufacturing and service systems, especially with limited number of sensors. Two methodologies, namely, "CS based sensor system design" and "CS based process analytics" have been investigated. The former proposes to optimally design a sensing system for multi-stage manufacturing systems with high dimensional streaming data. The latter develops sparse estimation techniques with theoretical performance guarantees devised for real-time monitoring and fault diagnosis of complex systems, such as Additive Manufacturing (AM). As a result, the use of these methodologies has several promising advantages, such as, enabling fault diagnosis for large systems using a limited number of sensors, performing online classification for high dimensional data, optimal sensor selection, etc. The effectiveness of the proposed methodologies have been demonstrated using case studies from not only the aforementioned advanced manufacturing systems, but also service applications, such as wearable sensors for human activity identification, and brain data analysis.

Biography
Kaveh Bastani is currently a Ph.D. candidate in the Department of Industrial and Systems Engineering at Virginia Tech. He received his B.S. degree in Industrial Engineering from Sharif University of Technology, Tehran, Iran, in 2008, and his M.S. degree in quality management from Chalmers University of Technology, Gothenburg, Sweden, in 2010. He was a Ph.D. student and research assistant at the School of Industrial Engineering and Management at Oklahoma State University from 2010 to 2013. His research interests include statistical signal processing, compressive sensing, statistical machine learning and data mining, with applications of real-time monitoring, diagnosis, and prognostics for large and complex manufacturing and service systems.