Ensemble Modeling via Design of Experimental and Observational Data Fusion in Manufacturing

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The advancement of sensor networks and computing technologies has resulted in both temporally and spatially dense data-rich environments in manufacturing. Heterogeneity and high dimensionality of the data pose great challenges for manufacturing system improvement. This is primarily due to the lack of systematic models to handle mix-types of data to represent different types of information. Motivated by this challenge, this research focuses on integration of design of experimental data and observational data in manufacturing modeling. In manufacturing, design of experiments is widely used to identify significant variables and optimize process settings. Validation productions are performed afterwards to evaluate the optimal process settings. Both experimental data and observational data are collected in manufacturing. However, current methodologies often use a single type of data for manufacturing modeling. This research presents a method to efficiently model a manufacturing process by integrating the two types of data. We propose an ensemble modeling strategy through the constrained likelihood approach, where the constraints incorporate the sequential nature and inherent features of the two types of data. It therefore achieves better estimation and prediction than the conventional methods. Simulations and a case study of semiconductor manufacturing are provided to illustrate the merits of the proposed method.

Biography

Dr. Ran Jin is an Assistant Professor at the Grado Department of Industrial and Systems Engineering at Virginia Tech. He received his Ph.D. degree in Industrial Engineering from Georgia Tech, Atlanta, his Master's degrees in Industrial Engineering and in Statistics, both from the University of Michigan, Ann Arbor, and his bachelor's degree in Electronic Engineering from Tsinghua University, Beijing.

Dr. Jin's research interests are in engineering driven data fusion for manufacturing system modeling and quality improvement, such as quality engineering in new product realization and manufacturing scale-up, and variation reduction based on spatial correlated responses. His research projects include quality control in wafer manufacturing, ingot crystal growth manufacturing, 3D printing, continuous fiber manufacturing, and thermal spray coating processes. He is a member of American Society of Mechanical Engineers (ASME), Institute of Operations Research and the Management Sciences (INFORMS), and Institute of Industrial Engineers (IIE). For more information about Dr. Jin, please visit: http://www.ise.vt.edu/People/Faculty/Bios/JinRan_bio.html.