CoCo Seminar Series
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Mining Dynamic Recurrences in Nonlinear and Nonstationary Systems for Feature Extraction, Process Monitoring and Fault Diagnosis

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Wednesday March 8th, 2017 11:00am-12:00pm (note the irregular time)
Engineering Building H-9 (Knoll-MacDonald Commons / Watson Commons)

Nonlinear dynamics arise whenever multifarious entities of a system cooperate, compete, or interfere. Effective monitoring and control of nonlinear dynamics will increase system quality and integrity, thereby leading to significant economic and societal impacts. In order to cope with system complexity and increase information visibility, modern industries are investing in a variety of sensor networks and dedicated data centers. Real-time sensing gives rise to "big data". Realizing the full potential of "big data" for advanced quality control requires fundamentally new methodologies to harness and exploit complexity. This talk will present novel nonlinear methodologies that mine dynamic recurrences from in-process big data for real-time system informatics, monitoring, and control. Recurrence (i.e., approximate repetitions of a certain event) is one of the most common phenomena in natural and engineering systems. For examples, the human heart is near-periodically beating to maintain vital living organs. Stamping machines are cyclically forming sheet metals during production. Process monitoring of dynamic transitions in complex systems (e.g., disease conditions or manufacturing quality) is more concerned about aperiodic recurrences and heterogeneous recurrence variations. However, little has been done to investigate heterogeneous recurrence variations and link with the objectives of process monitoring and anomaly detection. This talk will present the state of art in nonlinear recurrence analysis and a new heterogeneous recurrence methodology for monitoring and control of nonlinear stochastic processes. Specifically, the developed methodologies will be demonstrated in both manufacturing and healthcare applications. The proposed methodology is generally applicable to a variety of complex systems exhibiting nonlinear dynamics, e.g., precision machining, sleep apnea, aging study, nanomanufacturing, biomanufacturing. In the end, future research directions will be discussed.

Dr. Hui Yang is the Harold and Inge Marcus Career Associate Professor in the Harold and Inge Marcus Department of Industrial and Manufacturing Engineering at The Pennsylvania State University. He was an Assistant Professor in the Department of Industrial and Management Systems Engineering at the University of South Florida from 2009 to 2015. He is a recipient of the NSF CAREER award and the 2015 Outstanding Faculty Award at the University of South Florida. His research interests focus on sensor-based modeling and analysis of complex systems for process monitoring, process control, system diagnostics, condition prognostics, quality improvement, and performance optimization.

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