Industrial & Systems Engineering
Seminar Announcement

Manufacturing personalized point of care wearable sensors for human health

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Abstract: Recent advances in wireless communications, machine learning and manufacturing technologies offer an unprecedented opportunity to create personalized wearable sensors and prognostics dashboards that can revolutionize the way we assure human health and wellness at the point-of-care. This talk overviews the relevant activities at Texas A&M University emerging from our recent manufacturing initiative, and introduces an ongoing effort towards developing personalized wearable sensors that can enhance quality of life among epileptic patients. A methodological challenge here is to reconstruct the complex brain dynamics, especially the underlying couplings from multiple channels of EEG. The current approaches are inadequate to discern between direct versus indirect couplings in the presence of noise, high dimensionality, sparse interactions, as well as nonlinear and transient dynamics of real world processes. We present a sparse regression (referred to as the l1-min) approach with theoretical bounds on the constraints on the allowable perturbation to recover the network structure that guarantees sparsity and robustness to noise. We also introduce procedures to further enhance prediction scores (i.e., reduce inference errors), and the numerical stability of l1-min approach, as well as a statistic based on the spectral content of the graph representation of the network to detect qualitative changes in the underlying dynamics. We employ this statistic to detect qualitative changes in the coupling structure of the dynamic system. Extensive investigations suggest that our approach can significantly improve, oftentimes by 5 orders of magnitude over the methods reported previously for inferring the structure of dynamic networks, and that the statistic can serve as a highly discriminatory feature to detect seizure from EEG signals. We also discuss our initial results on embedding this method into a 3-D printed personalized electronic device for EEG collection and seizure monitoring.

Bio: *Satish T. S. Bukkapatnam* received his Ph.D. degree in industrial and manufacturing engineering from the Pennsylvania State University. He currently serves as Rockwell International Professor with Department of Industrial and Systems Engineering department at Texas A&M University, College Station, TX, USA. He is also the Director of Texas A&M Engineering Experimentation Station (TEES) Institute for Manufacturing Systems, and has joint appointments with Biomedical and Mechanical Engineering departments. His research addresses the harnessing of high-resolution nonlinear dynamic information, especially from wireless MEMS sensors, to improve the monitoring and prognostics, mainly of ultraprecision and nanomanufacturing processes and machines, and cardiorespiratory processes. His research has led to 141 peer-reviewed publications (82 published/ accepted in journals and 59 in conference proceedings); five pending patents; $5 million in grants as PI/Co-PI from the National Science Foundation, the U.S. Department of Defense, and the private sector; and 14 best-paper/poster recognitions. He is a fellow of the Institute for Industrial and Systems Engineers (IISE), and he has been recognized with Oklahoma State University regents distinguished research, Halliburton outstanding college of engineering faculty, IISE Eldin outstanding young industrial engineer and the Society of Manufacturing Engineers Dougherty outstanding young manufacturing engineer awards.

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