

State and Event Estimation in Stochastic Hybrid Systems with Applications to Smart Grids

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Emerging technologies introduce complex systems that encounter switching uncertainties from system faults and failures, communication uncertainties, system reorganizations, physical and cyber attacks, etc. Randomly switching uncertainties in dynamic systems can be modeled by stochastic hybrid systems. Such uncertainties interrupt system observability randomly, and introduce some fundamental technical challenges in state and event estimation. In this presentation, we summarize some recent progress on observability, observer design, and event detection for randomly switched linear systems whose subsystems are unobservable. An operator must combine information from different subsystems and integrate observer designs with stochastic data of the switching process to achieve simultaneously estimation of the entire system's continuous states and detection of discrete events. The coordinated design methods for subsystem observers and their organization for estimating both continuous and discrete states will be discussed. Fundamental conditions and limitations, and convergence properties will be summarized. Applications of the new methodologies to smart grids will be illustrated.

Le Yi Wang received the Ph.D. degree in electrical engineering from McGill University, Montreal, Canada, in 1990. Since 1990, he has been with Wayne State University, Detroit, Michigan, where he is currently a professor in the Department of Electrical and Computer Engineering. His research interests are in the areas of complexity and information, system identification, robust control, H-infinity optimization, time-varying systems, adaptive systems, hybrid and nonlinear systems, information processing and learning, as well as medical, automotive, communications, power systems, and computer applications of control methodologies. He was a keynote speaker in several international conferences. He serves on the IFAC Technical Committee on Modeling, Identification and Signal Processing. He was an Associate Editor of the IEEE Transactions on Automatic Control and several other journals, and an Associate Editor of Journal of Control Theory and Applications. He was a Visiting Faculty at University of Michigan in 1996, a Visiting Faculty Fellow at University of Western Sydney, Australia, in 2009 and 2013, a Visiting Faculty at Vienna University of Technology, Austria, in 2016, an Organizer and Lecturer of the Advanced Study Institute in INSA Bourges and INRIA Lille, France, in 2022. He is an Eminent Engineer in Tau Beta Pi, a member of Academy of Scholars at Wayne State University, and a Fellow of IEEE.

