The Department of Electrical and Computer Engineering

Announces the

Final Defense of Dissertation

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Date: July 9, 2019
Time: 11:30 AM to 1:30 PM
Location: Winston Chung Hall Room 202

Data-Driven Analysis of Distribution Synchrophasors with Applications to Situational Awareness, Load Modeling, and Reliability

Abstract:

The recent development of distribution-level phasor measurement units, a.k.a. micro-PMUs, has been an important step towards achieving situational awareness in power distribution networks. The challenge however is to transform the large amount of data that is generated by micro-PMUs to actionable information and then match the information to use-cases with practical value to system operators. This open problem is addressed in this thesis. First, we introduce novel *data-driven event detection* techniques to pick out valuable portion of data from extremely large raw micro-PMU data. Subsequently, *data-driven event classifiers* are developed to effectively classify power quality events. Importantly, we use field expert knowledge and utility records to conduct an extensive data-driven event labeling. Moreover, certain aspects from event detection analysis are adopted as additional features to be fed into the classifier model. The developed data analytic package is tested over 15 days of real-world data from two micro-PMUs on a distribution feeder in Riverside, CA. In total, we analyze 1.2 billion measurement points, and 10,700 events. The effectiveness of the developed event classifier is compared with prevalent multi-class classification methods. Importantly, six real-world use-cases are presented for the proposed data analytics tools, including: *transient load modeling for application in frequency regulation market*, *static load modeling*, *remote asset monitoring*, *protection system diagnosis*, *event source location identification*, *lightning initiated contingency analysis*.