Anomaly Detection of Capacitor Banks with Shorted Elements

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OVERVIEW

Advances in machine learning (ML) drive innovative engineering solutions across industries. This talk presents our recent work demonstrating the feasibility and practicality of deploying ML in the utility power sector. In particular, it focuses on identifying anomalies in the health conditions of large high-voltage shunt power capacitor banks in transmission substations. The identification process utilizes voltage and current waveforms captured by power quality monitors. In fuseless capacitor banks, the anomalous condition results from failed capacitor elements manifesting as short circuits. Depending on the number of shorted elements, affected capacitor banks may either remain in service or be forced to de-energize. This work employs a two-stage modularized ML design. The first stage examines whether shorted capacitor elements lead to involuntary de-energization or continued service. Consequential events are directed to the second-stage ML model for detecting the anomalous condition. These models are trained with four months of data collected from a 161-kV substation, while the performance is evaluated based on four years of data. If time permits, this talk will also discuss the transferability of ML models by assessing their performance when applied to data from other substations.

BIO

Dr. Surya Santoso is Professor of Electrical and Computer Engineering at the University of Texas at Austin and holds Engineering Foundation Centennial Teaching Fellowship in Electrical Engineering. His research and teaching interests lie in the broad area of electric power transmission and distribution systems. He is the sole author of Fundamentals of Electric Power Quality (2010) and co-author of Electrical Power Systems Quality (3rd edition, 2012). Additionally, he is the editor of the Handbook of Electric Power Calculations (4th edition, 2015) and the Standard Handbook for Electrical Engineers (17th edition, 2018). He was Editor of IEEE Transactions on Power Systems for four years. He was elevated to IEEE Fellow in 2015 for contributions to automated root cause analysis of electric power quality disturbance phenomena. He is the Past Immediate Chair of the IEEE PES Transmission and Distribution Committee and an IEEE Fellow.