School of Computer Science and Engineering Presentation

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Online Unsupervised Kernel Algorithms for Outlier Detection in the Power Grid

Abstract: We study the detection of gross measurement errors and hidden data attacks in the power system as an online outlier detection problem. An online probability density based technique is presented to identify bad measurements within a sensor data stream in a decentralized manner using only the data from the neighboring buses and a one-hop communication system. Analyzing the spatial and temporal dependency between the measurements, the proposed algorithm identifies the bad data. To develop an online outlier detection algorithm with lower complexity, a sparse online least-squares one-class support vector machine classification algorithm is developed to provide real-time quality information, before the data is fed into the computationally expensive state estimator. An coherence criterion is used to obtain a sparse solution by sequentially processing each data point only once, keeping with the requirement of data processing over data stream. We also present a fast unsupervised kernel affine projection algorithm using the least-squares one-class support vector machine framework to further reduce complexity. A kernel NLMS type algorithm is then developed as a special case. The performances of the proposed algorithms are then verified through simulations on IEEE benchmark test systems.