DE-FOA-0001861-OE0000913 (Oct 1, 2019-May 22, 2022): Big Data Synchrophasor Monitoring and Analytics for Resiliency Tracking (BD SMART)

Partners:
Temple University, Quanta Technology, OSI Soft

BD Smart: Project Status

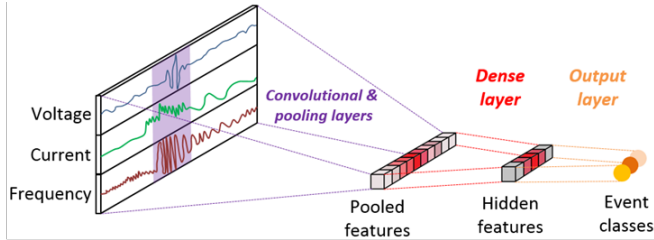Mladen Kezunovic, Regents Professor, Texas A&M University

North American Synchrophasor Initiative, Virtual Meeting, October 5-7, 2021

Events Detection and Classification from PMU Data

Problem formulation: Given a **signal segment** $\mathbf{s}(t-\Delta, t+\Delta) = [\mathbf{s}^{(1)}(t-\Delta, t+\Delta), ..., \mathbf{s}^{(M)}(t-\Delta, t+\Delta)]$,

from multiple PMU devices, **predict** $y \in \{0, ..., C\}$ which indicates the **type of event** that occurred during $[t-\Delta, t+\Delta]$.
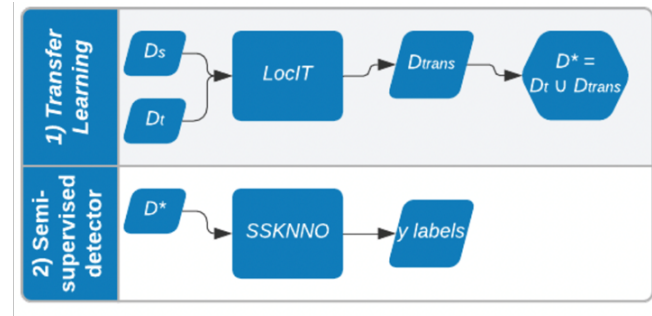
Q1: Can we automate feature learning?
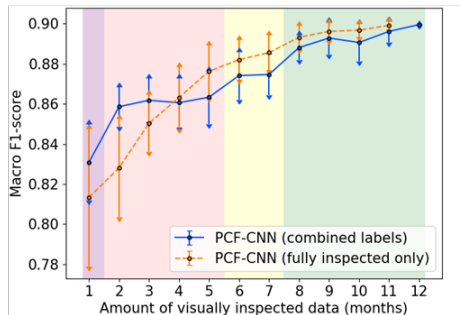Yes - Simultaneous Channel Filtering

Q2: Should we learn from more data or from better data?
Yes - use both if data is small

Q3: Can we use relevant labeled PMU data from a related task?
Yes - Transfer Learning

Q4: Can we enhance PMU data through simulations?
Yes, but need 3 phase data
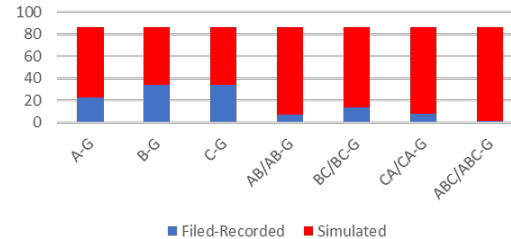
Publications

- M. Pavlovski, M. Alqudah, T. Dokic, A. Abdel Hai, M. Kezunovic, Z. Obradovic, "Use of Hierarchical Convolutional Neural Networks for Event Classification on PMU Data," journal paper, IEEE Trans. on Instrumentation and Measurement, In Press.

- A. Abdel Hai, T. Dokic, M. Pavlovski, M. Alqudah, M. Kezunovic, Z. Obradovic, "Transfer Learning for Event Detection from PMU Measurements with Scarce Labels," IEEE Access, In Press.

- H. Otudi, T. Dokic, T. Mohamed, Y. Hi, M. Kezunovic, Z. Obradovic, "Line Faults Classification Using Machine Learning On Three phases Voltages Extracted from Large Dataset of PMU Measurements," HICSS-55 Conference, January 2022.

- M. Alqudah, M. Pavlovski, T. Dokic, M. Kezunovic, Y. Hu, Z. Obradovic, "Convolution-based Event Detection Utilizing Timeseries Data Streams from Phasor Measurement Units Sparsely Located Across Electric Power Systems," In Review.

- R. Baembitov, T. Dokic, M. Kezunovic and Z. Obradovic, "Fast Extraction and Characterization of Fundamental Frequency Events from a Large PMU Dataset Using Big Data Analytics," HICSS-54 Conference, Hawaii, USA, January 2021.

Recommendations

- Anonymizing synchrophasor data by removing the grid topology and PMU placement is significantly reducing the ability of ML/AI techniques to deal with the event detection, classification and anticipation

- Bad data in many instances can easily be removed, or managed, but the abundance of it suggest that more care needs to be paid to the synchrophasor system set-up, commissioning and periodic testing to improve data quality

- The labeling and time stamping done manually based on SCADA or other data is not going to produce the best result for the development and implement of automated data analytics for event characterization using synchrophasor data

- Due to the ever-growing size of the captured PMU data, future processing by only visual means by the operators will not suffice and automated means will have to be developed and fully implement for the cost-effective solution

- The results of this project demonstrated that the technology for development and implementation of automated means for characterizing the events is readily available, but related data reporting standards and practices need to support the technology