High-Fidelity High-Resolution and Secure Monitoring and Control of Future Grids: A Synergy of AI, Data Science, and Hardware Security

Lang Tong and Ed Suh, Cornell University
Meng Wang and Joe Chow, Rensselaer Polytechnic Institute

Project vision

- Harness advances of data revolution, AI, and security research in unlocking the full potential of PMU and advanced sensing technology.
- Address vulnerabilities of substations to cyber attacks and develop provably secure computing architecture that enables critical sensing and control actions in events of attack.

Major technical challenges

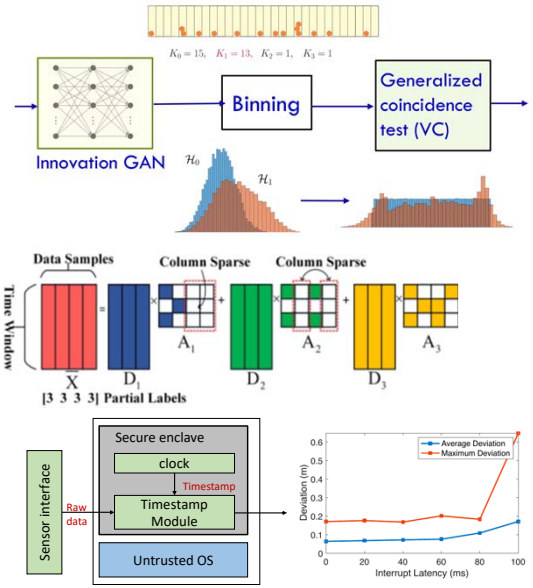
- High penetration of renewables and inverter-based resources introduces complex and rapid system dynamics. An AI powered CPS approach to grid resiliency is essential.
- The potential of adversarial attacks on data and control planes of power grids requires sophisticated and integrated monitoring and computing architecture.
- The reliability requirement of power systems calls for machine learning approaches with performance assurance.

Technical approach, innovations, and new contributions

- A novel high-fidelity subband compression for real-time streaming of continuous point-on-wave measurements.
- A deep learning approach to extract innovations. sequence for real-time universal anomaly detection.
- A real-time data recovery approach to correct data quality issues with analytical guarantees.
- A novel machine learning approach to disaggregate loads from aggregate data at substations.
- A novel secure hardware solution that prevents modifications and interruptions of untrusted OS.
- A demonstration of today's securing computing platform.

Scientific impact

- Advancing the science of CPS monitoring and control with novel ML and AI solutions to secure operations of highly dynamic engineering systems.
- Advancing the science of CPS security with secure and resilient computing architecture for digital substations and remote terminal units.
- Broadening impacts on other CPS fields including secure autonomous CPS systems, multi-modal sensing and data fusion, and human-in-the-loop decisions.



Broader impacts

- Enabling high-resolution monitoring and control technology that prevents catastrophic failure from natural disasters.
- Two orders of magnitude reduction of bandwidth requirement for real-time CPOW streaming.
- Increasing the public trust in incorporating AI technology in critical domains.
- Enabling accurate data recovery due to severe disturbance and monitoring outage
- Education and Outreach: smart grid summer camp, Curie Academy.

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