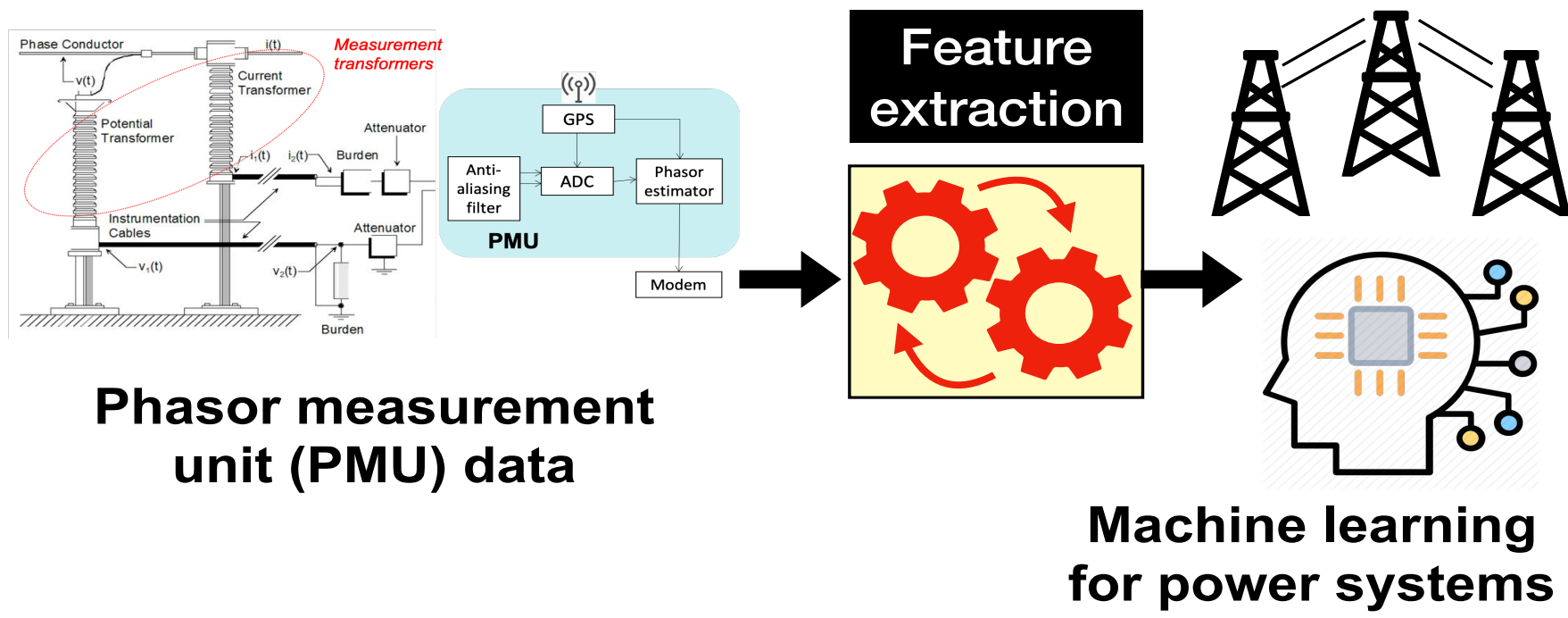


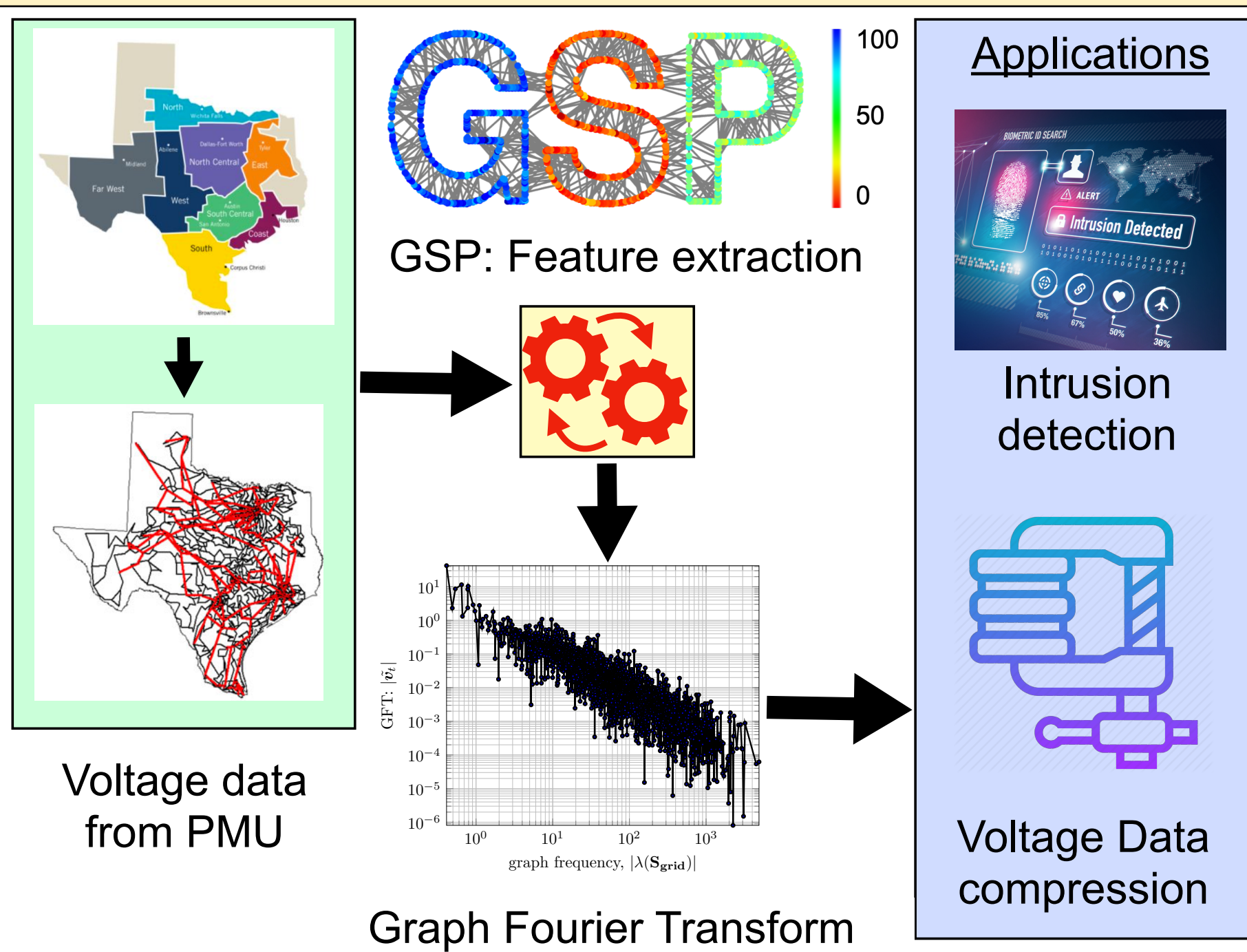
MACHINE LEARNING EVERYWHERE!

- Thanks to Big-Data from Phasor Measurement Units (PMU)
- First step for machine learning: **feature extraction**
- Used for: false data injection attack detection, voltage data compression



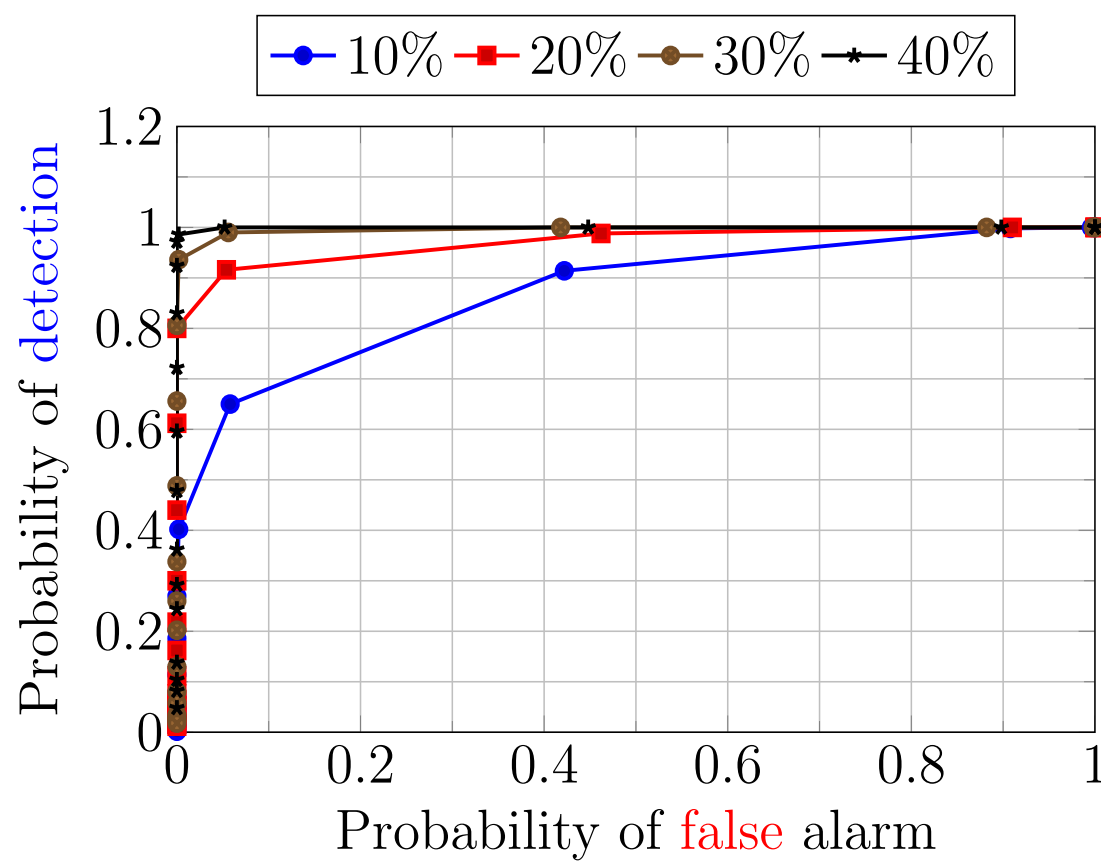
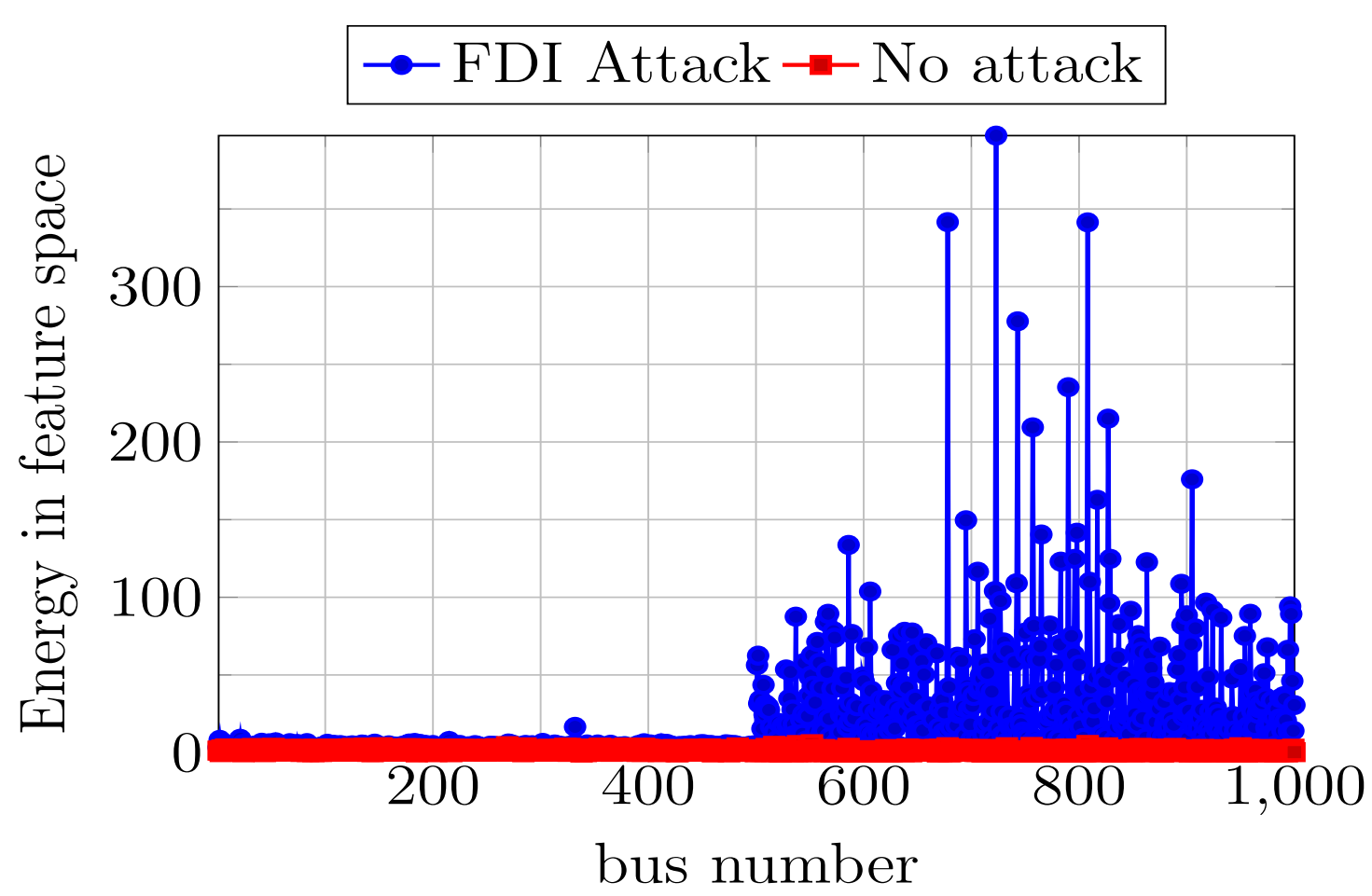
RESEARCH VISION

Develop a feature extraction mechanism for voltage phasor measurements using Graph Signal Processing (GSP) and use them for different applications in power systems

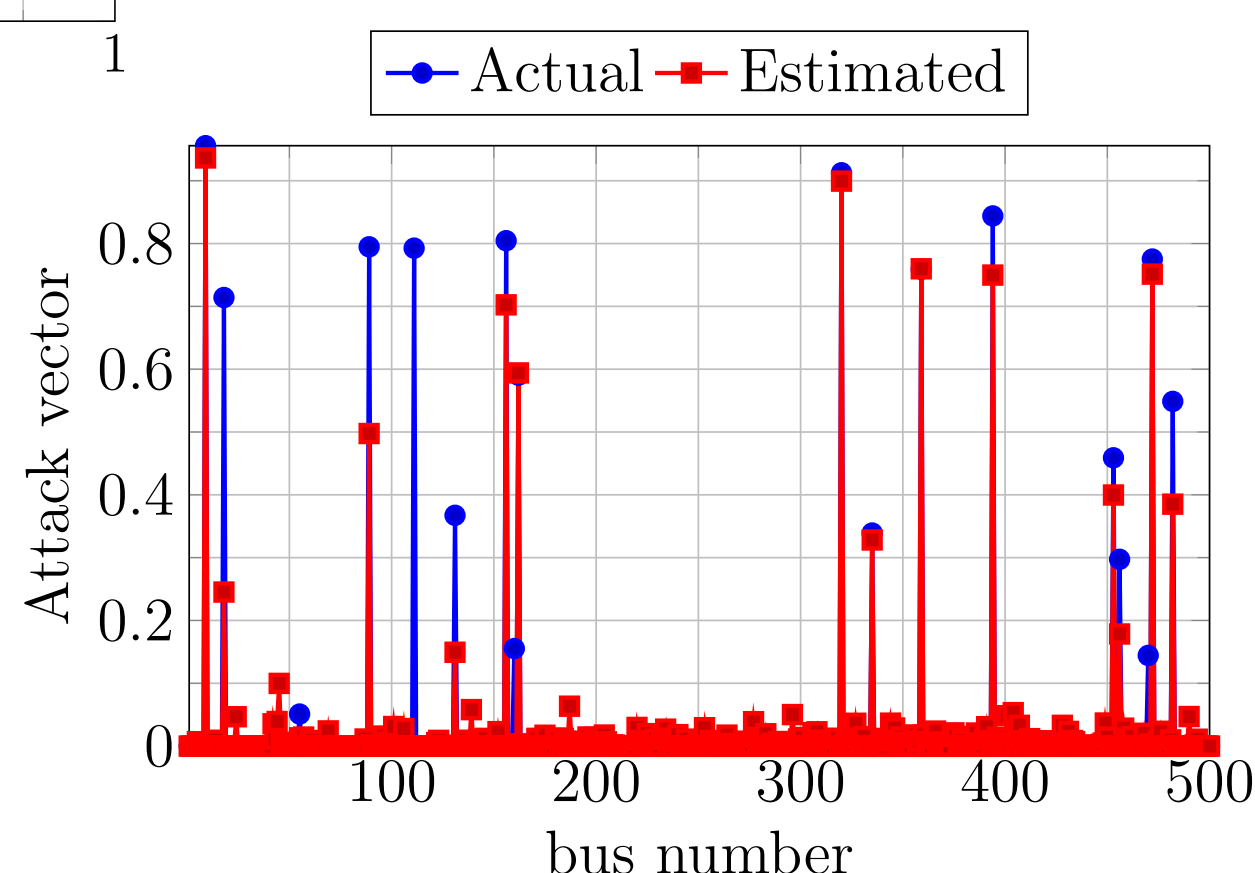


DETECTION OF FALSE DATA INJECTION ATTACKS

- Project measurements into appropriate domain to obtain features
- More energy of features \rightarrow **attack!**



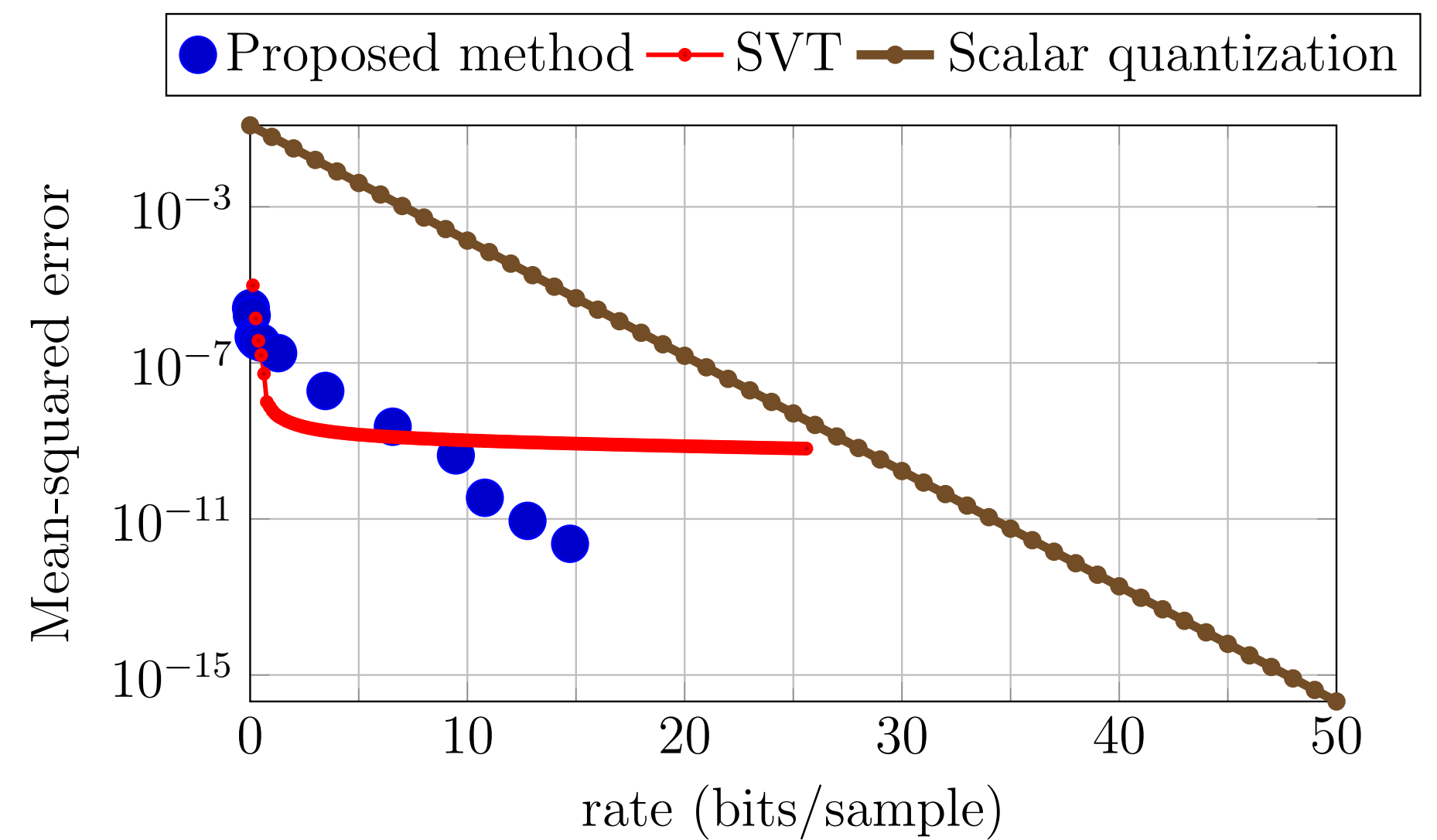
- PMUs at 25% of buses
- Detection performance with certain percent of PMU buses attacked
- Even when percent of buses attacked is small, it can be detected!



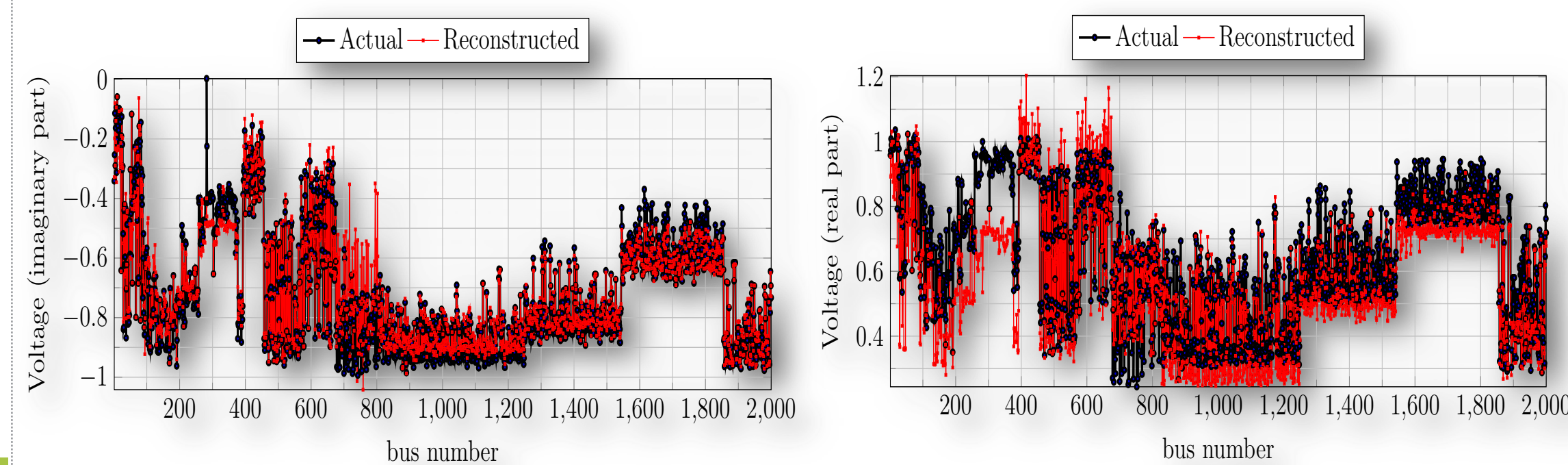
Compromised buses + attack vector can be identified

VOLTAGE DATA COMPRESSION

- Our lossy compression method is sequential and uses very few bits for a certain tolerated mean-squared error
- Low-dimensional model derived from Graph Signal Processing used
- Better than quantization and singular value thresholding (SVT)
- A **provisional patent** is also filed



- With strategically placed PMUs, more compression possible
- Voltage data reconstruction when only 5% of measurements are stored



Future Directions

- Prototype voltage data compression methodology
- Make attack detection techniques **differentially private**
- Identify other applications and attack scenarios

IMPACT ON STATE OF GRID SECURITY

Impacts on Your Grid

- Detect data-injection attacks by continuous deployment of the algorithm
- Use the feature space for other machine learning applications

Business Benefits

- Data storage space **minimized**. Only store relevant **features**
- **Fast** detection of attacks and **isolation** of compromised buses
- No need for training: **save** computing infrastructure **costs** and time!

COLLABORATION OPPORTUNITIES

This research would benefit from collaboration with industry partners in the following areas:

- **Datasets** of PMU measurements from actual distribution systems
- Specifications about **other applications** in the industry that benefit from machine learning algorithms
- Contact: Anna.Scaglione@asu.edu, raksha.ramakrishna@asu.edu
- Activity webpage: <https://cred-c.org/researchactivity/Analytics>