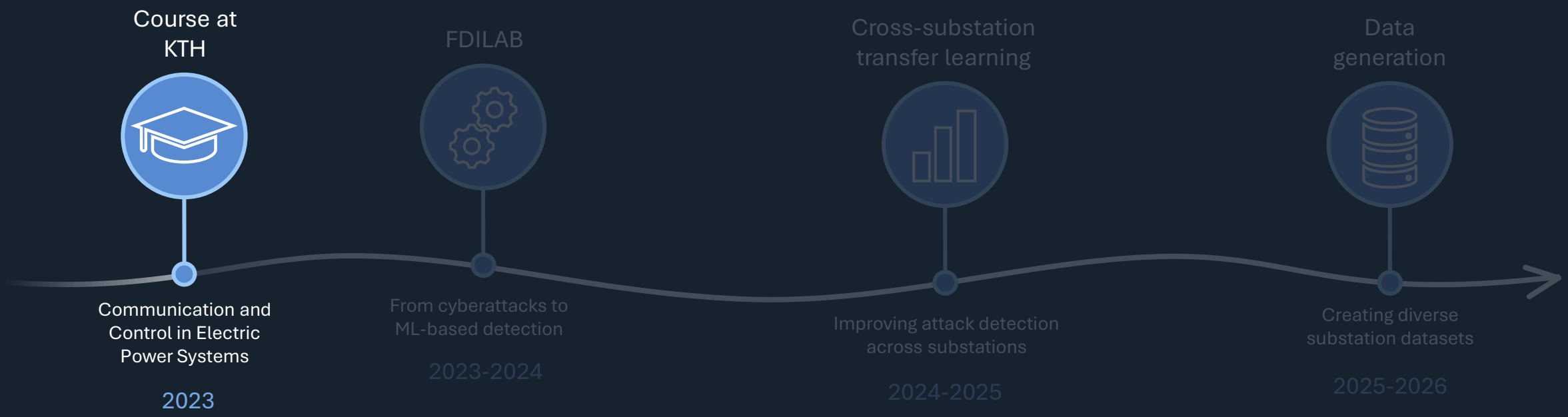
How do we study cyberattacks when real-world data is scarce?

Power systems → Cybersecurity data → Cybersecurity research

Filip Natvig | Uppsala university

A research journey

From a course at KTH to a broader collaboration



When it started

A course at KTH became my first research project

Course at KTH

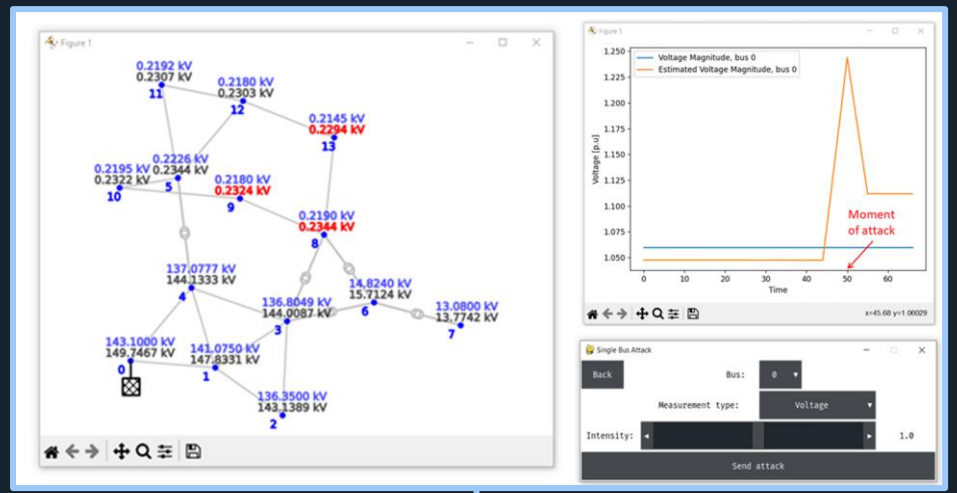
Communication and Control in Electric Power Systems

2023

Course project

Develop an idea with potential to become a research paper

FDILAB



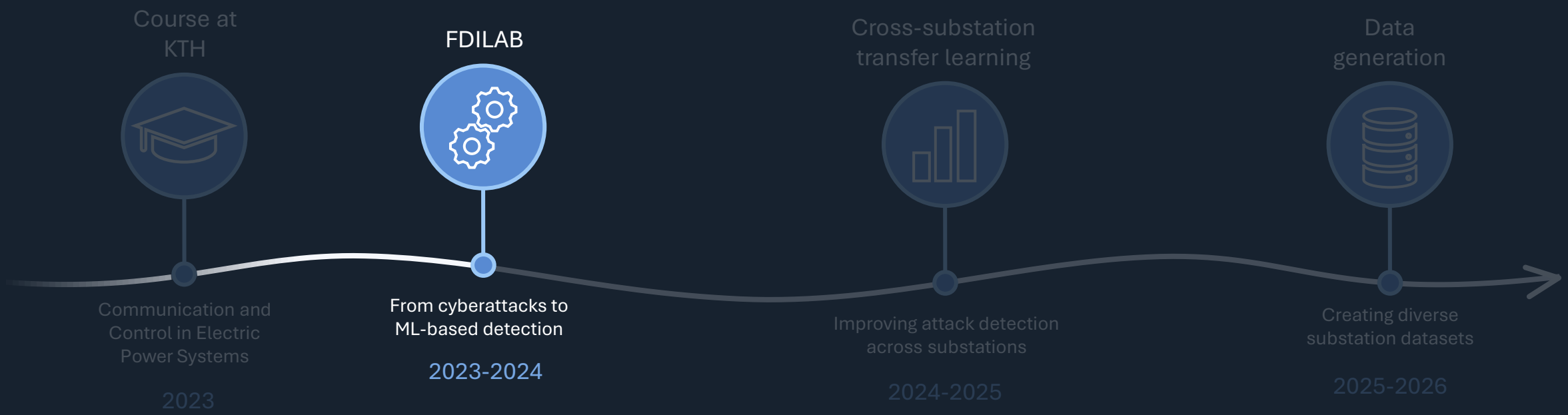
A simple testbed for experimenting with false data injection attacks

2023

F. Natvig, G. N. Ericsson and L. Nordström, "A Learning Testbed for False Data Injection Attacks," *2023 IEEE PES Innovative Smart Grid Technologies Europe (ISGT EUROPE)*, Grenoble, France, 2023.

A research journey

From a course at KTH to a broader collaboration



FDILAB evolves

From attacking the grid to detecting attacks

Experiment with attacks

FDILAB

A simple testbed for experimenting with false data injection attacks

2023

Generate data and scenarios

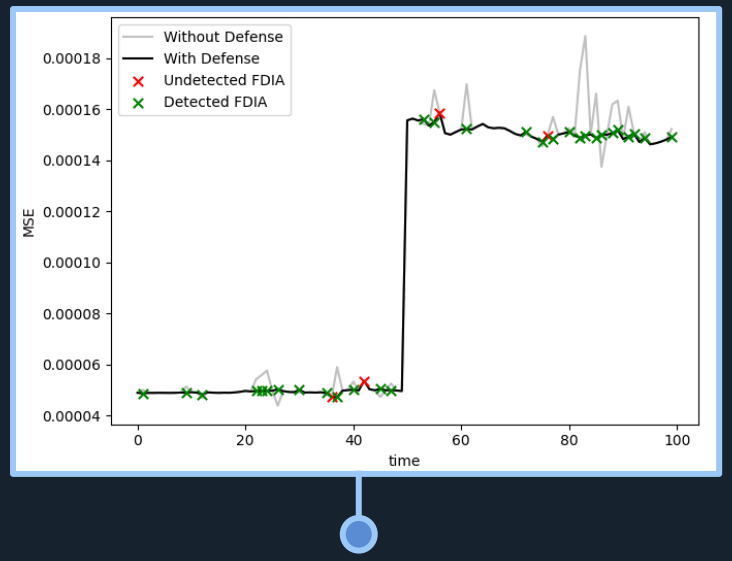
Extended FDILAB

Generate and export datasets from different operation and attack scenarios

Test detection methods

Defend

Integrate and evaluate ML-based detection algorithms



FDILAB v2

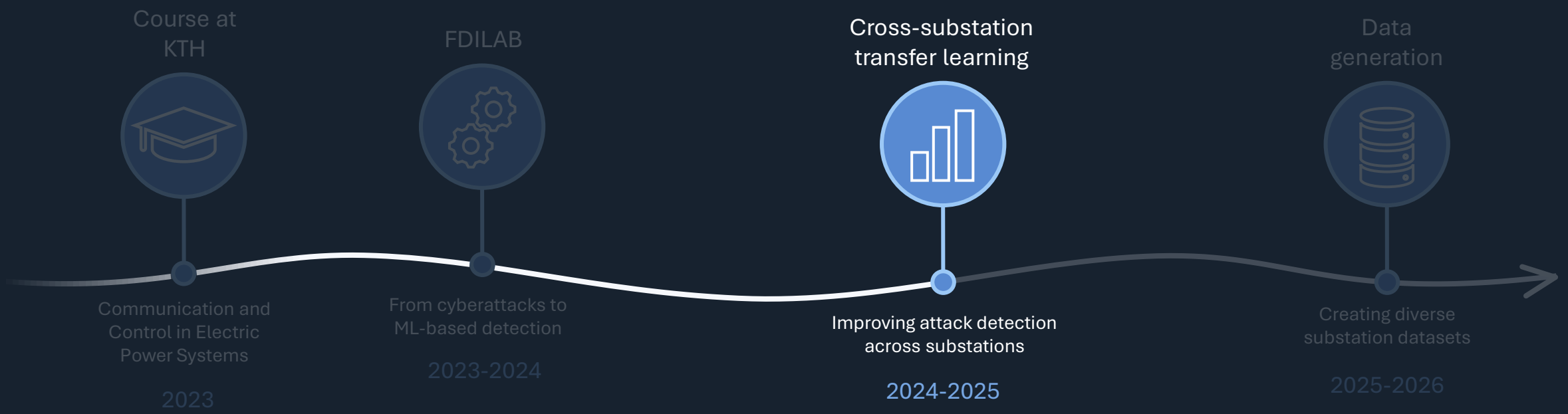
Data generation and ML-based detection in a unified testbed

2024

F. Natvig, G. N. Ericsson and L. Nordström, "FDILAB—An Open-Source Training Tool for Power System Cybersecurity, Machine Learning and Anomaly Detection," 2024 IEEE Power & Energy Society General Meeting (PESGM), Seattle, WA, USA, 2024

A research journey

From a course at KTH to a broader collaboration



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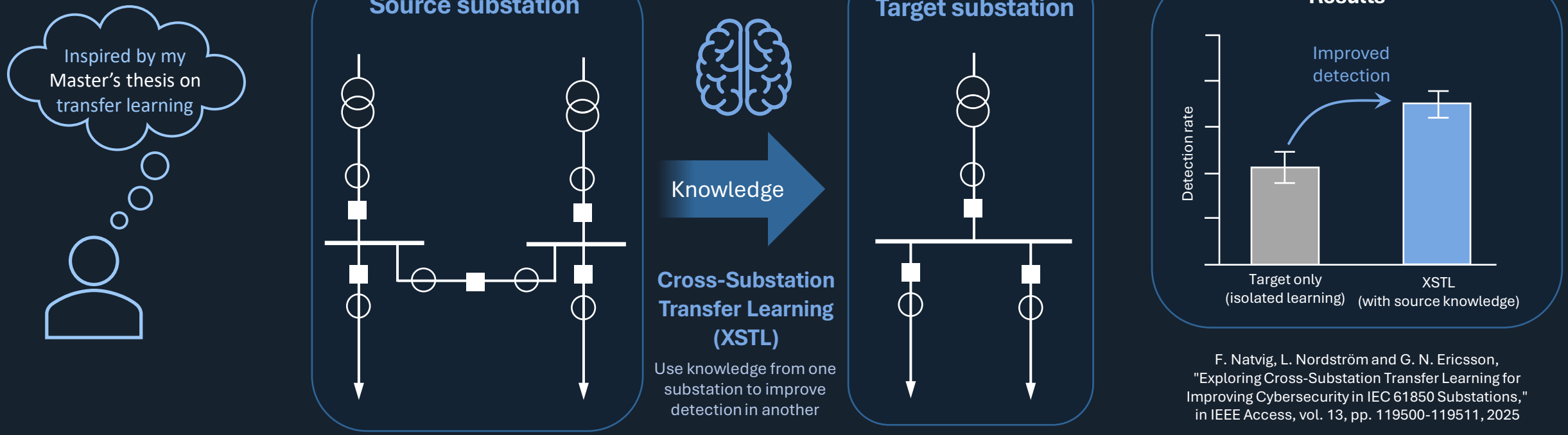
A new direction

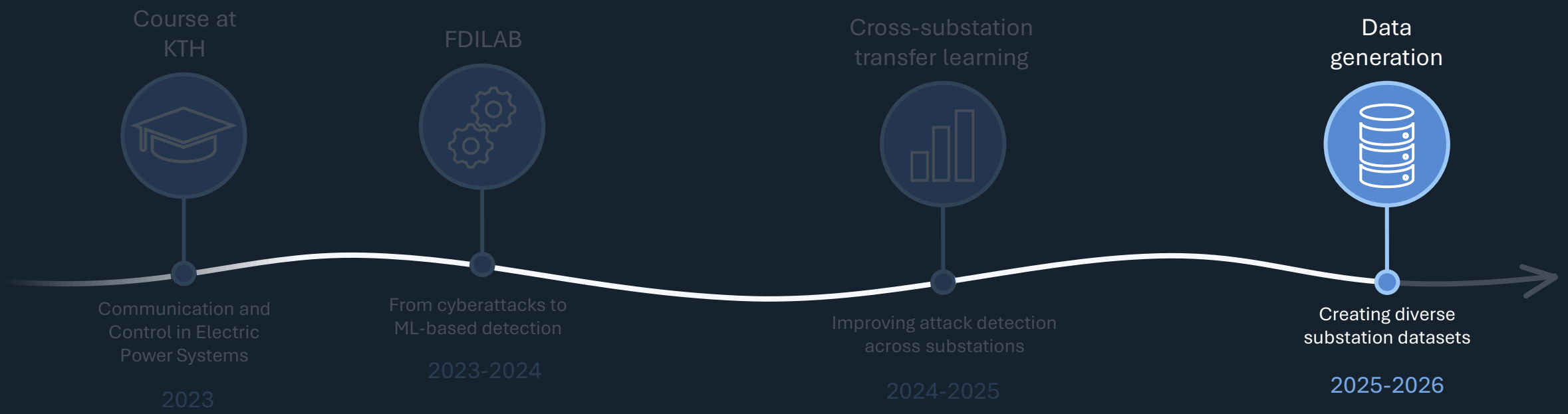
Can one substation learn from another?



F. Natvig, L. Nordström and G. N. Ericsson, "Exploring Cross-Substation Transfer Learning for Improving Cybersecurity in IEC 61850 Substations," in IEEE Access, vol. 13, pp. 119500-119511, 2025

A research journey

From a course at KTH to a broader collaboration



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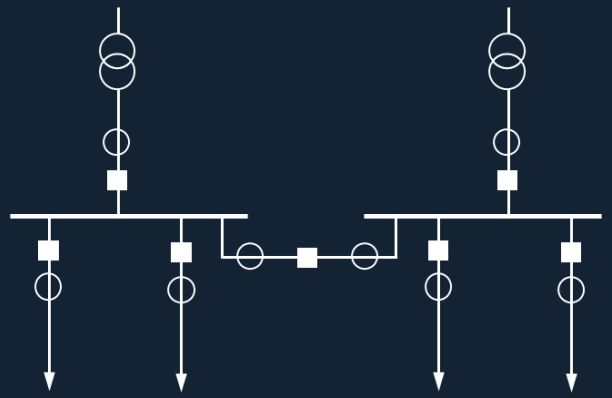
The data challenge

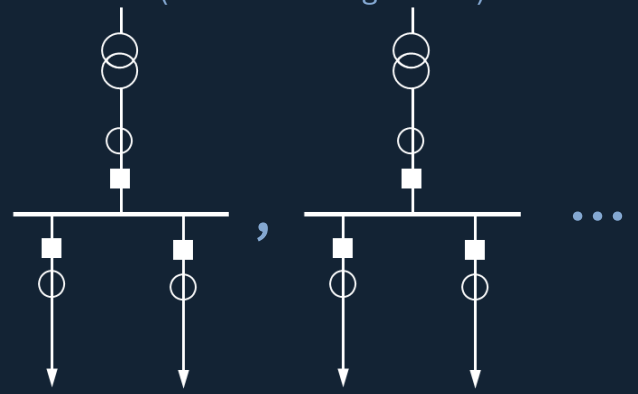
What if the data we need don’t exist?

From one dataset to many



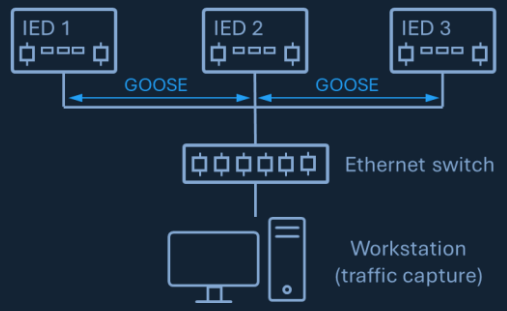
Dataset manipulation technique

Multiple substation datasets
(different configuration)



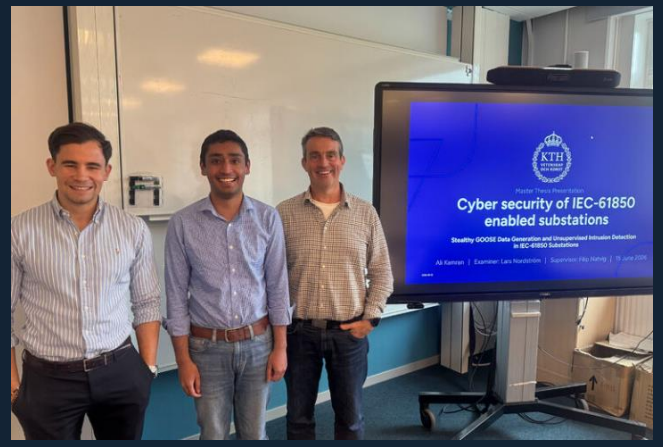
CIGRE Symposium 2025, Trondheim
“Dataset Manipulation for Cross Substation Transfer Learning: A Promising Path to Enhanced Cybersecurity”

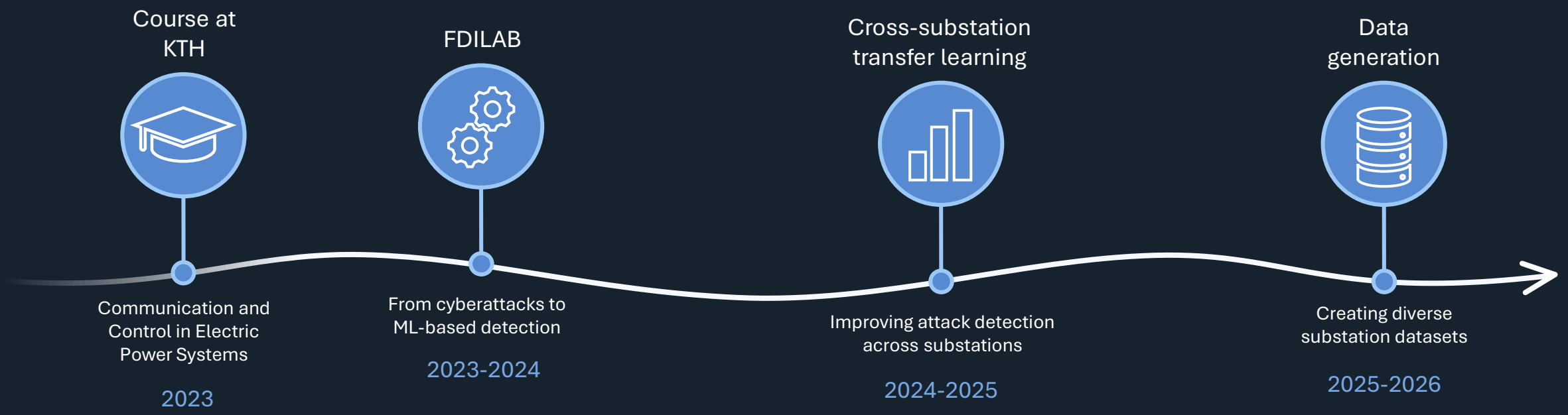
From physical systems to new data



Physical IEC 61850 testbed
(based on the MSc thesis work of Ali Kamran)

New IEC 61850 dataset
(realistic traffic with cyber events)



A research journey

From a course at KTH to a broader collaboration