North Carolina Agricultural and Technical State University

Cross-Domain Anomaly Detection in Cyber-Physical Systems: Dr. Yaa Acquaah

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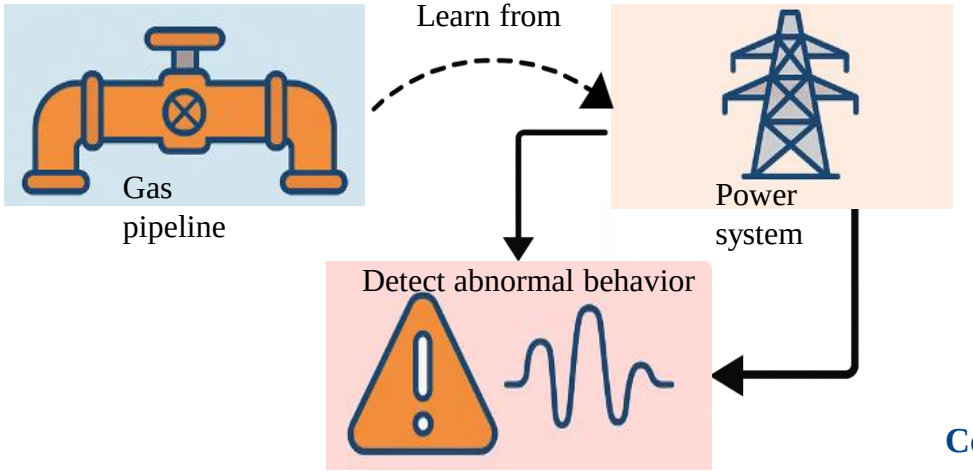
Background

- Cross-domain anomaly detection in a cyber-physical system (CPS) involves identifying abnormal behavior in one system by transferring knowledge learned from a different domain.
  - ➢ Example is learning from Power System to detect anomalies in Gas Pipeline.
- Enables anomaly detection across diverse domains without training separate models for each.

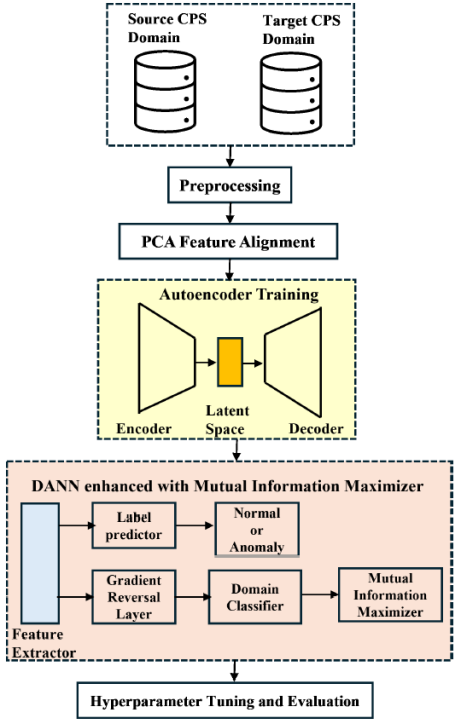


Knowledge Transfer for Cross-Domain Anomaly Detection in CPS.

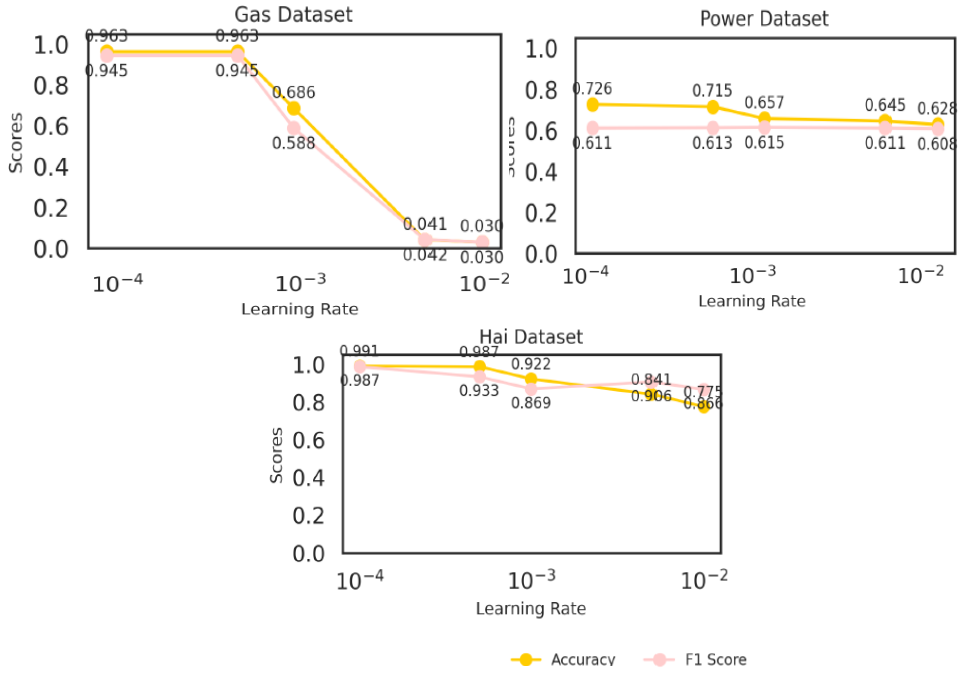
Objectives

- To develop a model capable of learning domain-invariant representations for anomaly detection across CPS datasets.
- To evaluate the model's ability to generalize across multiple CPS domains using metrics like Fréchet Inception Distance (FID) and cosine similarity.
- To assess the model's effectiveness in detecting anomalies in real-world CPS applications (gas, power, HAI systems).

CPS Cross-Domain Anomaly Detection Workflow



Learning Rate Sensitivity Analysis



Cosine Similarity Analysis Across Domains

Performance Comparison: Hybrid Model vs. Baseline Models

Dataset	Model	Accuracy	F1 Score
Gas Pipeline	DANN + Autoencoder+ MIM	0.963	0.945
	DANN + Autoencoder	0.963	0.945
	DANN	0.963	0.945
Power System	DANN + Autoencoder+ MIM	0.726	0.611
	DANN + Autoencoder	0.693	0.621
	DANN	0.693	0.621
HAI	DANN + Autoencoder+ MIM	0.991	0.987
	DANN + Autoencoder	0.771	0.863
	DANN	0.771	0.863