National Institute of Technology Rourkela

Departmental Seminar

Seminar Title	: A GCN-XGBOOST Framework for Robust PMU Data Recovery and Dynamic Mode Estimation in Power Systems
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Venue	: EE Seminar Room (EE-205)
Date and Time	: 02 Sep 2025 (5:00 PM)
Abstract	: The incorporation of a higher proportion of renewable energy sources, coupled with the evolving dynamics of modern power systems, has significantly increased the challenge of ensuring grid stability, resilience, and reliability. Phasor Measurement Units (PMUs) enabled Wide-Area Monitoring Systems (WAMS) provide real-time monitoring information crucial for maintaining system stability. However, the data from PMUs can often be corrupted due to issues such as communication failures, hardware malfunctions, and cyber threats, leading to missing values, outliers, and noise. This corruption severely impacts the accuracy and reliability of grid monitoring and control. To tackle these issues, this paper introduces a machine learning-driven framework that integrates a Graph Convolutional Network (GCN) and Extreme Gradient Boosting (XGBOOST) for robust data recovery. GCN is utilized for outlier detection and removal by leveraging spatial dependencies among PMU measurements, while XGBOOST is employed for imputation of missing values due to its capability to handle missing data, capturing complex relationships and providing accurate predictions for restoring corrupted PMU signals. Following the data recovery, the TLS-ESPRIT method is applied to accurately estimate modal parameters essential for power system stability. The proposed methodology is tested on a synthetic test signal and a real oscillatory ringdown signal from the IEEE 39-bus system, validated through a Real-Time Digital Simulator (RTDS). The outcomes confirms the efficacy of the proposed scheme in improving PMU data integrity, enhancing grid monitoring, and supporting dynamic mode estimation for maintaining power system stability and resilience.