National Institute of Technology Rourkela

Departmental Seminar

Seminar Title	: A Machine Learning-Driven Oscillatory Mode Estimation Scheme for Smart and Sustainable Energy Systems Using Degraded PMU Measurements
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Venue	: Seminar Room (EE-205)
Date and Time	: 17 Jul 2025 (5:00PM)
Abstract	: As modern power systems evolve with the growing penetration of renewable energy and dynamic grid operations, ensuring stability, resilience, and sustainability has become a critical challenge. Phasor Measurement Unit (PMU) driven Wide Area Measurement Systems (WAMS) supplies real-time information which is essential to strengthen grid stability. However, PMU measured data is often corrupted due to loss of communications, malfunction of hardware, and cyber threats, leading to missing values, outliers, and noise, which hampers the stability and reliability of the power system. To tackle these challenges, this paper presents a machine learning-based scheme that integrates a Density-Based Spatial Clustering of Applications with Noise (DBSCAN) for removal of outliers with Graph Attention Network (GAT) for missing values imputation. DBSCAN locates the anomalous data points by preserving the PMU signals integrity, whereas GAT makes use of temporal dependencies in signal variations and spatial correlations among PMU nodes to restore the missing measurements correctly. Subsequent to the recovery process, the TLS-ESPRIT technique is employed to accurately evaluate the modal parameters, crucial for grid stability. The efficacy of the proposed scheme is checked by using a synthetic test signal and an oscillatory ringdown signal from the IEEE 39-bus system validated using a Real-Time Digital Simulator (RTDS). The results shows the potential of the proposed strategy in improving the automation of the power system, strengthening the grid resilience, and ensuring sustainable energy system operations.