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Enhancing Electrical Grid Reliability through Predictive Cycle Detection with Graph Neural Networks

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This paper presents an end-end study focused on improving grid reliability with the application of Graph Neural Networks (GNNs). Graph representation of the electrical grid yields the model of nodes of substations and transformers interconnection of power lines constructed by the data from the National Grid Electricity System Operator (ESO) Data Portal. Based on their connections, node feature updating and encoding by predicting grid reliability with a multi-layered Graph Attention Network (GAT) was employed. In predicting failure regions, the proposed model with rigorously trained and tested state shows higher accuracy compared to existing methods. The results of the model signify the model's capability to efficiently manage large-scale data with actionable insight generation for specific use in cases such as predictive maintenance, which ensures the resilience of modern power systems and integrating renewable energy in the modern power system.

Keywords: *grid reliability, Graph Neural Networks, predictive detection, AI in grid management, preventive maintenance*