Development of a Transformer Fault Identification Model via Machine Learning: Integrating Gas Co-Relation and Feature Extraction from DGA

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Supervisor: Prof. W.D.A.S. Rodrigo

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Prof. W.D.A.S. Rodrigo

2 ABSTRACT

Dissolved Gas Analysis (DGA) is a widely established diagnostic tool for assessing the internal condition of power transformers by detecting gases generated from thermal and electrical stresses within the oil-paper insulation system. Conventional diagnostic methods such as the Duval Triangle, Rogers Ratio Method, and IEC 60599 rely on static gas ratio thresholds and predefined fault zones, which often result in ambiguous or inaccurate classifications when confronted with overlapping gas signatures, nonlinear gas interactions, and evolving transformer designs.

This research presents a transformer fault identification module that leverages machine learning (ML) integrated with an attention-based feature extraction mechanism. The proposed model enhances fault classification accuracy by learning complex, nonlinear correlations between dissolved gases, dynamically weighting their diagnostic significance, and overcoming the rigid boundaries of traditional methods. Trained and validated on real-world DGA datasets with confirmed fault types, the model successfully categorizes faults such as partial discharges, electrical arcing, and thermal faults (T1–T3).

By transforming raw DGA data into intelligent predictive insights, the system provides accurate diagnoses and actionable maintenance recommendations. The ultimate goal of this study is to advance transformer condition monitoring by offering a scalable, adaptive, and interpretable ML-driven module for fault recognition, contributing to more efficient asset management and predictive maintenance strategies.

Keywords: Machine Learning, Artificial Interlligence, Dissolve Gas Analysis, Tranformer based ML model, Attention mechanism, Feature extraction

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