SymphonyAI INDUSTRIAL

DATASHEET

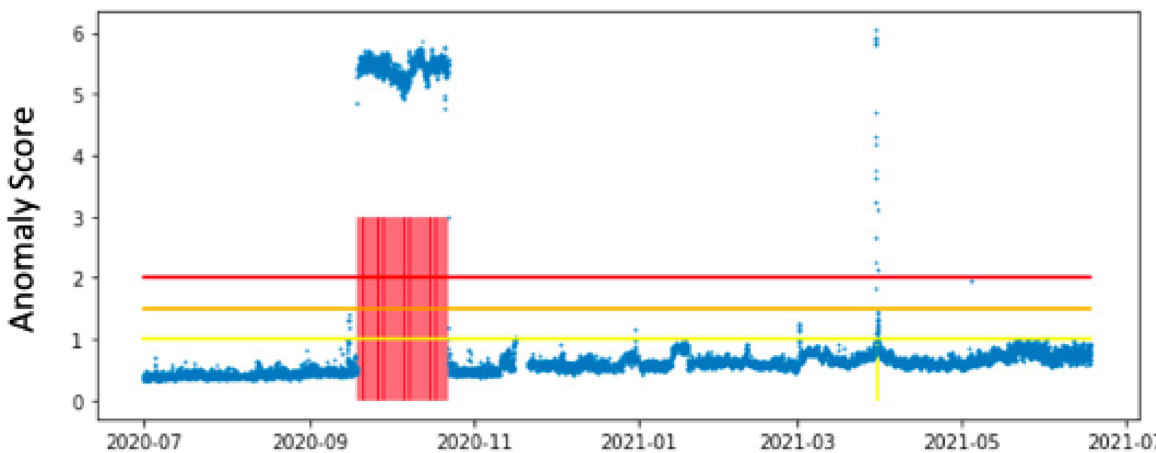
APM360 for Electrical Systems

Electrical system monitoring

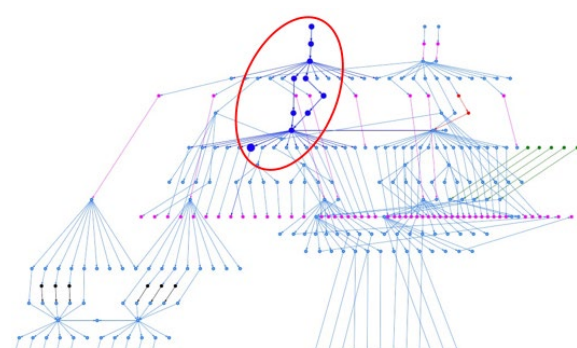
SIAI's APM360 can be used to monitor complex electrical systems using both data-driven and physics-based models.

The **APM360 Anomaly Detection Engine (ADE)** can be used to monitor electrical systems for potential faults, anomalies, or changes in operating conditions. It does this by using deep learning algorithms that learn the behaviour of the system from historical data. Examples of devices that can be monitored include Power Quality Meters (PQMs), Protective Relays (PRs) and transformers. The ADE monitors incoming data and raises alerts when there is a potential anomaly.

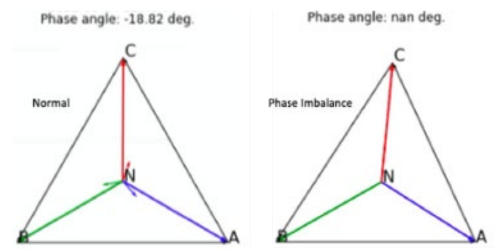
However, simply identifying that there is an anomaly is often not enough. Due to the



interconnectivity of electrical systems, any fault, anomaly, or operational change has a ripple effect across multiple devices and systems, all of which can then show anomalous behaviour. In such a situation, it becomes difficult to trace the origin of the fault. To address this issue, APM360 uses a **System-of-Systems approach** in which devices across all the interconnected electrical systems are represented as a **Directed Graph**, with graph edges represent connections between devices. ADE



results from individual systems are merged and network analysis algorithms used to "collapse" interrelated alerts from multiple systems into a single alert with probability scores assigned to devices most likely to be the source of the problem.



Besides the data-based anomaly detection, APM360 also uses physics-based models to monitor individual devices as well as switchboards. Imbalances in three-phase voltages and currents can be monitored using algorithms in the **APM360 Model Library** for calculating the negative-sequence and zero-sequence voltage and current vectors. These can be used to warn of imbalances at the device (e.g., PQM) level as well as at the switchboard level.

In addition, the APM360 platform allows for the creation of custom KPIs according to need, as well as custom models for cases where a simple KPI definition is insufficient.

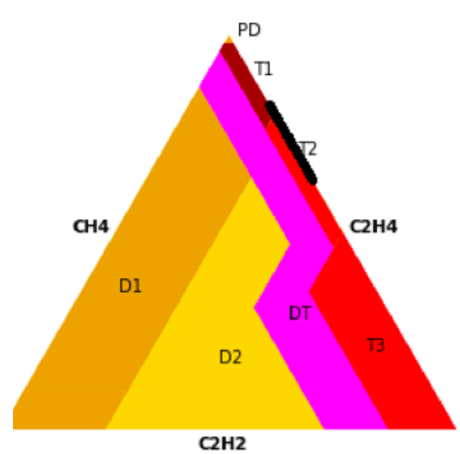
Asset monitoring

Transformers

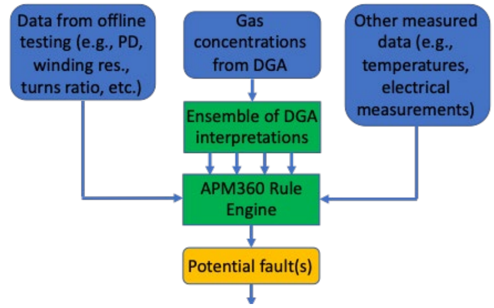
SIAI's **FMEA Template Library** contains templates for monitoring various types of industrial assets. Included amongst these are templates for monitoring the health of transformers.

The transformer FMEA template uses electrical measurements, temperature measurements (of the oil and windings) as well as online DGA to monitor asset health and can be applied to various types of transformers (e.g., power transformers, instrument transformers) as well as transformer components such as OLTCs.

The interpretation of gas concentrations from DGA is based on a custom AI-driven ensemble approach which combines the results of various gas ratio methods specified in IEEE Standard C57.104 and IEC Standard 60599 such as the Doernenburg Ratio method, the Rogers Ratio method, the IEC Ratio method, and the Duval Triangle method.



The custom ensemble approach uses a combination of **APM360's Rule Engine** along with data-driven techniques for baselining and setting thresholds for gas concentrations and gas ratios in cases where the standards do not have recommended operational ranges (e.g., for on-load tap changers). Besides gas concentration and ratio thresholds from the standards, the Rule Engine can be easily customised if a non-standard quantity is to be monitored and considered in the fault identification algorithm.



In addition, the FMEA template can be customised and fine-tuned with data, if available, from historical offline testing (e.g., PD, winding resistance, turns ratio, leakage reactance, SFRA, etc.).

The **APM360 Apparent Cause Engine (ACE)** uses the results of the FMEA template to map potential faults (e.g., thermal faults, partial discharges, arcing) to potential causes as well as advisories for further investigation or corrective action. Such advisories could range from visual inspection to specific test recommendations for the next planned maintenance to planning for an outage (in extreme cases).

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