

Automated Event Mining Based on PMU Data

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Introduction

Automated Event Mining (AEM) application is designed to operate independently as a standalone application to detect events and generate event reports. AEM consists of a Data Collection Module, Event Detection Module and an Event Reporting Module. It will also have links to trigger an offline event analysis tool for performing additional event analysis. AEM also is designed to provide the insight of the data quality and helps to find out the amount of data is missing and how much of the data is good, bad or uncertain for both PMU level and signal level.

Data Source

Data sources for AEM include, and are not limited to, synchrophasor (recorded data) and simulated phasors (simulated data) archived in flat files (CSV, COMTRADE, DST), Historians (PI, eDNA, open Historian) and Relational Databases.

Types of Events

The different event types include oscillations, poorly and negatively damped contingencies, generation trip, unit ramp up and down, line faults, line trips, reactive zones, and high wide area phase angle events. There are four event engines developed so far including oscillations, low voltage, high phase angle difference, and frequency excursions.



Key Functions

The project will deliver the following benefits to utilities:

- **System performance tracking to identify bad actor**
 - Repeated events at specific locations
 - Bad PMU data quality including calibration issues such as detecting sustained low voltage
- **Build event library based on historical data**
 - Categorized events based on severity and types
 - Share event library for training and detailed analysis
- **Offline application integration for detailed event analysis**
 - Avoid manual investigation to identify event data, time, and corresponding signals
 - Streamline event analysis process
- **Event Reporting**
 - System status update for managers
 - NERC frequency excursion reporting for compliance requirements
- **System Baseline**
 - Alarm threshold settings for real-time synchrophasor applications

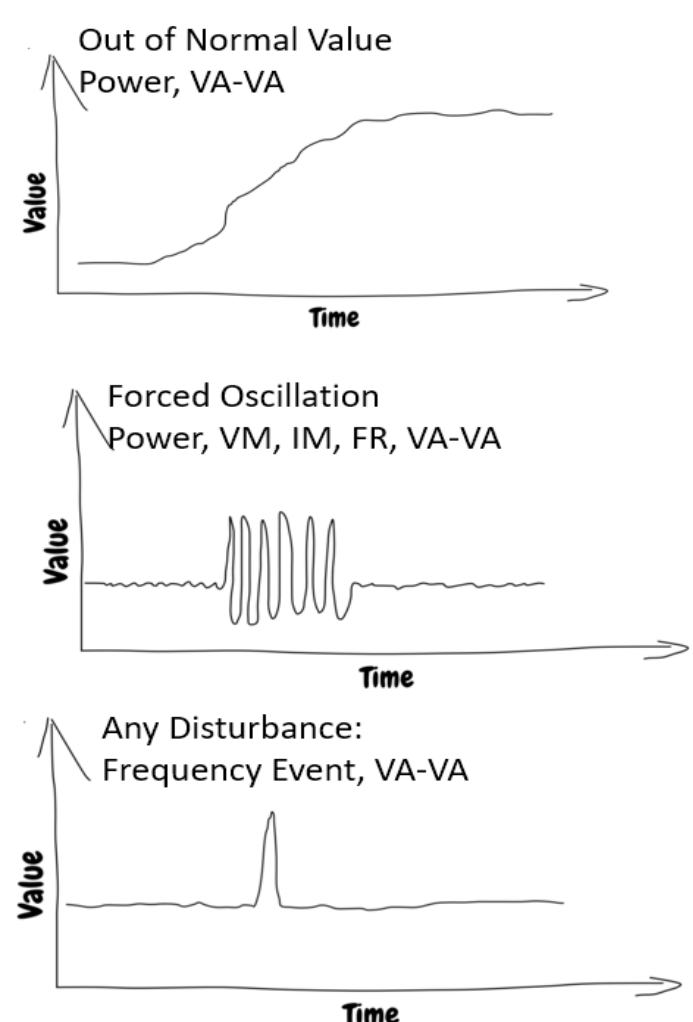
Procedure

Step 1 – Preprocessing

- Reads the header of the historical files
- Provides the statistical summary of the historical data (number of files, sampling rate, number of PMUs, number of the signals, number of types of the signals, list of the signals, number of voltage levels)
- Reads database summary information and allows signal selection and date time range selection.

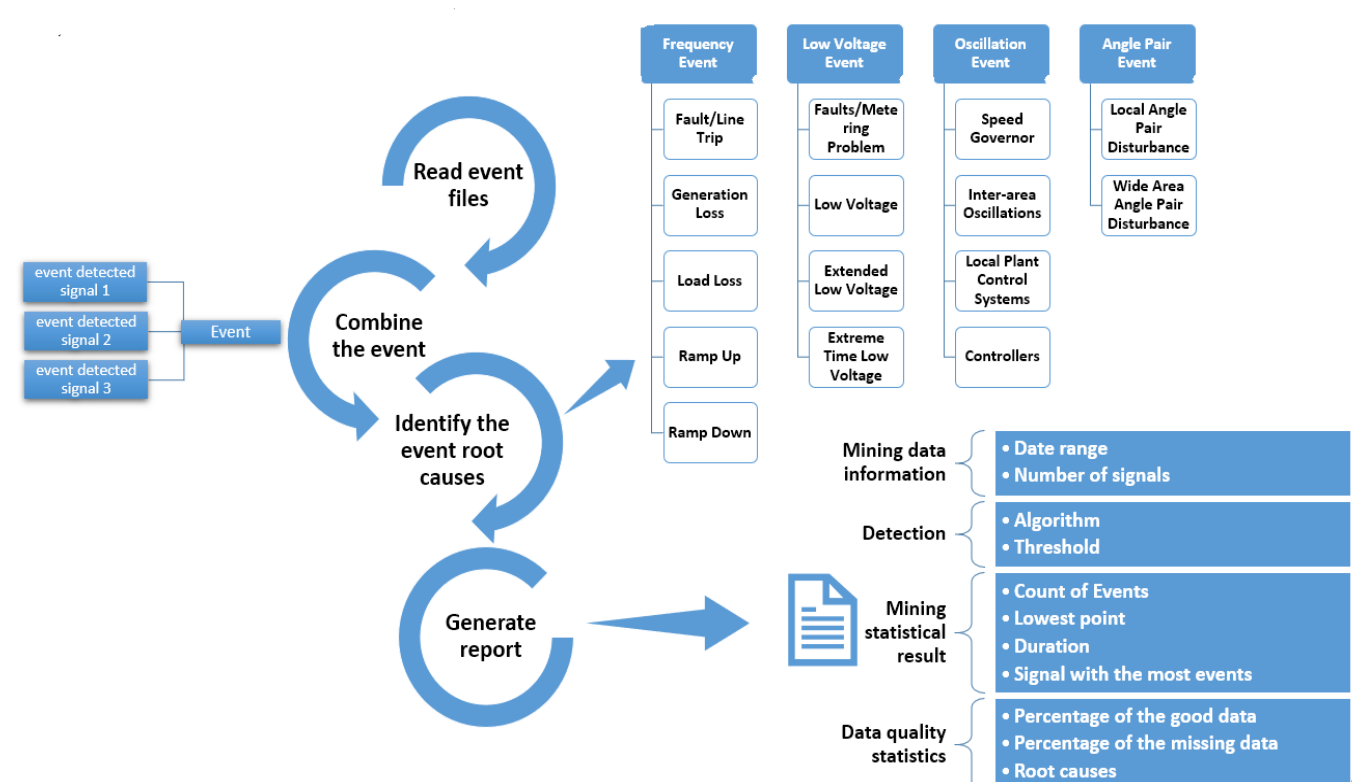
Step 2 – Event Mining

- Event threshold is decided by signals' statistics.
- Intermediate event mining results
 - Status of processing progress
 - PMU signal quality monitor



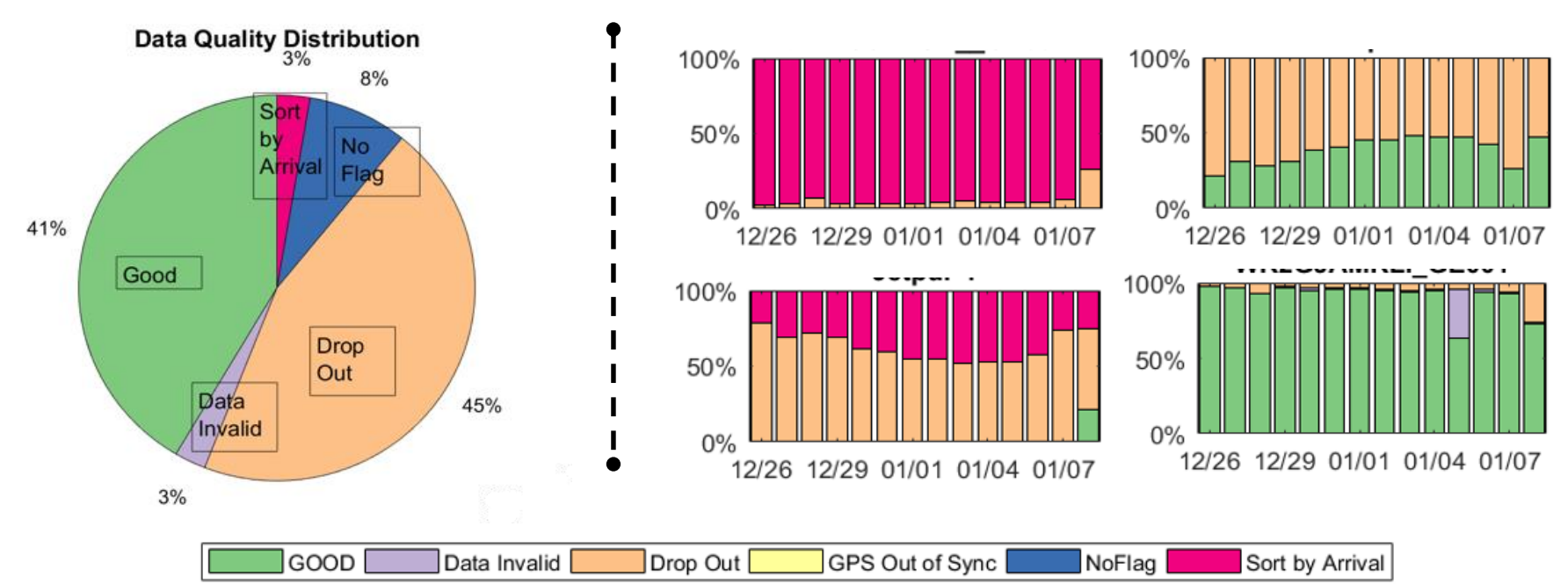
Step 3 - Post Processing

- Combine the duplicated events and signals participating in same event
- Categorize the events
- Create the event report for sharing

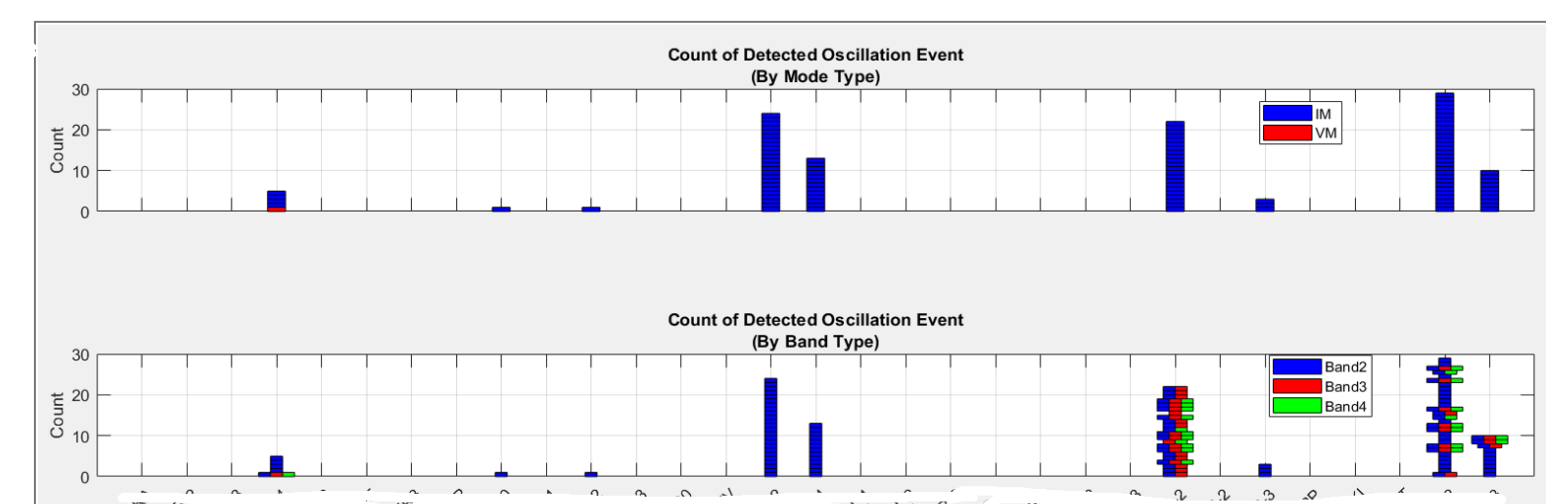
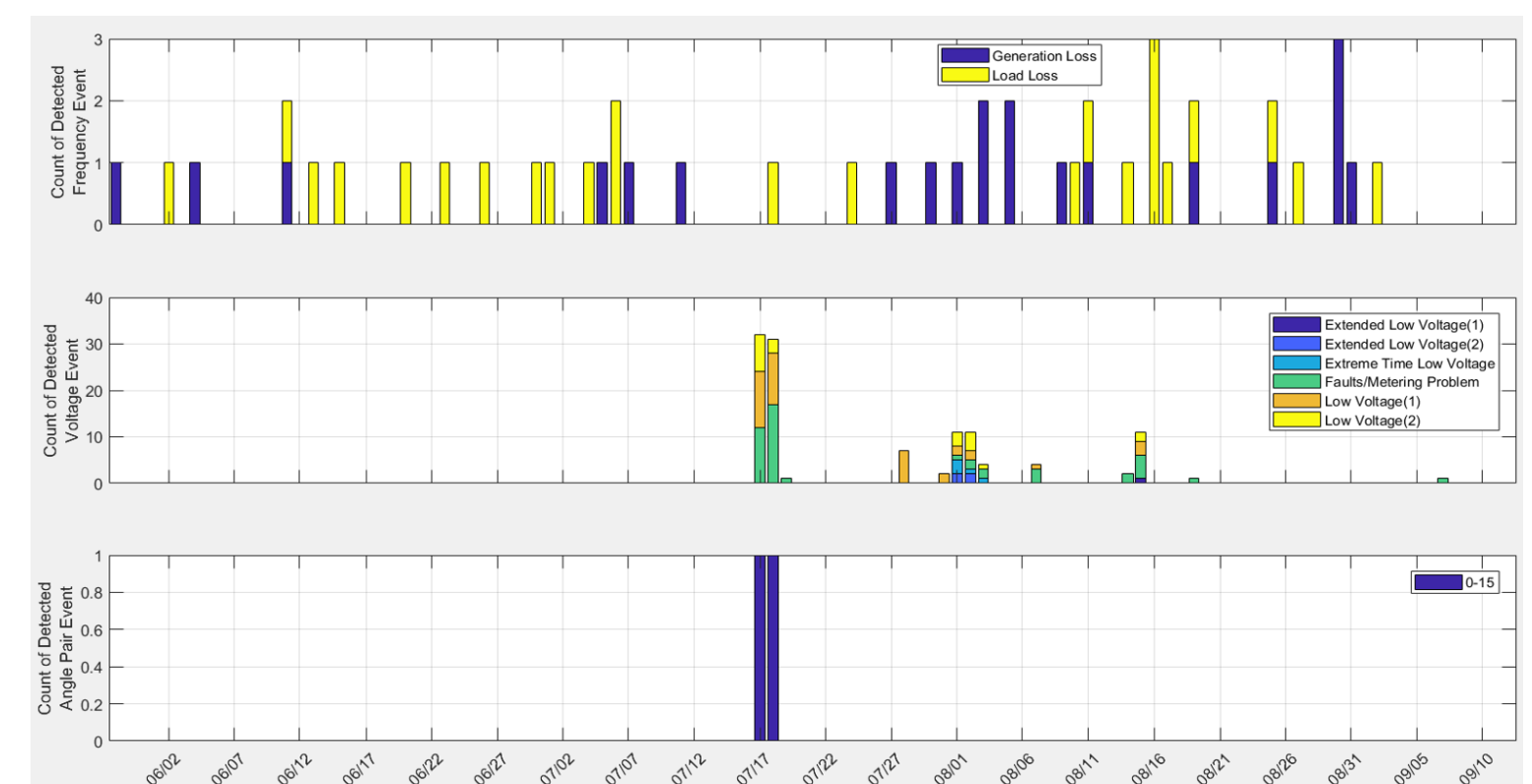


Sample Reports

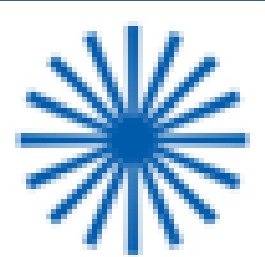
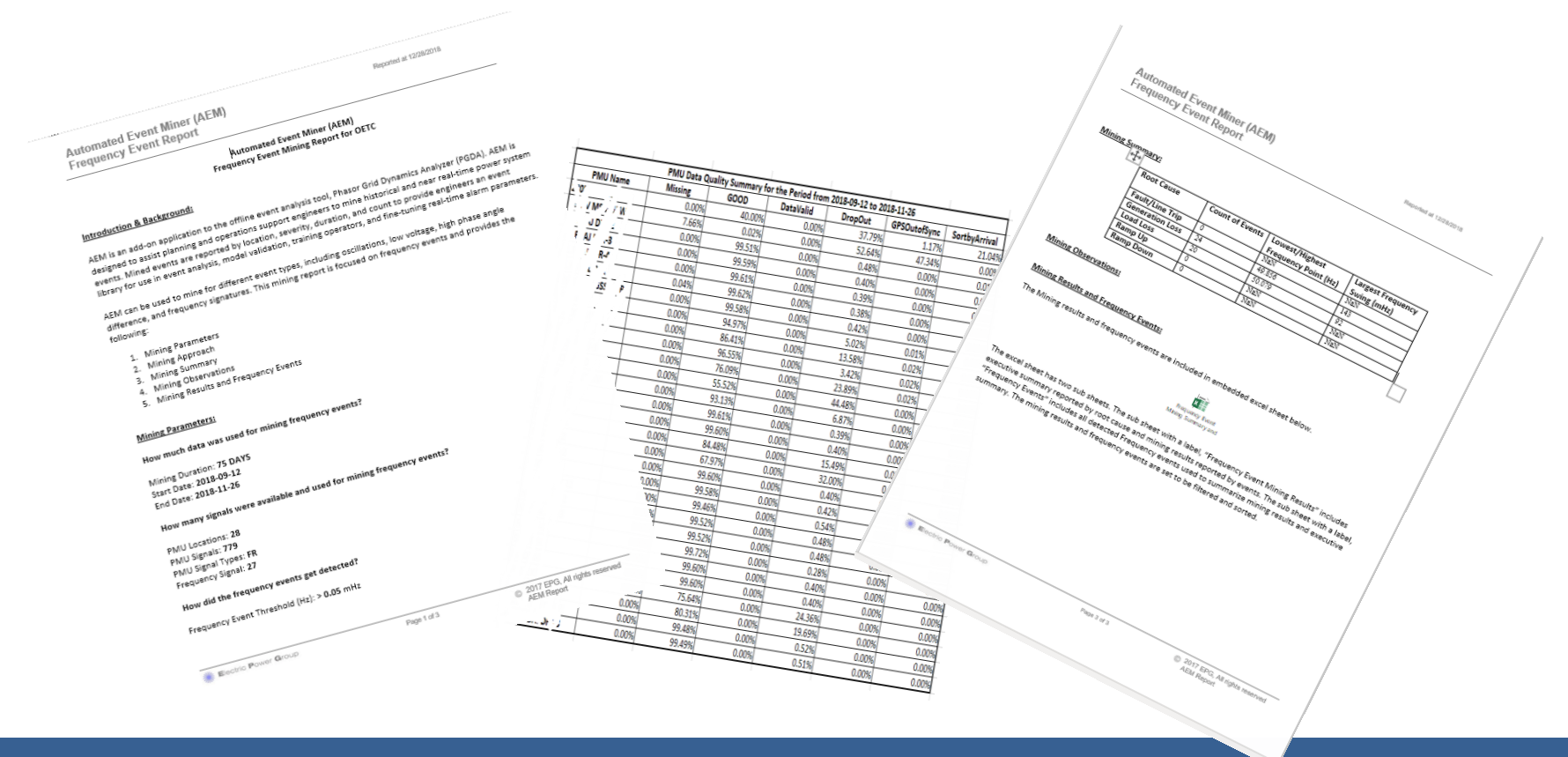
1. PMU Detailed Data Quality Report



2. Detected Frequency, Low Voltage, Oscillation and Angle Pair Events Grouped by Identified Root Causes.



3. Automated Report Generation



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