I. Introduction

An increasing number of monitoring devices have been installed at substations in the power system to better monitor, protect and control power systems. Voltage and current waveforms, phasors, magnitudes, active and reactive power, frequency, and change of frequency may be captured depending on the characteristics of the recording device.

Several researches have been focussed on alternative applications of power disturbance data; since, these disturbances carry valuable information about the conditions of power system and its equipment. For example, capacitor switching transients have been used for evaluating capacitor bank condition, estimating system damping level and harmonic resonances. As another example, relay recorded fault data have been used to locate the fault location in transmission and distribution systems.

This survey reviews different application of power disturbance data, presents some example of practical implementations and discusses the challenges in automated analysis of these data.

II. Categorization

![Diagram of power system applications]

- Network
- Fault Location
- Switched Capacitor Location
- Damping Analysis
- Islanding Detection
-DG Protective Relay
- Generator Voltage Control
- Parameter Monitoring
- Load Monitoring
- Other

III. Sample Applications

- Distribution Fault Anticipation (DFA)
- Texas A&M
- Funded by EPRI

DFA analytics offer the potential to detect incipient events before the outage happens while other smart-grid technologies are designed to respond after a fault has resulted in a sustained outage. Field experience has shown that many incipient conditions may exist on distribution feeders for a long period of time up to weeks or even longer and may produce dozens of momentary interruptions.

Fig. 3 and Fig. 4 show an example of DFA application. In this case, a tree limb caused intermittent phase to ground short circuits and finally burned the line down. The data recorded by DFA revealed that during the period of these events the faults had very similar characteristics which could have been used as a warning to prevent the final outage.

![Diagram of DFA analytics]

Fig. 3. An example of fault which caused two trips and reclosings (no outage happens)

![Diagram of DFA analytics]

Fig. 4. Fault currents which burned down the line and caused an outage

IV. Challenges

As the interest toward extracting valuable information from power disturbances increases and practical applications become more widespread, the amount of data that has to be processed significantly increases. The huge amount of data has made manual analysis very tedious, time consuming, and error prone. Therefore, automated analysis of the data has attracted much attention in the last decade. The goal is to use automated processes to extract useful, actionable information to increase reliability and asset utilization.

V. Conclusion

The research regarding this topic can be conducted in various directions. One of them can be extending the methodology for new applications. For example generator incipient fault detection is an application that has been proposed but not implemented yet. Similarly, the data might be useful for extracting new information about the power system and its component. Especially, the improvements in disturbance recording devices might be useful in extracting new information never possible before.

Another topic can be developing new methods for current applications that overcome the shortcomings of current methods. Another research direction is related to handling the huge volume of data. This includes a wide range of tasks from communicating and storing the recorded data to applying appropriate automated techniques that can handle this volume of data.