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# Effective Feature Set–Based High Impedance Fault Detector

Background

High impedance fault (HIF) normally occur in distribution power systems with voltages ranging from 4 kV to 34.5 kV, and are caused by downed or disturbed conductors. An HIF may present a hazard to public safety in the immediate vicinity. Unfortunately, HIFs cannot always be recorded in the fault report to relay engineers and are thus susceptible to underreporting. Further, conventional protection methods may only clear 17.5% of staged HIFs. With renewable integration into distribution grids, the importance of HIF detection increases dramatically. Although recent efforts have integrated filtering and machine learning for detection, focus has been limited to narrow and generalized HIF feature sets. Because it is unlikely that a certain category can effectively capture all characteristics of HIFs, combining a range of physical features from multiple types of signal processing techniques can provide the key to improving detection robustness.

Invention Description

Researchers at Arizona State University have developed a new variable-importance-based feature selection method for HIF detection. This is achieved by identifying an effective HIF feature set out from a larger pool; specifically, the HIF feature pool is created by extracting a fault's time of occurrence, duration, and magnitude. First, quantities such as active power and reactive power based on voltage and current time series are calculated. The derivatives of these quantities can then be used to signal a potential change due to HIF. A discrete Fourier transform (DFT) quantifies the harmonics so those anomalies can be recorded for later inspection, while a Kalman Filter (KF)–based harmonics coefficient estimation characterizes fault magnitude. Finally, power expert information is integrated into the pool, such as the angle difference between zero and negative sequence voltage. Emphasis is placed on preserving versatility of feature extraction, information ranking, and detection logic across different HIF models.

Potential Applications

- High impedance fault detection
- Distribution power systems

- Electrical grid monitoring

Benefits and Advantages

- Highly suitable for machine learning
- Processes a wide range of fault characteristics

Related Publication (PDF)

Laboratory Homepage  of Professor Yang Weng