Abstract

Energy is a vital element for assessing the economic condition of a country and its living standard. This has been witnessed throughout human history, most notably in the years following the industrial revolution. The ever-increasing demand for electricity has led to the integration of distributed generation in distribution power networks. As the number of interconnections in power networks rises, it becomes more complicated. The fundamental responsibility of all power system engineers is to ensure that services are reliable and consistent. It is also important to minimize the maintenance time and improve system recovery time after breakdown or fault.

HIF detection in power networks is essential, and it is also challenging owing to the low magnitude of the fault current. Failure to identify HIF increases the risk of fire and poses a safety risk to persons. Wavelet Transform has been employed in most of the schemes developed in this research work due to its superior capacity to analyze non-stationary signals (that occur during faults) in both the time and frequency domain. The energy spectrum of wavelet coefficients has been used to detect, differentiate and classify LIFs and HIFs. The wavelet coefficients are derived from one end current signals using DWT in this process. Based on wavelet transform and fuzzy inference system, a novel approach for detecting and classifying faults in transmission lines in the presence of distributed generation has been developed. To classify faults, the fuzzy inference system uses the line impedance determined from the ratio of the approximation coefficients of voltage and current signals. Line impedance has also been utilized as input to an ANFIS-based fault locator to determine the location of an SLG fault in transmission lines. An admittance-based fault index was calculated to propose a novel transmission line protection method to detect and classify non-linear HIF in transmission networks, including evolving and cross-country faults. This method has also been tested on an IEEE 9-bus test system, confirming that it can be implemented in real-world power networks. Series compensation provides various benefits, including increased transmission capacity, improved system stability, voltage regulation management, and optimal load distribution across parallel feeders. An innovative and efficient real time backup protection method for series compensated transmission lines linked to wind farms has been developed to identifies the fault and differentiates between internal and external faults using phase angle differences of positive sequence current signals collected from both ends of the line segment. Moreover, DP has been used to classify internal faults. Finally, a PSD-based ground fault protection scheme for series compensated transmission lines has been developed. PSD has been computed from the wavelet covariance matrix to classify the faults and has been fed into ANN to determine the fault position..