

Adaptive Protection Scheme for Enhancing System Protection in Distribution Networks with Distributed Generation

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Abstract

Integrating green energy-based distributed generation (DG) into power systems remains a top research priority for decades, driven by technological advances, environmental concerns, economic factors, and global trends. Although DGs offer many advantages, they also introduce new challenges, such as voltage regulation, system inertia, stability, and protection coordination. DG units contribute to network currents during faults, impacting their magnitude and characteristics. This affects the sensitivity and selectivity of Directional Overcurrent Relays (DOCR), leading to potential miscoordination when the new fault current profiles do not match traditional protection parameters designed for passive power networks. Consequently, conventional protection schemes cannot ensure the required reliability and sensitivity for distribution systems. To address these issues, Adaptive Protection Schemes (APS) have emerged as a key research focus. A hybrid adaptive protection strategy for a distribution system with DGs based on the Adaptive Neuro-Fuzzy Inference System (ANFIS) is presented. Its robustness to input uncertainties and adaptive learning capability provides superior results compared to conventional and stand-alone optimization approaches. An enhanced IEEE 33-bus system will be modelled in DigSILENT/PowerFactory with and without DGs, for coordinating DOCRs by simulating how network behaves under various fault and outage scenarios. The ANFIS logic toolbox of MATLAB is used to model the ANFIS logic controller that will be used for fault classification and generation of optimal TMS as per system configuration. The algorithm will dynamically update relays TMS in response to network topology, ensuring optimal operating time and relay Coordination Time Interval (CTI). The results will be compared with conventional approaches.

Keywords

Adaptive Protection, Distributed Generations, green-energy, DOCR, ANFIS.

Biography

Japheth Bwire is an Electrical Engineer with 11 years of experience having worked with Kenya Power PLC as a system protection engineer for 9 years before relocating to Ireland, where is currently working as senior protection engineer at EirGrid PLC. Primarily he has majored in design and implementation of protection schemes both for transmission and distribution networks. His research interests include adaptive protection in distribution networks and impact of adoption of electric vehicles to distribution networks. Japheth is a registered Professional Engineer with Engineers Board of Kenya and a Corporate Member of the Institution of Engineers Kenya. Japheth is currently pursuing his postgraduate Master of Science in Electrical Engineering (Power Systems Option) at Jomo Kenyatta University of Agriculture and Technology, Kenya