



SCHOLARLY PUBLICATIONS

School of Electrical Engineering

KIIT Deemed to be University

Journal Name: IEEE Access

IF: 4.2

Title: Intelligent Detection of High Impedance Faults in Microgrid Distribution Lines Using Optimized Machine Learning Models

Author: Bose Hamida I.B.; Bera P.K.; Al-Saadi T.; Pani S.R.; Mansouri M.

Details: May 2026

Abstract: This paper presents a data-driven protection scheme for high impedance fault (HIF) classification in microgrids. Conventional overcurrent protection often lacks the sensitivity to detect HIFs because of their low current magnitude and nonlinear characteristics. To address these limitations, we investigate an approach based on multiple machine learning (ML) classifier models for distribution line fault diagnosis. The proposed technique trains ML classifiers directly on raw three-phase differential current signals, allowing the models to autonomously learn patterns without manual feature extraction. The classifiers are optimized through a grid-search procedure and evaluated using a PSCAD/EMTDC model of a 5-bus AC microgrid test system with distributed generations (DGs) operating in both grid-connected and islanded modes. The generated dataset includes healthy conditions, internal faults (with/without HIF), and external faults with current transformer (CT) saturation. Nine ML models are assessed using accuracy, precision, recall, F1-score, receiver operating characteristic (ROC) analysis, computational cost, and noise sensitivity tests. The results indicate that the feedforward neural network (FFNN), random forest (RF), and stochastic gradient descent (SGD) classifiers exhibit robust and consistent classification performance on the test set. Significantly, even when using raw input data, the proposed methodology effectively discriminates subtle HIF signatures from other transient events and CT saturation conditions. These findings highlight the potential of optimized ML models, particularly FFNN and RF classifiers, to provide accurate and robust support for real-time microgrid protection.

The IEEE Access logo is displayed in a blue serif font, with 'IEEE' on the top line and 'Access' on the bottom line, followed by a registered trademark symbol.

URL: <https://ieeexplore.ieee.org/document/11513399>

