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Combined Mathematical Morphology and Data Mining Based High Impedance Fault Detection

Kavaskar Sekar [a, *], Nalin Kant Mohanty [b]

[a] *Research scholar, Department of Electrical and Electronics Engineering, Panimalar Engineering College, Chennai, Tamil Nadu, India.*

[b] *Professor, Department of Electrical & Electronics Engineering, Sri Venkateswara College of Engineering, Tamil Nadu, India.*

Abstract

This paper presents an intelligent scheme for high impedance fault detection using mathematical morphology and decision tree. The current signals are pre-processed using mathematical morphology and estimation of the signal features is used to generate a decision tree model. The final relaying operation based on generated data mining decision tree model. The proposed method is tested on a standard test system with a wide range of power system operating conditions. Simulation results show that the proposed method can be highly reliable in detecting high impedance fault for harmless and secured operations.

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Keywords: Mathematical Morphology, Decision tree, High impedance fault, Data mining.

1. Introduction

High Impedance Fault (HIF) occurs when the conductors break and touch the poor conducting surface. As a result, fault current is less than normal load current level [1], making conventional protection schemes not suitable for this category of fault. The fallen energized conductor may result in fire and endanger to human life.

* Corresponding author. Tel.:+91-9894909616;
E-mail address: thisiskavas@gmail.com

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An extensive literature review of HIF detection methods in [2]. Several articles reported for HIF detection so far. These are low order current harmonic ratio [3], Extended Kalman filter approach [4], Wavelet transforms [5, 6], Mathematical Morphology (MM) based filters [7], and knowledge discovery in databases and the application of data mining [8]. Significant developments have been made in the earlier decades for HIF detection. But the solution methodology still to be improved. The main goal of this work is to develop an intelligent protection method which can accurately identify and differentiate HIF from other normal power system events with the knowledge of HIF characteristics and data mining Decision Tree (DT) model.

2. **Methodology of the proposed work**

In the proposed method, current at targeted places are received and processed through a tool based on MM to find features such as change in energy, mean and standard deviations. These features are used to train DTs for HIF detection. The data mining based decision tree takes a final decision on trip signal for HIF detection. The proposed method provides a suitable solution for HIF. Fig.1 shows the detailed flow chart of the proposed method.

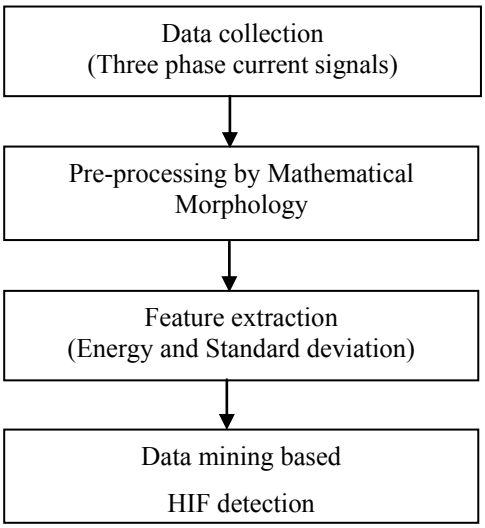

Fig.1. The proposed method.

3. System studied

3.1 Distribution system studied

The effectiveness of the proposed method is demonstrated on the standard test systems. The standard IEEE 13 bus system shown in Fig. 2 and IEEE 34 bus system shown in Fig. 3 was modelled by MATLAB / SIMULINK. The system data for both the system is given in [9]. The modelled substation bus has an equivalent voltage and a series of impedance of 0.01+ j 0.08 p.u. Distribution lines are modelled with lumped parameters. The voltage regulators are modelled by three phase two winding transformer with on-load tap changing transformer.

3.2 HIF model studied

HIFs are highly nonlinear and complex phenomenon and this HIF current have five significant attributes, namely asymmetry, nonlinearity, build up, shoulder and intermittence. The current with different peak values in both positive and negative cycles produces an asymmetry featured signal. Non-linearity arises from odd harmonics. The