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Application of Wavelet Technique for Fault Classification in Transmission Systems

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Abstract

Transmission systems (TS) plays a major role in electrical power systems. The interruption caused to the consumer because of TS faults is substantial. So TS needs a proper protection scheme to ensure continuous power supply to the consumers. This study proposes a novel scheme using wavelet technique for classification of faults in TS. In order to do so, the proposed scheme uses current measurements of just one side of the transmission line. Simulations are performed under different fault conditions using MATLAB. The stability of the proposed scheme under various cases is tested andreliable results have been obtained.

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*Keywords:*Fault; Fault classification; Transmission systems; Transmission line protection; Wavelet technique; Multi resolution analysis

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1. Introduction

Here in this world, major number of problems are linked with population. The population on the earth increasing day by day. Due to this the requirement of energy in daily life gradually increasing. Electricity is the one of the basic need for survival to everyone on this earth. And hence the demand for electricity is raising, which means there is a necessity for more power generation. It is a challenging task for power engineers to provide good quality and un-interrupted power to the consumers. Generally the power system is divided into four parts namely, generation, transmission, distribution and utilization. Out of all these transmission plays major role and it is like a heart of the entire power system. But in entire power system maximum number of faults occurs in transmission systems. Transmission can be done in two ways,one is over head and other is underground. The predominant way to transmit the power is by using over headlines due to its inherent advantages over underground cables. Overhead transmission lines (OHTL) are exposed to atmospheric conditions because of this the possibilities of fault occurrence in OHTL is more [1]. Henceforth the main objective of power engineers is to implement a better protection scheme to TS.
Faults in OHTL are mainly classified into two types, one is open conductor (series) and short circuit (shunt) faults. Series faults are again classified into two types, one is one open conductor faults and other is two open conductor fault. Compared to shunt faults, open conductor faults very rarely occur. The most commonly occurring faults in transmission lines are short circuit faults. Short circuit faults are classified into two types, symmetrical faults and unsymmetrical faults. Symmetrical faults are 3-phase faults, these are most sever faults. Unsymmetrical faults are line to ground, line to line and double line to ground faults. The most frequently occurring fault in TS is line to ground fault. Fault analysis can be divided into three parts namely, fault detection, fault classification and fault location. Fault classification is one of the major task in fault analysis [2].There are a couple of techniques that can be employed in simulation for this purpose. The major techniques are wavelet technique [3], [9], [12], artificial neural networks [5], [11], [14], fuzzy logic [4], [13], [15], wavelet-neural networks [8], wavelet-fuzzy [10], neuro-fuzzy [6], [7]. The accuracy and time response of wavelet approach is better than all the other major techniques and it provides much better results. In order to identify the nature of faults, wavelet techniques are extensively used to solve complex protection issues. This article presents a novel approach using application of wavelet technique for fault classification using one of the terminal end currents of the TS.
This paper is prepared as follows. Section 2 gives introduction to wavelets. Section 3,explains the classification of faults using wavelet technique. Section 4,explains the outcomes of the presented technique. Lastly, Section 5 givesthe conclusion.

2. Wavelet Technique

Wavelet technique is a powerful mathematical tool, useful for processing signals.Wavelet technique appropriately chooses a proper wavelet function known as mother wavelet and this selected function is analysedusing translated and scaled versions.It can analyse the transient, non-stationary or time varying phenomena. Multi resolution analysis (MRA) is one of the best tools to analyse the signals at different frequencies with different resolutions.MRAis designed to give poor time resolutionand good frequency resolution at low frequencies, poor frequency resolution and good time resolution at high frequencies. This approach mainly useful for low frequency component signals for long durations and high frequency component signals for short durations. Another best application of wavelet technique is multi-level decomposition. Signal can be decomposed until individual details contains a single sample by using multi-level decomposition.
Wavelet technique has been in operation in lot of different areas and provides an added advantage of low time response, which improves system efficiency. It has the ability of performing local analysis to the best level without hampering lot of time frequency data. Hence wavelet technique will be very useful in the power system fault analysis and so this articlepresents a novel approach using wavelet technique to identify nature of faults.

3. Fault classification using wavelet technique

The power system model considered for the simulation is as shown in single line diagram inFig. 1. A three phase transmission line of 200-km, operating with 400-kV sources at a load angle of 20^0 has been for simulation of proposed technique. The three phase currents are indicated as A, B and C respectively. And the ground is represented as G.