FAULTDETECTIONINTRANSMISSION LINE USING WAVELET TRASFORMED BASED TECHNIQUE

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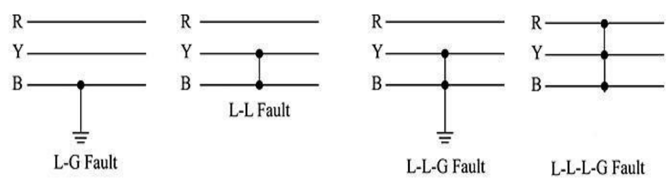
***Abstract*— The demand of electrical power energy has grown exponentially in recent times and to meet this demand electrical power system network needs more sophistication and consequently more complexity. Transmission lines, expanded over several kilometers, are the backbone of the electrical power system which acts as interconnection between power houses and electricity consumers. Transmission lines are mostly located in the openandtherefore,environmentaleffectscanresultinfault occurrences. The ability to detect and diagnose the faults can help greatly in the protection of transmission line. This paper presents modern solution of fault detection and diagnosis of overhead transmission lines by implementing Discrete Wavelet Transform(DWT). Faultsin transmission line of various categories have been created using MATLAB/Simulink. The current signals of each phase are obtained from sending end, and then decompose usingDWT to obtain the details coefficients up to five levels. Furthermore, normalized values are calculated from the norm of detail coefficients. In order to detect and diagnose the faults on transmission lines normalized values of each phase are compared with threshold values of the system. The proposed approach has been successfully tested for variouscategoriesoffaultsatdifferentoperatingconditions**

Keywords:TransmissionLines,Discrete Wavelet Transform, Fault detection, MATLAB

I. INTRODUCTION

The modern-day power system is a complex network of transmission lines that requires a sophisticated, accurate and reliable protection scheme. Since the establishment of power system,thechancesoffaultoccurringinelectricaltransmission lines are generally high as compared to other majorcomponents of power system. Due to this reason, faults detectionanddiagnosisareprimaryandhighpriorityobjectives for power protection engineers. Stability and economics of power system is greatly affected by the faults in transmission lines. It is, therefore, need of the hour to detect and diagnose these faults very efficiently and correctly. The faults at AChigh voltage transmission lines are shown in figure 1 and these faults are classified into different types such as: single line to ground fault (SLG) 7080%, line to line fault (LL) 10-17%, double line to ground fault (LLG) 8-10%, and triple line fault (LLL) 2-3%.



FigNo.1FaultsatTransmission lines

II. WAVELETTRANSFORM

WT is an effective tool for analyzing the current and voltage signals in frequency and time domains. WT is a very useful tool in science and engineering, especially for signals and image processing. In WT techniques, signals are decomposed by low and high frequency filters to obtain the approximate and detailed coefficients. Furthermore, the decomposed signals are used for the detection of faults and their localization by using approximation and detailed coefficients. WT with a combination of fuzzy logic technique are used for fault classification and for locating the point of fault in transmission lines. Wavelet with multi resolution analysis (MRA) is employed for fault sorting and fuzzy logic is usedto extract features from wavelet MRA that give the information about faults location. ANN in combination with WThascontributedgreatlyinsolvingpowersystemproblems such as load forecasting, fault detection, fault diagnosis, and location. In this technique WT is applied for fault finding by decomposing the currents and voltage signals and ANN classifies the faults based on WT decomposed signals. In this paper, modern technique is suggested for fault detection and diagnosis. The proposed technique uses normalized value of each phase which is calculated from the norm of detail coefficients using DWT with MRA choosing mother wavelet Daubechies. attracted both theoreticians and engineers in the 1990's. It is a very powerful tool in the area of signal processing and image compression. WT overcame the disadvantages of Fourier transform (FT). In FT, signal can only be localized in frequency domain and have no information about the signal in time domain. However in WT signals are localized in frequency as well as in time domain. This ability of WT attracted the researchers to use it as a tool to analyze the transients in power system. The availability of wavelet indifferentsizes and shapes likemorlet,daubenchies,

coiflets and haar is a key strength of wavelet analysis. The disturbance of electrical power system are explored by WT, the exploring function, which is named wavelets, modifies their time-width according to frequencyin such amanner that lowerfrequencywaveletwillbebroaderandhigherfrequency Wavelts will be very narrow.

I. DISCRETEWAVELETTANSFORM

DiscreteWaveletTransform(DWT)with MRAisaveryuseful tooltoanalyzethetransientsinpowersystemascomparedwith transmission line fault. DWT decomposes the signals by using low pass and high pass filters into low frequency signals called approximation coefficients and high frequency signals called detail coefficients at different scales of resolution.

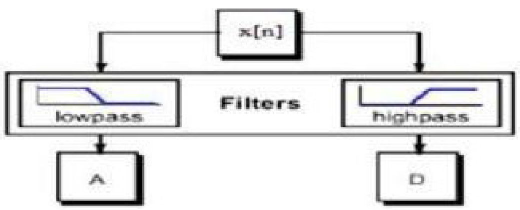


Fig.2.DiscreteWaveletTransform

II. PROPOSEDALGOTHRIMOFFAULT DETECTION

Both symmetrical and unsymmetrical faults s are analyzed in transmission lines. The bus A feeds from generator and bus B connects to load. The fault occurs at transmission line at distance x between bus A to B. In this proposed method faults oftransmissionlinesarefirstsimulatedinMATLAB/Simulink, then the waveforms of three phase fault current signals are recorded in work space through current transform, and detail coefficients are obtained by decomposing these three phase current signals with the help of DWT with MRA by choosing mother wavelet up to five levels. The norm of detailcoefficients of each phase at level five are calculated, then the normalized values from norm are determined and compared with threshold values of the system. Figure depicts the flow chart of proposed method. If the normalized values of each phase are less than threshold value then system is healthy whereas in abnormal condition normalized values of phases exceed from threshold value

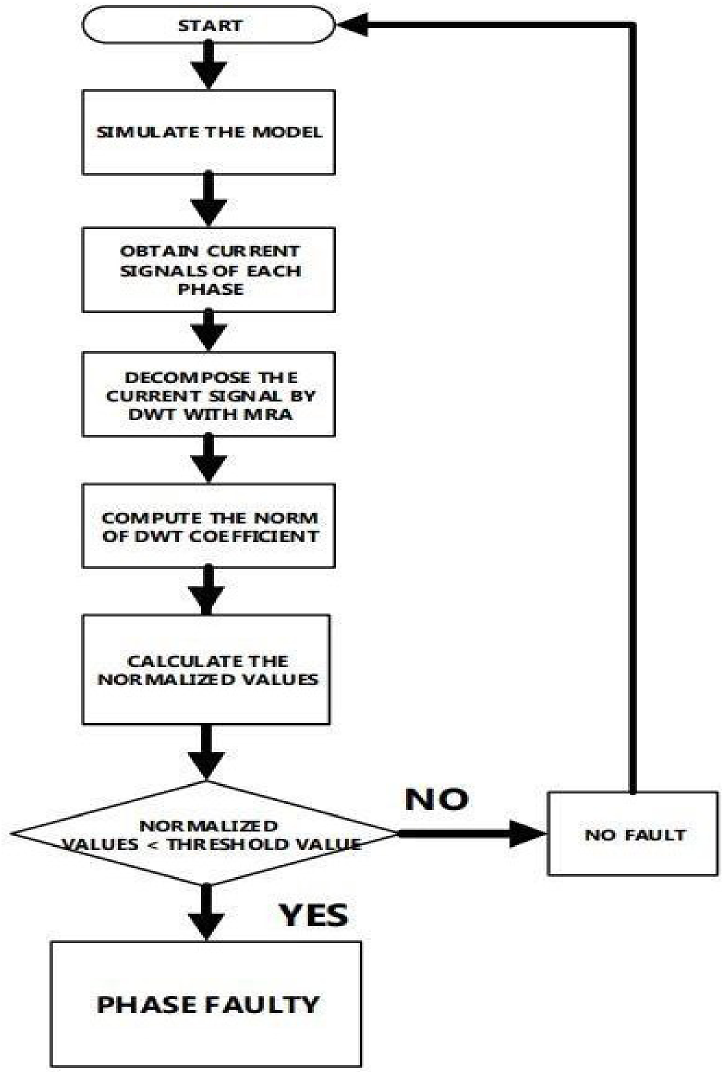


Fig.3.FlowChartofFaultDetection and Classification

A. DISCUSSIONONPROPOSEDSIMULINKMODEL

A typical 220 kV three phase transmission line system, havinga generator at bus A and load at bus B, has been used for simulation to implement thedeveloped proposed method based on DWT with MRA. The system consists of a generator,current transformers (CT) used for each phase, transmission lines and a three-phase load. Power GUI block used in simulating the model that permit to select continuous, discretization and phasor solution for solve electrical circuit. Faults of different types at various locations on transmission lines are simulated by using the MATLAB/Simulink. Current signals of each phase are recorded in MATLAB workspacethan DWT is applied on these current signals for faultdetection.

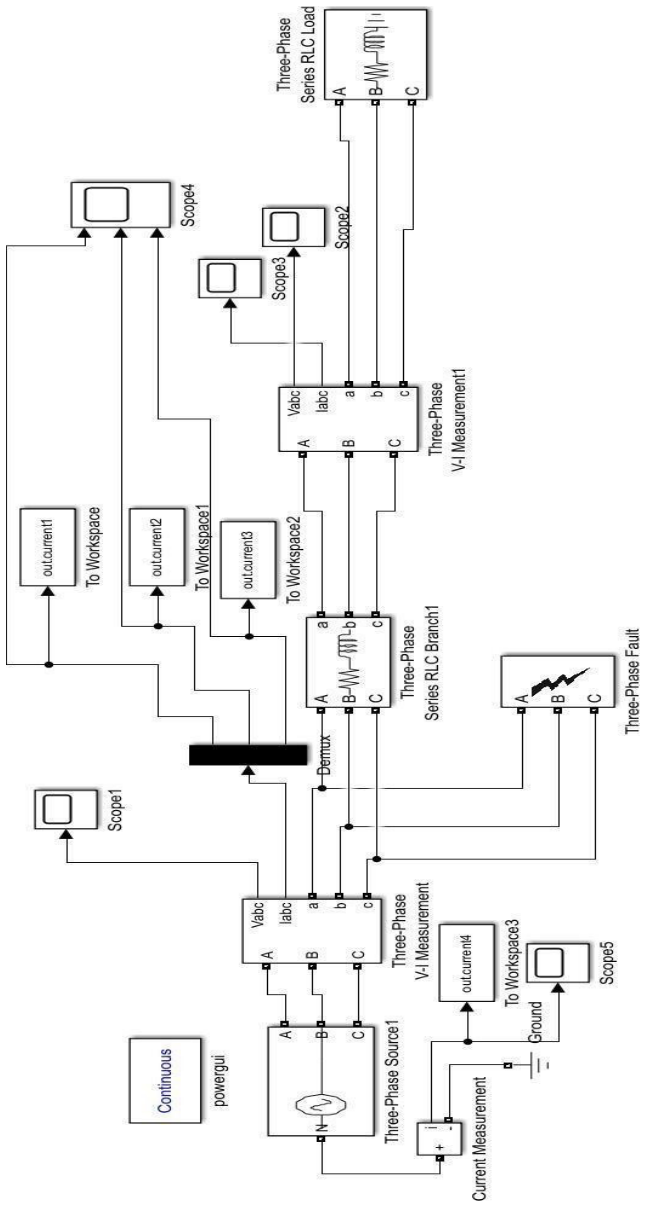


Fig.4.ProposedSimulinkModel

III.DISCUSSIONAND ANALYSISOF RESULTS

The proposed technique was first developed in SIMULINK. DWT with MRA was applied at current signal of each phasefor calculating normalized values from norm of detail coefficients these normalized values of current signals are compared with threshold values of system for fault detection. Figure 5 shows voltage and current signals waveforms of healthy system and figure 6 depicts the voltage and current signal waveforms of phase to phase fault. Figure 7 shows the normalized values of all phases of a healthy system. A systemis considered healthy when maximum peak of any phase normalized value is less than the threshold value.

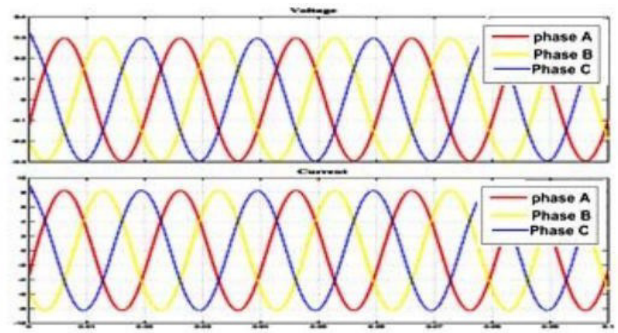


Fig.5.VoltageandCurrentWaveformofnormalsystem

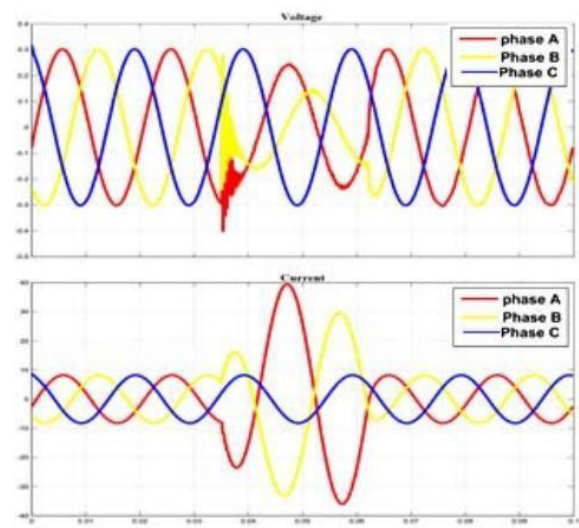


Fig.6.VoltageandCurrentWaveformABfault

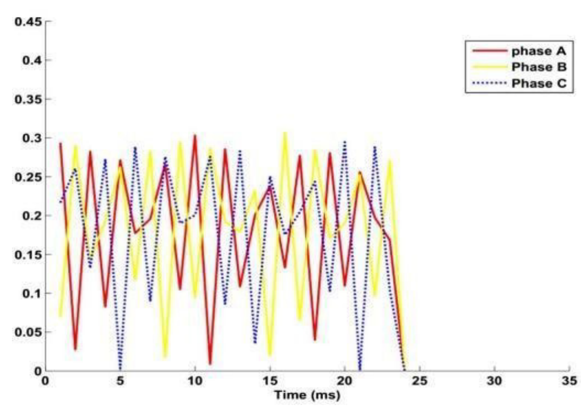


Fig.7.Normalizedvalueofhealthy System

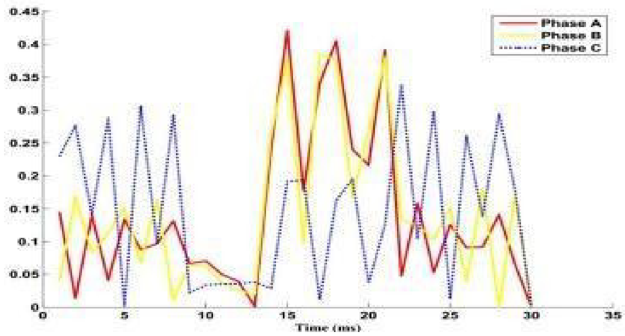


Fig.8.Normalizedvalueof A-Gfault

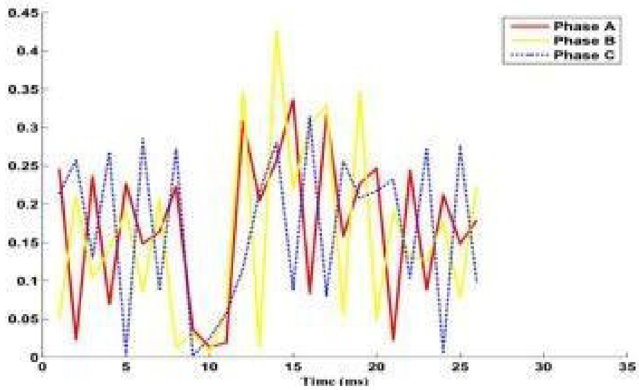


Fig.9.Normalizedvalueof B-Gfault

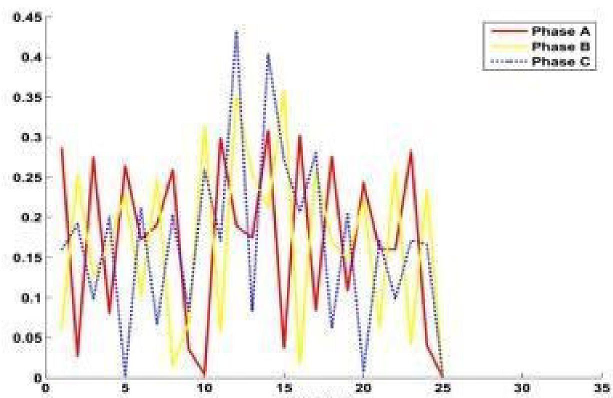


Fig.10.NormalizedvalueofC-Gfault

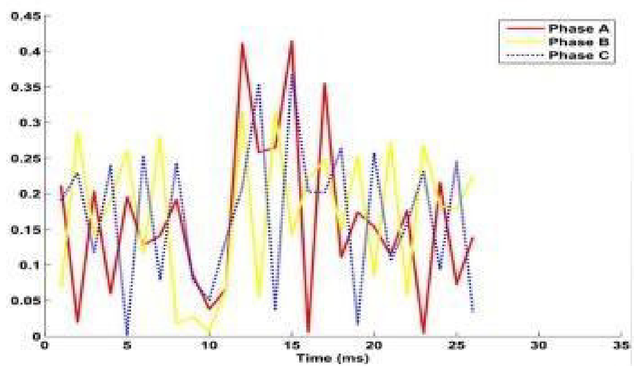


Fig.11.Normalizedvalueof A-Bfault

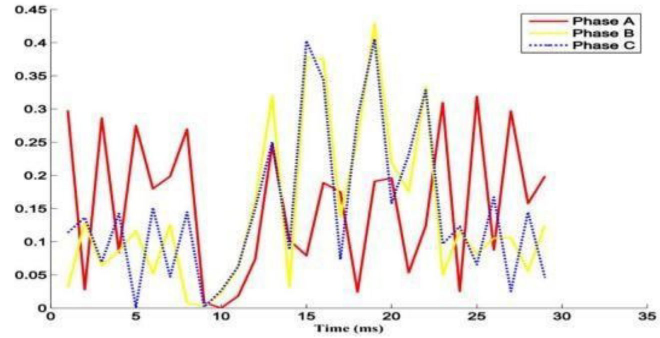


Fig.12.Normalizedvalueof B-Cfault

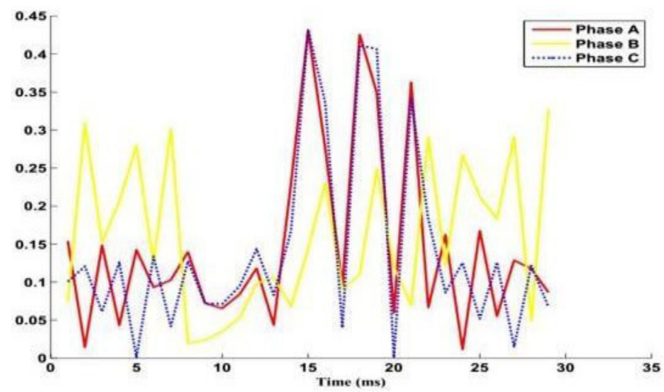


Fig.13.Normalizedvalueof C-Afault

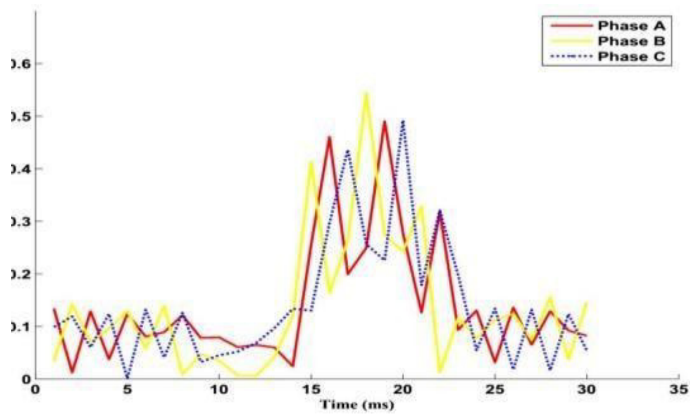


Fig.16.NormalizedvalueofA-B-C fault

Types of faults	Max coff of phase R current	Max.coff of phase Y current	Max.coff of phase B current	Max.coff of phase Neutral current
Three phase to ground fault	1.611e+07	8.1909e+07	3.3645+07	9.4582-10
Three phase fault	1.611e+07	8.1909e+07	3.3645+07	0.0064
Double line to ground (RY-G) fault	1.1581e+07	3.8638e+07	119.5684	1.602e+06
Double line to ground (YB-G) fault	119.5684	1.611e+07	1.568e+07	1.2352e+07
Double line to ground (RB-G) faul	1.568e+07	119.5684	3.647e+07	1.602e+06
Line to line(R-Y) fault	1.2352e+07	3.3647e+07	119.5684	0.0168
Line to line(Y-B) fault	119.5684	1.2352e+07	3.3647e+07	0.0064
Line to line(B-R) fault	3.3647e+07	119.5684	1.2352e+07	0.0016
Single line toground (R-G) fault	1.8061e+06	134.1287	119.5684	1.1581e+07
Single line toground (Y-G) fault	119.5684	1.8061e+06	134.1287	1.602e+06
Single line toground (B-G) fault	134.1287	119.5684	1.8061e+06	3.8638e+07
System without fault	104.9841	104.9841	119.5684	9.4582e-10

IV. CONCLUSION

This paper presents modern technique for fault detection of transmission lines, based on DWT. In this method current signals from each phase are obtained. Then these currentsignals are decomposed using DWT with MRA. Thenormalized values from norm of detail coefficients are calculated and compared with threshold value of system. It has been observed that if the system is working under normal operating conditions the normalized values are less than the threshold value. However in case of abnormal operating conditions, the normalized values exceed from thresholdvalues. Reliability of the proposed method has been successfully tested on different locations on transmission lines in order to detect various types of faults. This method is more accurate than other methods of fault detection and fault resistance does not affect the proposed fault detected method. This method, however, needs high computational skills. In future,accordingtodesignalgorithmdigitalrelaycanbedesign for protection of transmission line.

V. REFERENCES

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