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Multi Terminal Transmission Line Fault Detection using ANN and Wavelet Packet Decomposition

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Abstract*: *Identification of fault area on transmission lines is the main aim of this paper. By using Wavelet packet transform technique signals are decomposed to extract the broken current and voltage signals from the faulty phase. For estimating fault location extricated highlights are connected to artificial neural system (ANN). Their examination become increasingly convoluted and tedious as data increases in size. To diminish the measure of highlight vectors the vitality rule is connected to wavelet packet coefficients. For reducing data sets in size the test consequences of ANN exhibit that the applying of vitality basis to current flags after WPT is an exceptionally amazing and solid strategy. By lessening the information by WPT technique fault identification become easy and faster.

Index Terms*: *ANN, Wavelet energy, Wavelet transform, Wavelet packet transform

I. INTRODUCTION

Whenever at least two conductors interacts with one another or with ground blame will happen. Deficiencies are arranged in three stage frameworks are as follows:

- line- faults.to-ground .
- Line-to-line.
- Line-line-to-ground faults.
- Three phase symmetrical

For over 80% of all flaws in power frameworks ground shortcomings have been considered as one of the fundamental Problems. On power system equipment's these issues offer ascent to genuine harm. Ground fault not just impacts the supplies of the power system but also effects the power quality on transmission lines. All together not to cause harms thus, it is important to decide the blame area on hold. The main cause which leads to short circuits are flashover, lightning strikes, winged animals, wind, snow and ice-load and furthermore twisting of insulator materials. Separation of faulty section from the transmission line is fundamental to identify the fault rapidly. For power quality and safety locating the fault is very important.

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II. FEATURE EXTRACTION BASED ON WAVELET PACKET TRANSFORM

A. Packet decomposition

The wavelet bundle procedure is an augmentation of conventional wavelet deterioration that presents increasingly possible results for banner dealing with. In wavelet change, signals split into a detail and an estimation. The estimation gained from first-level is part into new detail and supposition and this methodology is repeated. Because of the manner in which that WT rots only the approximations of the banner, it may cause issues while applying WT to in explicit applications where the crucial information is arranged in higher repeat parts. The key refinement among WT and WPT is that WPT parts not simply.

B. *Wavelet energy*

The wavelet imperativeness is the entire of square of clear wavelet change coefficients. The imperativeness of wavelet coefficient is changing over various scales subordinate upon the data signals. The wavelet imperativeness of coefficients c(t) can be depicted as pursues:

$$E(s(t)) = \sum_{j=1}^{N} AjCj\text{^}2$$

with appropriate scaling coefficients aj for the coefficient cj gotten from the relating signal s(t). The vitality of banner is contained generally in the gauge part and a little in the detail part. For example, the estimate coefficient at the essential measurement contains considerably more vitality than various coefficients at the proportional component of the disintegration tree. Since the deficient signs have high repeat parts, it is progressively specific to utilize vitality of detail coefficients. In this manner, we can obtain seven features with three-levels WPT for only a solitary imperfect banner

C . Artificial nueral network:

Artificial neural system is commonly used in the structure domains, for instance, media transmission, prescription, control and control structures. ANN is involved various computational getting ready parts called neurons or of course center points. These center points work in parallel and are related together in topologies that are vaguely shown after normal neural structures.

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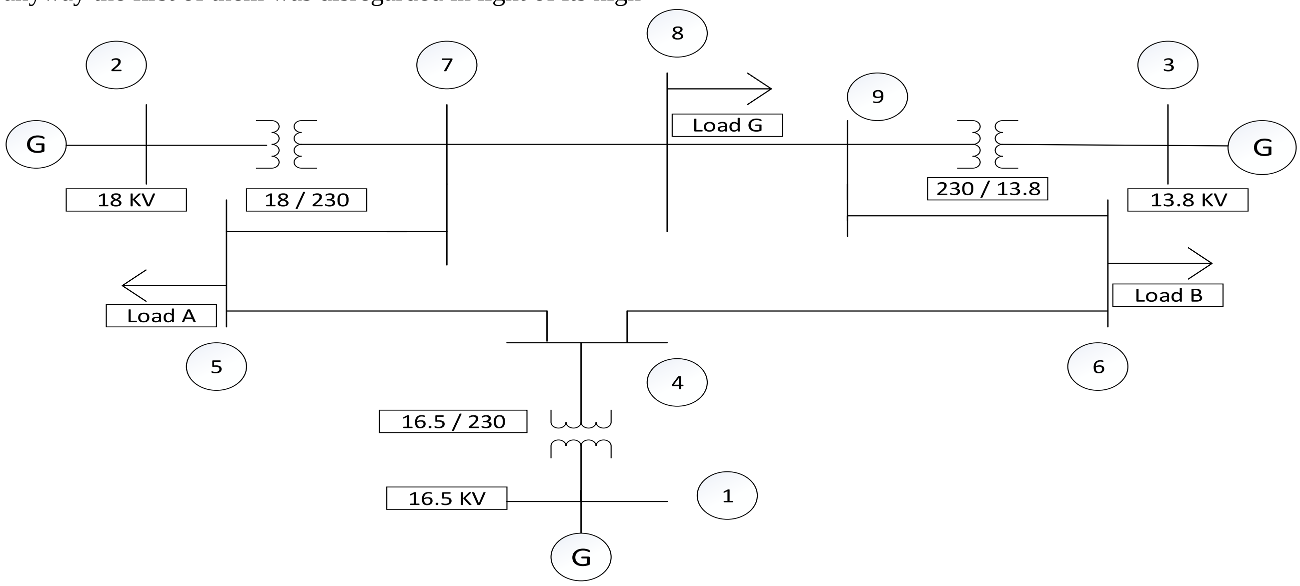
The planning of ANN is passed on out to relate right yield responses to explicit information structure. For planning WPT and ANN based accuse locator, the features which have a spot with imperfect current and voltage signals were used for getting ready and testing of ANN consequent to reprocessing. The amount of neurons for the hid layer is picked to be 12 and hyperbolic deviation work was used as the commencement limit of the covered layer neurons. Doused direct limit was used for the yield layer. The planning philosophy of neural framework has been showed up. WPT was used as a part extractor which gives discernable trademark incorporates about the signs. For the wavelet package rot, half cycle of pre-fault and half cycle of post-fault has been considered. After wavelet parcel rot, imperativeness and Shannon type entropy worldview have been associated with WPT detail. Subsequently, estimations of the data precedents can be reduced and profitable information can be evacuated for the planning of ANN. Eight features were evacuated for each broken current and voltage signals, anyway the first of them was disregarded in light of its high essentialness regard. The wavelet group examination was performed with three-level rot and Daubechies8 was picked as mother wavelet. The square graph of proposed methodology and the structure of the neural framework are showed up separately.

III. Simulation Methodology

IEEE 9 bus system is taken for testing and there are 9 buses, three buses are generator buses i.e..1,2,3.Three are load buses i.e. are 5,6,8. Total 9 buses and 6 transmission lines. Basic kV at all load buses is 230kV and frequency of 60Hz. Line parameters are R_0 = 0.224825 Ohms/km; L_0 = 3.22e-3 H/km; C_0 = 4.74e-9 F/km; R_1 = 0.08993 Ohms/km; L_1 = 1.29e-3 H/km; C_1 = 7.922e-9 F/km. Each phase current signals are measured with 40 µ.sec of sampling time. The obtained current and voltage signals are modified through wavelet packet decomposition.



For simulation used inception angles are 0˚,45˚,90˚ and 11 types of faults those are LG,LL,LLG,LLL,LLG… total 5346 patterns are developed by using different inception angles and fault resistances (fr=1,10,15). those patterns are given as inputs for deep neural networks to know fault location

IV. Results

At normal condition

Measured at Bus	Line No	A	B	C	GFI
Bus-4	1	0.210278	0.097876	0.595078	0.514275
Bus-4	2	0.084623	0.261391	0.643469	0.534777
Bus-7	3	0.012178	0.202865	0.314449	0.373838
Bus-7	4	0.221669	0.048614	0.4779	0.460869
Bus-9	5	0.131201	0.072434	0.398608	0.420902
Bus-9	6	0.002298	0.050295	0.074097	0.181472

Fault currents at Bus-4 Due to C-G Fault on Transmission line-1

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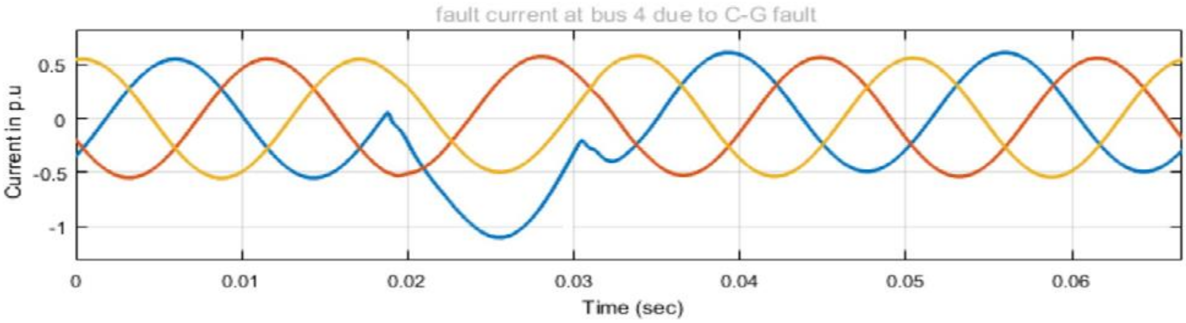
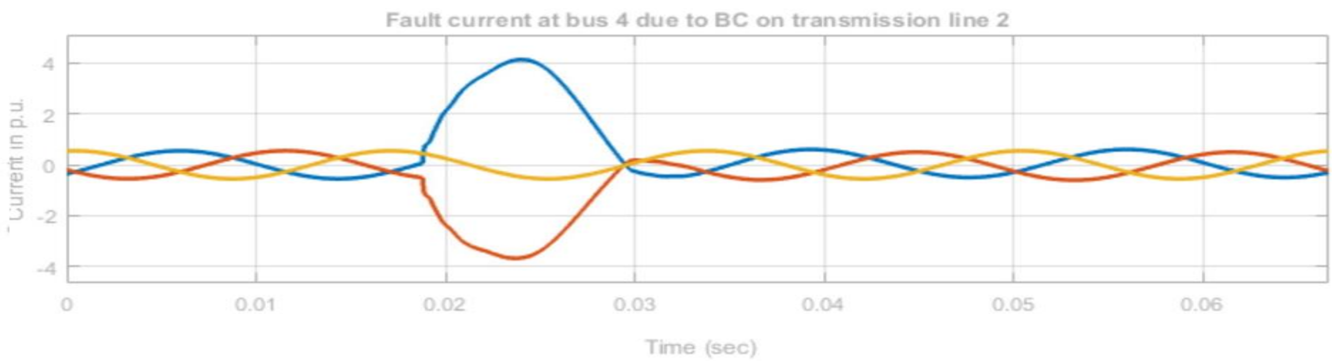
Fault Inception Angle	Distance (km)	Fault Resistance=1 Ohm				Fault Resistance=10 Ohm				Fault Resistance=15 Ohm			
		A	B	C	GFI	A	B	C	GFI	A	B	C	GFI
0^0	20	0.107	0.300	4.395	0.987	0.107	0.300	4.173	0.972	0.107	0.300	4.07	0.964
45^0	20	0.095	0.704	2.06	0.8619	0.094	0.707	1.60	0.804	0.095	0.704	1.919	0.843
90^0	20	0.021	0.387	0.587	0.512	0.023	0.386	0.588	0.5144	0.023	0.386	1.588	0.514
0^0	60	0.015	0.296	1.649	0.718	0.104	0.295	1.606	0.711	0.104	0.295	1.583	0.708
45^0	60	0.697	0.39	0.701	0.661	0.097	0.614	0.697	0.643	0.098	0.667	0.695	0.655
90^0	60	0.391	0.38	0.582	0.504	0.015	0.390	0.583	0.504	0.015	0.339	0.538	0.505



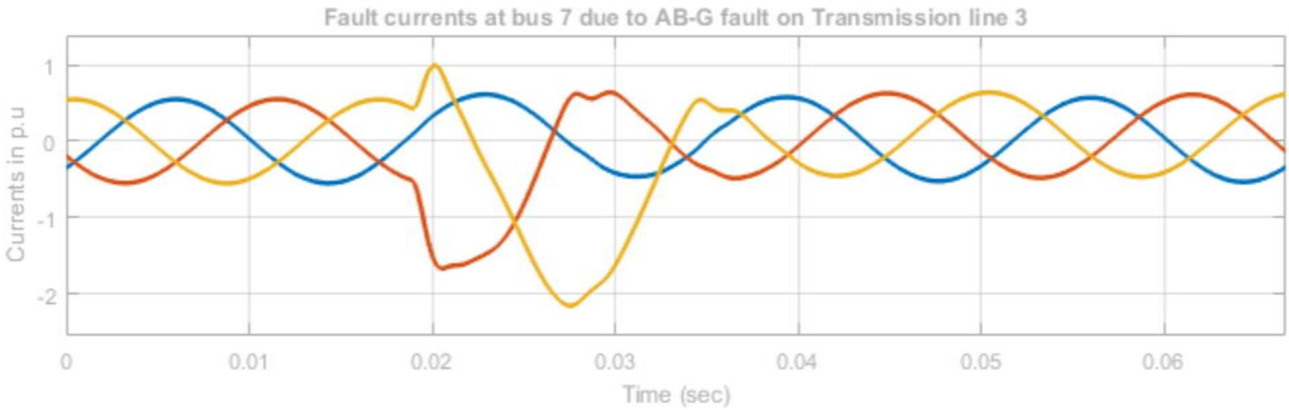
Fault current at Bus-4 Due to B-C Fault on Transmission line-2

Fault Inception Angle	Distance (km)	Fault Resistance=1 Ohm				Fault Resistance=10 Ohm				Fault Resistance=15 Ohm			
		A	B	C	GFI	A	B	C	GFI	A	B	C	GFI
0^0	20	0.210	2.518	4.185	1.36	0.210	2.32	3.94	1.32	0.210	2.23	3.814	1.30
45^0	20	0.062	5.052	4.495	1.498	0.016	4.717	4.179	1.447	0.016	4.547	4.019	1.42
90^0	20	0.005	4.98	5.30	1.535	0.042	2.113	0.670	0.969	0.402	2.065	0.643	0.958
0^0	50	0.210	0.845	1.900	0.919	0.210	0.792	1.820	0.899	0.210	0.765	1.779	0.889
45^0	50	0.062	2.104	1.750	0.967	0.016	2.001	1.656	0.943	0.016	1.949	1.609	0.930
90^0	50	0.005	2.346	2.570	1.068	0.258	1.306	0.402	0.762	0.247	1.282	0.402	0.754



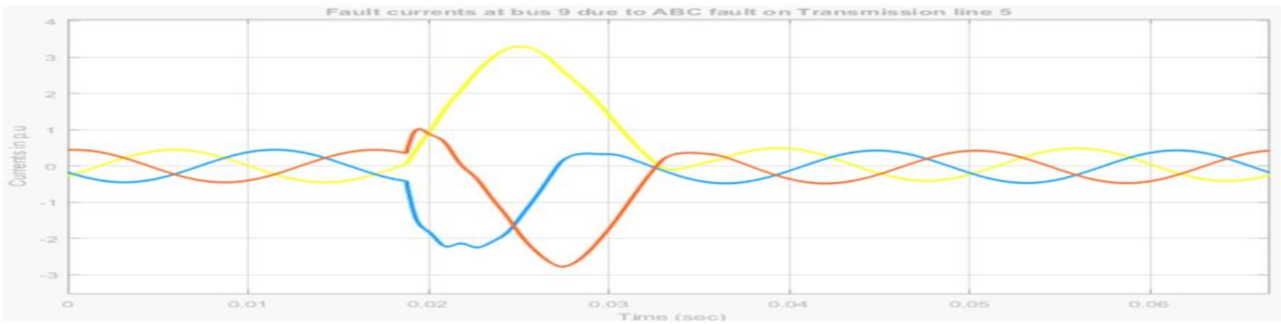
Fault currents at Bus-7 Due to AB-G Fault on Transmission line-3

Fault Inception Angle	Distance (km)	Fault Resistance=1 Ohm				Fault Resistance=10 Ohm				Fault Resistance=15 Ohm			
		A	B	C	GFI	A	B	C	GFI	A	B	C	GFI
0^0	20	0.513	0.403	0.126	0.568	0.513	0.396	0.123	0.565	0.300	0.392	0.121	0.513
45^0	20	0.367	1.217	0.082	0.665	0.366	1.167	0.074	0.652	0.366	1.141	0.070	0.646
90^0	20	1.353	1.710	0.179	0.868	1.281	1.628	0.179	0.847	1.244	1.586	0.017	0.836
0^0	50	0.549	0.534	0.218	0.646	0.539	0.533	0.211	0.641	0.294	0.533	0.208	0.533
45^0	50	0.380	2.095	0.220	0.844	0.379	1.996	0.199	0.825	0.379	1.946	0.189	0.815
90^0	50	2.532	3.003	0.017	1.152	2.391	0.017	0.017	1.122	2.319	2.771	0.017	1.106



Fault currents at Bus-9 Due to ABC Fault on Transmission line-3

Fault Inception Angle	Distance (km)	Fault Resistance=1 Ohm				Fault Resistance=10 Ohm				Fault Resistance=15 Ohm			
		A	B	C	GFI	A	B	C	GFI	A	B	C	GFI
0^0	20	2.13	2.2	1.5	0.07	1.91	1.97	1.45	0.07	1.81	1.88	1.42	0.08
45^0	20	2.31	1.96	1.57	0.06	2.05	1.8	1.49	0.07	1.94	1.73	1.44	0.08
90^0	20	2.26	1.51	2.05	0.07	2.02	1.46	1.84	0.07	1.93	1.42	1.74	0.08
0^0	50	1.87	1.62	1.3	0.05	1.67	1.49	1.23	0.06	1.59	1.44	1.19	0.06
45^0	50	1.91	1.42	1.46	0.05	1.71	1.34	1.34	0.06	1.63	1.3	1.29	0.07
90^0	50	1.85	1.27	1.67	0.05	1.66	1.22	1.55	0.06	1.59	1.19	1.43	0.07



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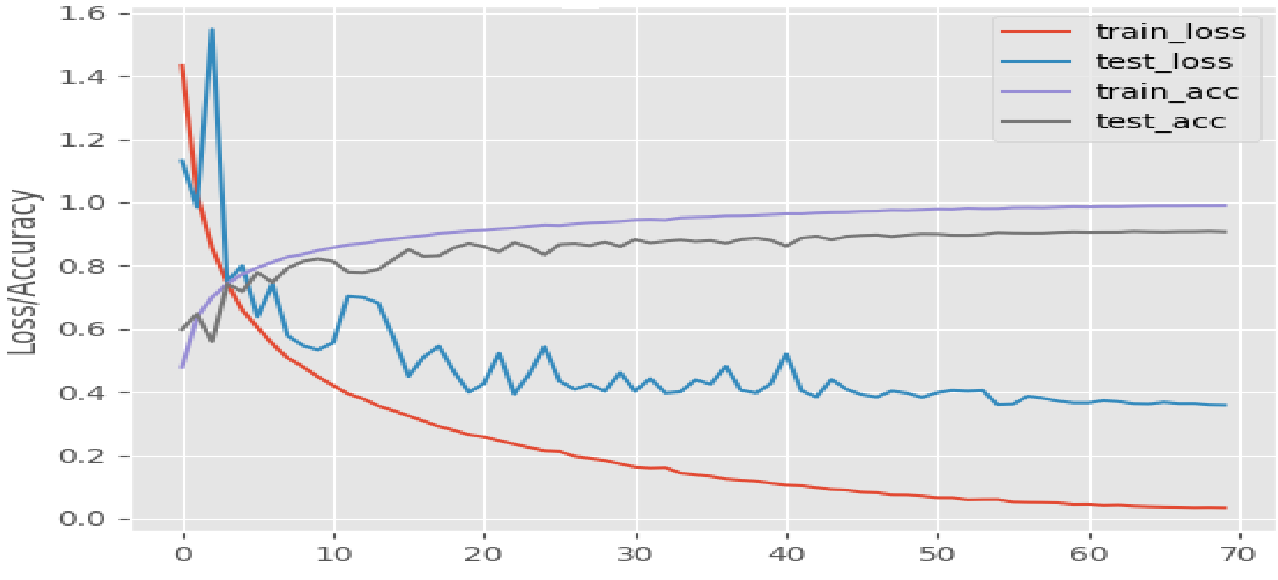

V.CONCLUSION

To know or identify exact fault location on transmission lines data reduction techniques are used for accurate and fast response. In the recent years wavelet transform is widely used for estimating of fault location. In this paper we used wavelet packet decomposition technique for fast response and accurate data. Basically wavelets are used for signal processing but in present scenario wavelets are using for different applications. The proposed method provide more features about signal. Signal decomposition is done at first level coefficients and based on that coefficients energy is calculated for each current signal than the data is reduced. The patterns are given as inputs for deep neural networking algorithms by giving this inputs for deep networking algorithms fault location is identified in less time.

REFERENCES

1. S. El. Safty & A. El-Zonkoly (2009), “Applying wavelet entropy principle in fault classification” Electrical Power and Energy Systems 31 pp.604-607
2. Pradhan A. K. et Al. (Oct. 2004), “Wavelet-fuzzy Combined Approach for Fault Classification of a Series-Compensated Transmission Line” IEEE Trans. on Power Delivery, Vol. 19, No. 4.
3. Jung. H et. al. (2007), “Novel Technique for Fault location estimation on parallel transmission lines using wavelet” Electrical Power and energy Systems 29 pp.76-82
4. MATLAB 7.9.0 (R2009b) versionWavelet Toolbox, MathWorks Company.
5. Kim. K.H. et al. (2007), “Wavelet and Neuro-Fuzzy Fault Location for Combined Transmission Systems” Electrical Power and Energy Systems 29 pp. 445-454
6. Chunju. F et Al. (2007), “Application of Wavelet Fuzzy Neural Network in Location Single Line to Ground Fault (SLG) in Distribution Lines” Electric Power and Energy Systems 29 pp. 497-503
7. Eisa. A. Amir. A. & Ramar. K, (2010) “Accurate one-end Fault location for Overhead Transmission Lines in Interconnected power system” Electrical Power and Energy Systems 32 pp. 383-389
8. Salim. R.H et al. (April 2009), “Extended fault-Location Formulation for Power distribution Systems” IEEE Trans. on Power Delivery, Vol.24, No.2
9. Borghetti. A et al. (2006), “On the Use of Continuous-Wavelet Transform for Fault Location in Distribution Power Systems” Electrical Power and Energy Systems 28 pp. 608-617.

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