Journal of research in engineering and its applications
Vol. 1, issue.1, (2018), pp. 45-55

Wavelet Technique for Faults Identification in Transmission Lines

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Abstract

The point of this paper is to comprehend wavelet procedure and ID of blame utilizing wavelet change. This paper introduces rapid blame recognizable proof and assurance of energy framework lines in view of wavelet change strategy. It is a special technique which is utilized to distinguish the area and recognizable proof of blame in control framework. Blames in control framework are single line to ground, twofold line to ground and three stage shortcomings. In this paper the regular time-adequacy reaction is introduced and the outcome demonstrates that wavelet prompts recognize the kind of blame and its area. The outcomes show that wavelet system is quick contrasted with time abundancy procedure.

Keywords: *Wavelet, Single Line to Ground fault, Double Line to Ground fault, three phase fault*

1. INTRODUCTION

The increased growth of power systems both in size and complexity has brought about the need for fast and reliable relays to protect major equipment and to maintain system stability. The conventional protective relays are either of electromagnetic or static type. Though successfully used, static relays suffer from a number of disadvantages, e.g. inflexibility, incapability to changing system conditions and complexity. In Power Systems, the Protection system consists of a combination of solid state relays and electromagnetic relays. Electromagnetic relays are used in simpler applications such as over correct relaying while solid state relays are used in distance relaying.The concept of digital protection employing computers which shows much promise in providing improved performance, has evolved during past few decades. In the beginning, the digital protection uses a large computer system for total protection of power system. This protective system proved to be very costly and requires a large space. Digital Computers can easily fulfil the protection requirements of modern power systems without difficulties.

Generally the power stations are arranged far from the heap focuses bringing about many kilometer length of overhead lines being presented to climatic conditions. The odds of flaws happening because of tempests, falling of outside articles on the lines, flashovers coming about because of earth stores on protectors are more prominent for overhead lines than for different parts of energy framework. Around half of aggregate deficiencies happen on overhead lines.When a blame happens on a power framework, the blame current is quite often more prominent than prefault stack current in any power framework component. An exceptionally straightforward and successful handing-off guideline is that of utilizing current greatness as a pointer of a blame. So as a cure the blame must be recognized and blamed stage must be expelled by a defensive system.A defensive framework shields control framework from injurious impacts of a maintained blame, which happens as an irregular occasion. On the off chance that some blamed power framework segment isn't segregated from framework rapidly, it might prompt power framework flimsiness or separation of the framework through the activity of other programmed defensive gadgets. A

defensive framework should along these lines expel the blamed component from whatever is left of energy framework as fast as could be expected under the circumstances.

For the cure of blamed zone, an exact investigation of waveforms of voltage and current amid blame episode is required. Numerous analysts have proposed systems for blame sort discovery. These methods depend essentially on concentrate the example of voltage and current waveforms related with the blame. Among these are Fourier investigation and Kalman sifting strategies which were principle tolls in flag handling for separate handing-off.

Wavelets are an as of late created scientific device for flag handling. Contrasted with Fourier examination, which depends on a solitary premise work, various premise elements of a somewhat wide utilitarian frame are accessible in wavelet investigation. The fundamental idea in wavelet change is to choose a suitable wavelet work "mother capacity" and after that perform examination utilizing moved and expanded forms of this wavelet. Wavelet can be picked with extremely attractive recurrence and time qualities when contrasted with Fourier systems. The fundamental distinction is that, rather than brief time Fourier change which utilizes a solitary investigation window, Wavelet change utilizes short windows at higher frequencies and long windows at low frequencies.

Wavelet Transform can disintegrate into various recurrence groups utilizing multi determination examination. It can be used in identifying deficiencies and to evaluate phasors of voltage and current signs, which are basic for transmission line separate assurance. A computerized separate insurance conspire for transmission lines in view of breaking down the deliberate voltage and current signs at transfer area utilizing Wavelet method with MRA is introduced in this paper. PC reproduction ponders have been directed utilizing MATLAB to produce voltage and current signs from reenacted arrange, which re at that point bolstered to Wavelet distinguishing proof calculation. The proposed recognizable proof calculation has been tried for line to ground blame, twofold line to ground blame, line to line blame and three stage blame.

2. FOURIER ANALYSIS

2.1. Introduction

Numerical changes are connected to signs to acquire additional data from that flag that isn't promptly accessible in the crude flag. The vast majority of the signs by and by are time space motions in their crude configuration i.e whatever that flag is estimating, is an element of time. As it were, the point at which we plot the flag, one of the tomahawks is time and other is generally adequacy. When we plot time space signals, we get time-plentifulness portrayal of the flag. This portrayal isn't generally best portrayal of the flag for most flag handling related applications. By and large, the most recognized data is covered up in the recurrence substance of the flag. The recurrence range of a flag is fundamentally the recurrence parts of that flag. The recurrence range of a flag demonstrates what frequencies exist in that flag. As a rule, the data that can't be promptly found in time space can be found in recurrence area.

2.2 *Fourier Transform*

The Fourier change of a flag in time area is taken, the recurrence adequacy portrayal of that flag is gotten. As it were, we now have a plot with one pivot being the recurrence and the other being adequacy. This plot discloses to us how much every recurrence exists in our flag. The strategy of speaking to a flag as an aggregate of exponentials can be reached out to non-

intermittent capacities using Fourier Transforms. The change combine can be gotten by composing a Fourier arrangement and taking cutoff points as period ends up endless.

Fourier transform of any signal is given by

$$F[x(t)] = X(w) = \int x(t)\, e^{-jwt}\, dt \qquad (1)$$

Inverse Fourier transform of any signal is given by

$$F^{-1}[x(t)] = x(t) = \frac{1}{} \int X(w)\, e^{-jwt}\, dw \qquad (2)$$

3. WAVELET ANALYSIS

3.1. Introduction

A wavelet is a waveform of adequately constrained span that has a normal estimation of zero. Wavelet hypothesis is an arithmetic related with building a model for non-stationary flag with an arrangement of segments that are called little waves called wavelets. Casually, a wavelet is a fleeting length wave. These capacities have been proposed regarding investigation of signs, essentially drifters in an extensive variety of applications. The fundamental idea in wavelet change is to choose a proper wavelet work "mother wavelet" and after that perform examination utilizing moved and expanded variants of this wavelet. Wavelet can be picked with exceptionally attractive recurrence and time qualities.

As indicated by Fourier hypothesis, flag can be communicated as an aggregate of conceivably limitless arrangement of sines and cosines. This aggregate is alluded to Fourier extension. The enormous impediment of Fourier development is it has just recurrence determination and no time determination. It decides all frequencies exhibit in the flag yet does not tell at what time they are available. To beat this issue, Wavelet change is proposed. It gives time and recurrence data all the while. In wavelet examination, the utilization of completely versatile tweaked window takes care of flag cutting issue. The window is moved along the flag and for each position the range is rehashed ordinarily with a somewhat shorter window for each new cycle. At last, the outcome will be an accumulation of time portrayal of the flag, all with various resolutions.

The premise capacities utilized as a part of Fourier investigation, sine waves and cosine waves, are unequivocally situated in recurrence data of a flag computed by traditional Fourier change which is a normal over the whole time span of the flag. In this manner, if there is a neighborhood transient over little interim of time in the aggregate term of the flag, the transient will add to Fourier Transform however its area on time hub will be lost. Albeit brief time Fourier change defeats time area issue to a bigger expand, it doesn't give different resolutions in time and recurrence, which is a critical trademark for dissecting transient flag containing high and low recurrence parts.

Wavelet analysis overcomes the restrictions of Fourier ways. in contrast to harmonic analysis that uses one basis perform, riffle analysis uses range of basis functions of a rather wide purposeful kind. The riffle performs square measure generated within the variety of translation and dilation of fastened function. the idea riffle is termed as a mother riffle. the fundamental distinction is, Short time Fourier rework uses one analysis window whereas riffle rework uses short windows at high frequencies and long windows at loa frequencies.

3.2. Capabilities of Wavelet Analysis

One above advantage is the adeptness to accomplish bounded analysis, i.e to assay a localized breadth of a beyond signal. The Fourier coefficients of a arresting shows annihilation decidedly absorbing but a collapsed spectrum with two peaks apery a individual frequency. However, a artifice of wavelet coefficients acutely shows the exact area in time of discontinuity. Wavelet assay is able of audition breakdown points, discontinuities in college derivatives and self-similarities. Wavelet assay can generally abbreviate or de babble a arresting after apparent degradation.

3.3. Multi Resolution Analysis (MRA)

MRA examinations the flag at various frequencies with various resolutions. It is intended to give great time determination and poor recurrence determination at high frequencies and poor time determination and great recurrence determination at low frequencies. Wavelet figurings depend on two crucial conditions: the scaling capacity φ(t) and wavelet work ψ(t).

$$\varphi(t) = \sqrt{\quad} \quad \overline{2}\sum h_{k\varphi}(2t-k) \tag{3}$$

$$\psi(t) = \sqrt{\quad} \quad \overline{2}\sum g_{k\psi}(2t-k) \tag{4}$$

Wavelet change can be executed inside uniquely planned match of FIR channels called quadrature reflect channels. These channels are unmistakable in light of the fact that their recurrence reactions of two FIR channels isolate the high and low recurrence segments of the information flag. The yields of these channels are devastated by a factor of two. The low recurrence channel yield is nourished into another indistinguishable QMF channel. This activity can be rehashed recursive as a tree or pyramid calculation, yielding a gathering of signs that partitions the range of unique flag into octave groups with progressively coarser estimations in time as width of each ghastly band limits and reductions in recurrence. The pyramid calculation can be connected to Wavelet change by utilizing wavelet.

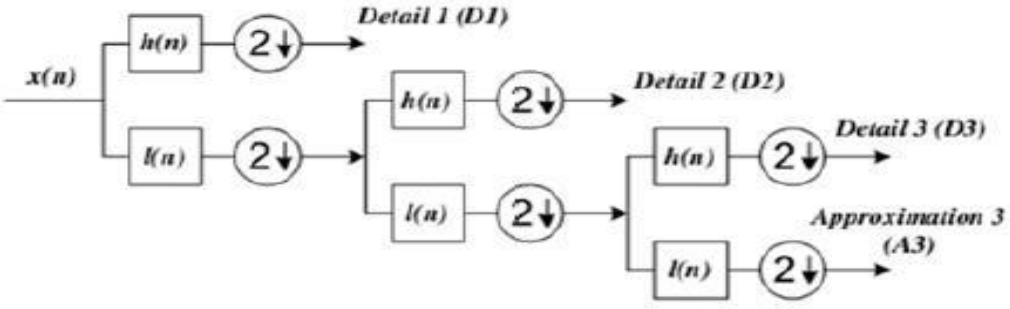

Figure 1.Wavelet multi resolution analysis

A similar wavelet coefficients are utilized as a part of both low pass and high pass channels. The LP channel coefficients are related with hk of scaling capacity and HP channel is related with g k of the wavelet work. The yields of LP channels are called approximations(A) and the yields of HP channels are called subtle elements. (D)

4. FAULT DETECTION AND CLASSIFICATION

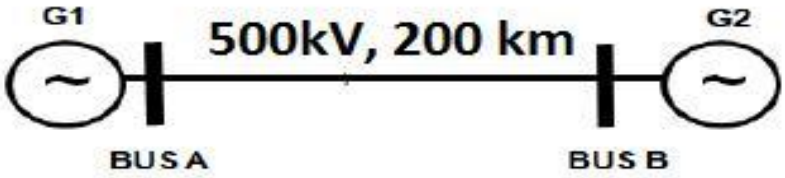

Figure 2. A 500kV transmission system

A run of the mill 500kV transmission framework appeared in Fig2. is utilized as a part of reproduction examines for single line to ground blame, line to line blame, twofold line to ground blame and three stage blame. It comprises of a 200km transmission line ended at two wellsprings of voltage 500kV at transport bars An and B individually. The ostensible recurrence is 50 Hz. Blame recognition can be acquired from the points of interest of first disintegration level of estimated current signs utilizing db1 wavelet. This level contains high frequencies that are related with deficiencies.

The length of sliding information window utilized for blame recognition is equivalent to one cycle of essential recurrence. By ascertaining standard of the detail coefficients(D1) for all streams, the phase(s) on unsettling influence can be distinguished. On the off chance that figured standard estimation of any stage current surpasses a specific edge, that shows that this stage is presented to a specific unsettling influence. This standard can be computed

$$\text{as } \|D1\| = \left| \sum_{k=1}^{\lceil n_d \rceil} D1(k) \right|^{1/2}$$

where Nd is the number of detail coefficients at that level.

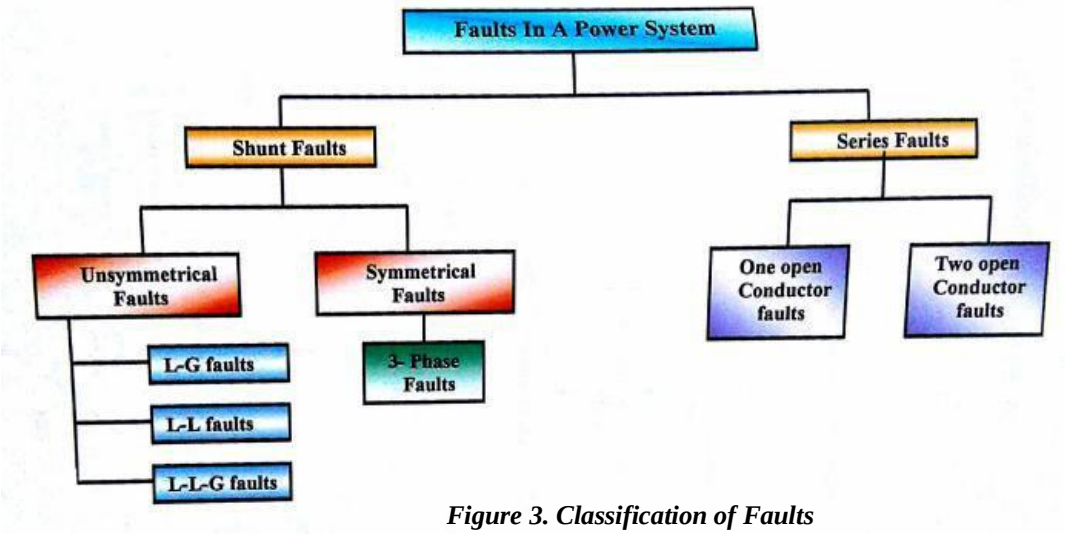

Figure 3. Classification of Faults

Utilizing db1 and from the decay level for the three line streams, a blame can be identified by watching standard of the detail coefficients D1. At this level, the high recurrence parts can be separated from flag and any unsettling influence can be recognized. In the event that standard of

D1 for all streams is not as much as a specific limit (M), it implies that lines are solid. Presently the quantity of blamed lines is recognized, if there is blame in just a single stage, it is line to ground blame. In the event that every one of the three stages are flawed, it is a three-stage blame. In the event that there are two flawed stages we need to group as line to line blame or twofold line to ground blame. Thus, after number of trails for deficiencies at different separations, it is watched that distinction of estimated coefficients is not as much as some incentive for line to line blame. Utilizing this we can separate line to line blames or twofold line to ground shortcomings.

The simulation of power system is carried out using MATLAB SIMULINK. The parameters are given below:

Source Voltages: EA=EB=500kV
Source Resistance: 17.177Ω
Source inductance: 145 H
Length of transmission line: 200km
Frequency = 50 Hz
Positive sequence Resistance=0.0249 Ω/km
Zero sequence Resistance=0.634 Ω/km
Positive sequence Inductance=0.00187H/km
Zero sequence Inductance=0.0058H/km
Positive sequence Capacitance=2.34e-8 F/km
Zero sequence Capacitance=1.75e-8 F/km

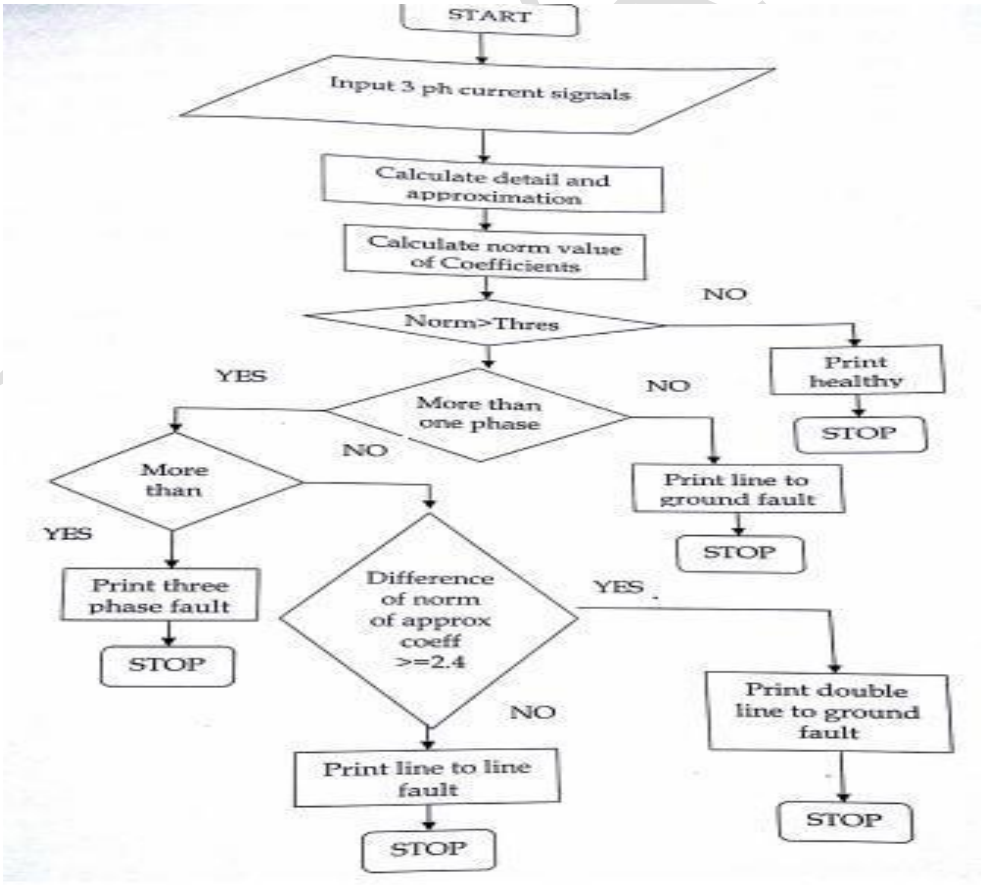

Figure 4.Fault classification algorithm

5. SIMULATION RESULTS

5.1 Single Line to Ground Fault:

Fig. 5 shows Simulink of single line to ground fault on phase A.

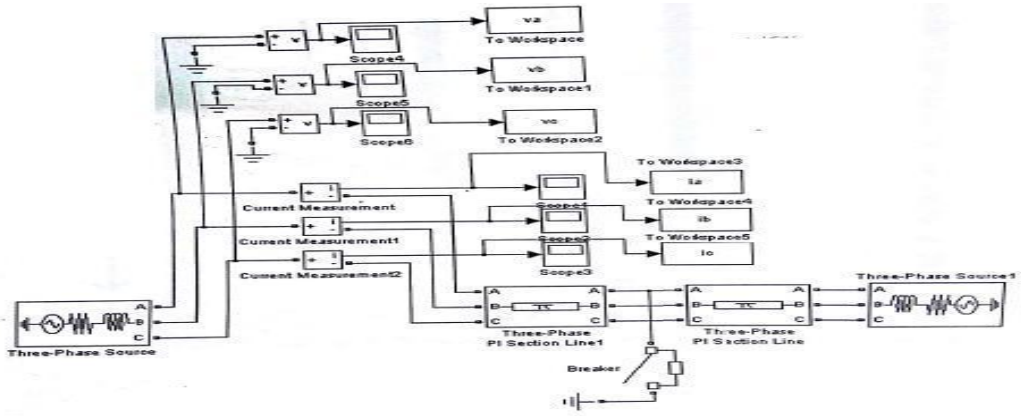

Figure 5.Simulink diagram of Single Line to Ground fault

The output currents waveforms for three phases are shown in Fig 6

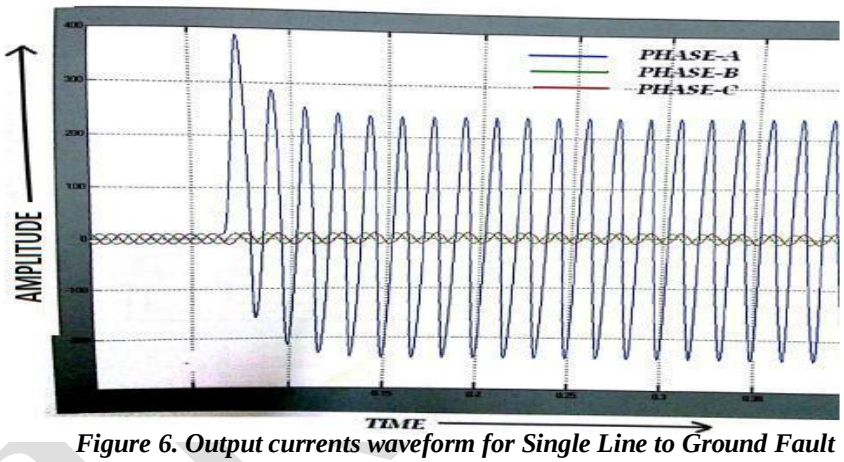

Figure 6. Output currents waveform for Single Line to Ground Fault

5.2 Line to Line Fault:

Fig.7 shows Simulink of single line to ground fault on phases A and B.

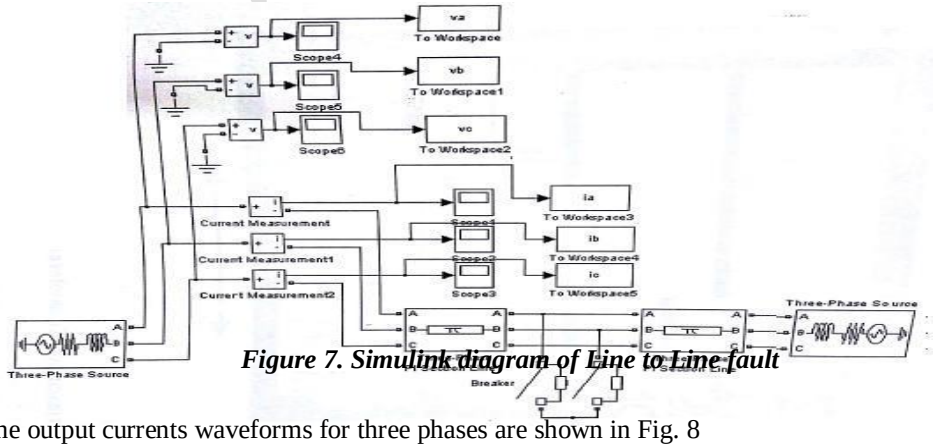

Figure 7. Simulink diagram of Line to Line fault

The output currents waveforms for three phases are shown in Fig. 8

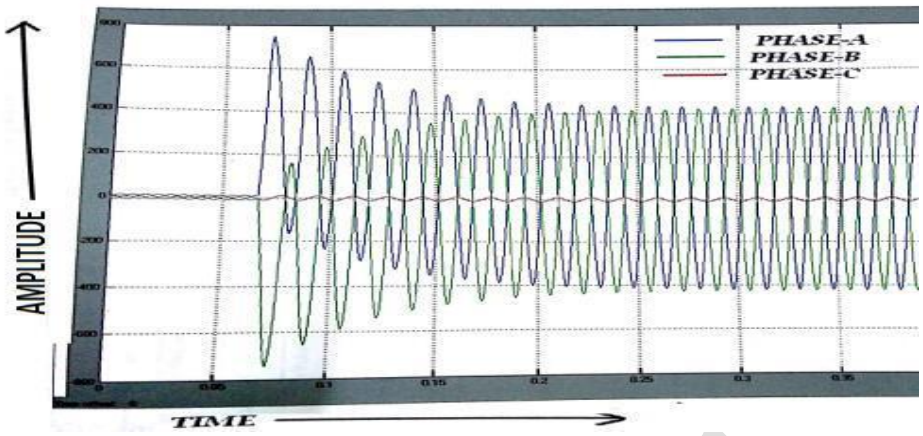

Figure 8. Output currents waveform for Line to line Fault

5.3. Double Line to Ground Fault:

Fig.9 shows Simulink of Double line to ground fault on phases A and B.

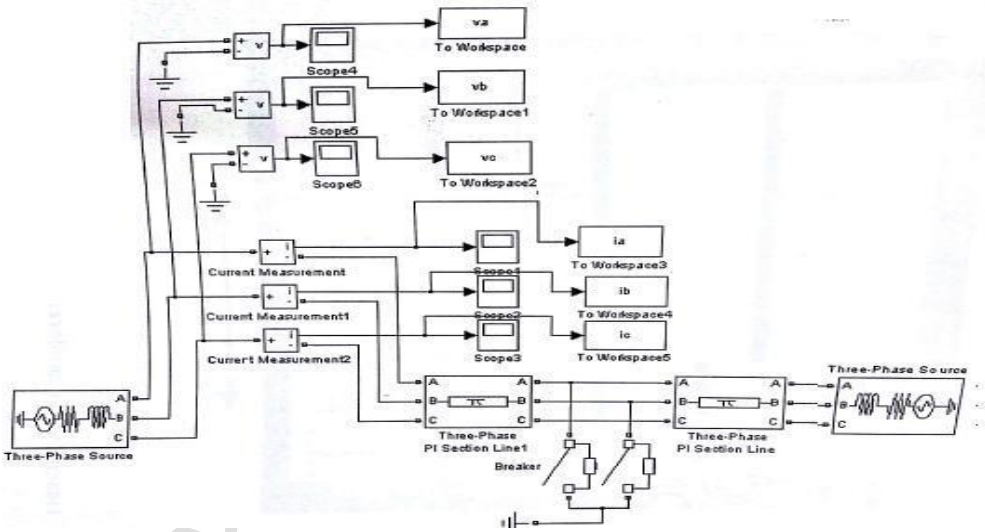

Figure 9.Simulink diagram of Double Line to Ground fault

The output currents waveforms for three phases are shown in Fig 10

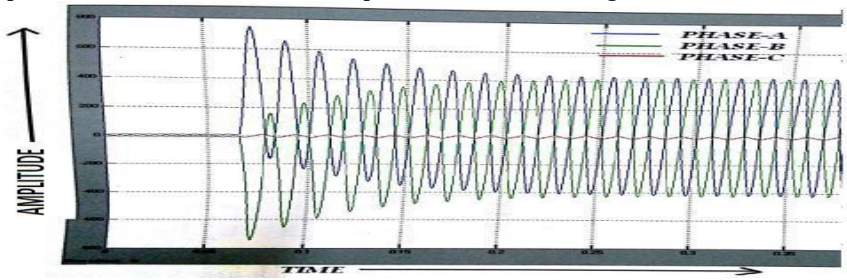

Figure 10. Output currents waveform for Double Line to ground Fault

5.4. Three-phase Fault:

Fig. 11 shows Simulink of Double line to ground fault on phases A and B

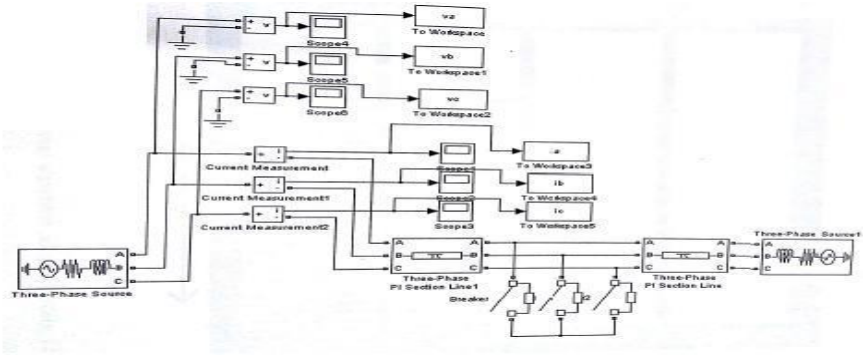

Figure 11. Simulink diagram of Three phase fault

The output currents waveforms for three phases are shown in Fig 12.

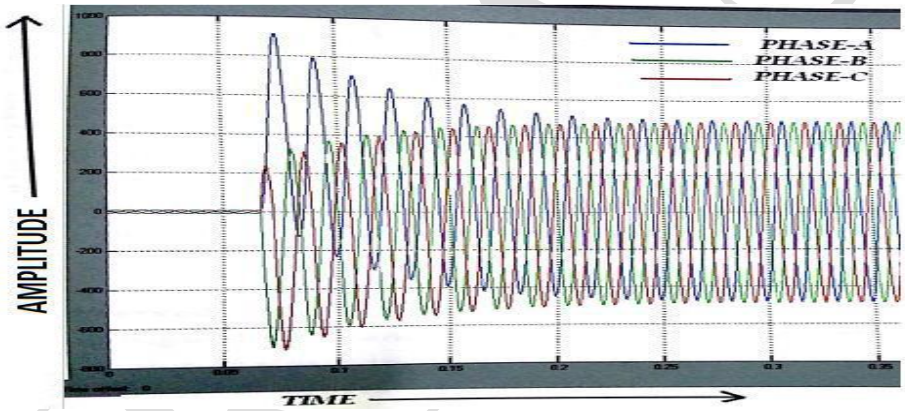

Figure 12. Output currents waveform for Three phase Fault

6. CONCLUSION

The reproduction comes about portray the ability of wavelet strategy to find and recognize a blame. Wavelet change strategy will be a guide to regular wave analysers utilized as a part of energy station for de-noising transmitted signs. Wavelet change technique is fruitful in location of flaws in AC systems. Looking at the outcomes got, it can be watched that wavelet change strategy is fit for recognizing and finding kind of blame.

References

[1] Ei Phyo Thwe, Min Min Oo, "Fault Detection and Classification for Transmission Line Protection System Using Artificial Neural Network," Journal of Electrical and Electronics Engineering, Vol 4, Issue 5., pp. 89-96, December 2016. pp.68-73.

[2] S.M. El Safty and M.A. Sharkas, "Identification of Transmission line faults using Wavelet Analysis", IEEE Transactions on Industrial Applications, ID: 0-7803-8294-3/04, 2004.

[3] Fernando H. Magnago and Ali Abur, "Fault Location Using Wavelets",IEEE Transactions on Power Delivery, Vol. 13, No. 4, pp.1475-1480,1998.

[4] "Wavelet Tutorial" by Robi Polikar.

[5] Ramesh Kumar, P.M. Deoghare, "Analysis of Transmission Line fault by using Wavelet," International Journal of Engineering Research and Technology, Vol 3, Issue 5., pp. 36-40, May 2014.

[6] Abhijit Jadav, Kawitha Thakur,"Fault detection and Classification in Transmission Line based on Wavelet Transform" International Journal of Scientific Engineering and Research, Vol. 3 , Issue 5, pp. 14-19, May 2015.