As per UGC guidelines an electronic bar code is provided to seure your paper

International Journal for Modern Trends in Science and Technology
Volume 9, Issue 08, pages 100-108.
ISSN: 2455-3778 online
Available online at: http://www.ijmtst.com/vol9issue09.html
DOI: https://doi.org/10.46501/IJMTST0909017

Three Phase Transmissions Line Fault Detection Using Wavelet Transform (DWT) in Mat Lab/Simulink

Priyanka T S | Basavaraja Banakara

Department of Electrical and Electronics Engineering, University BDT college of Engineering, Davanagere, Karnataka, India

To Cite this Article
Priyanka T S and Basavaraja Banakara. Three Phase Transmissions Line Fault Detection Using Wavelet Transform (DWT) in Mat Lab/Simulink, International Journal for Modern Trends in Science and Technology, 2023, 9(09), pages. 100-108.https://doi.org/10.46501/IJMTST0909017

Article Info
Received: 08 August 2023; Accepted: 18 August 2023; Published: 29 September 2023.

ABSTRACT

Now days an Electrical power system faults arise commonly in transmission line, an appropriate method of fault detection is essential in power system. To detect the fault based on (DWT) discrete wavelet. transform is proposed in this project. Detection is carried out by analysis of line faults, phase current and voltage. discrete wavelet transform (DWT) used to analysis of faults, transient voltage, current and disturbance on three phase transmission line, faults is executed, From this fault chances power loss will be there in transmission line.

This project will be focused on faults in power system and analysis of voltage sag, swell and impulse voltage generator using MATLAB/SIMULINK software. Fault results an interruption of power flow and fast detection of faults and accurate, it helps to maintain the supply voltage.

***KEYWORDS:** Transmission line fault detection, fault classifications, transmission line fault analysis using wavelet transform, analysis of voltage sag, swell & impulse voltage generator, comparison of Fourier transform and methods of fault detection*

1. INTRODUCTION

Possibly the biggest and most complicated man-made system (MMS). In this system will consisting of three major parts are generating station, high Voltage transmission and distribution. From generating station including renewable and non-renewable energy sources used to generate the Power, this will transfer in safe way to consumers. from this process transmission line placed an important aspect to supply the power from generating Station to the distribution stations. It provides continuous power supply to the consumer utilities. During this way occurrence of faults is higher, because of conductors contact with ground or it happens due to weather factors, lightning strikes and accumulation of snow, flashover, heavy rain, gales, birds. Transmission lines faults different way but mainly considered, line-to-line faults (LL), line-to-ground faults (LG), and two line-to-ground faults (LLG), and three phase faults are the four basic categories into which transmission lines defects are separated. Sometimes it's create damage on the equipment of the power system identify by using DWT and it used to analysis the faults, the transients are experienced by current and voltage when fault occur.

Clearing the faults swiftly it's necessary to identify, which transmission line defects to repair so that the power supply can be restored as quickly as feasible, it's more essential to satisfies the customer. The Electromagnetic transients in various kind of transmission line problems should be repaired in order to restore electricity as quickly as feasible, supply various disturbances and power quality issues in the lines. Transmission zones have transmission lines, power can be transmitted ether by AC or DC power is universally take up for transmitting of large Power. This transmission lines can be roughly divided into two categories: primary transmission and secondary transmission. Transmission line mainly classified open circuit and short circuit faults from this manly consider short circuit fault are classified as:

1. Single line to ground fault (SLG) – 70%-85%
2. Line to line fault (LL) -8%-15%
3. Dabble line to Ground fault (LLG) – 4%-10%
4. Tripple line fault (LLL) – 3%-5%

A. About Wavelet Transform (WT)

Wavelet is a mathematical function which deals with building model and it processing non stationary signals utilized by a group of parts, it's look like small waves that's called as wavelets. This Word was fabricated by j. Mallat more than Twenty years ago. It is nothing but a wave oscillation with an amplitude, A mathematical method for analysing transient signals in power system is the wavelet transform (WT). This will creates sudden momentary variation of voltage signal, current and Frequency, it results to increasing the Power quality disturbances or faults in the power system.

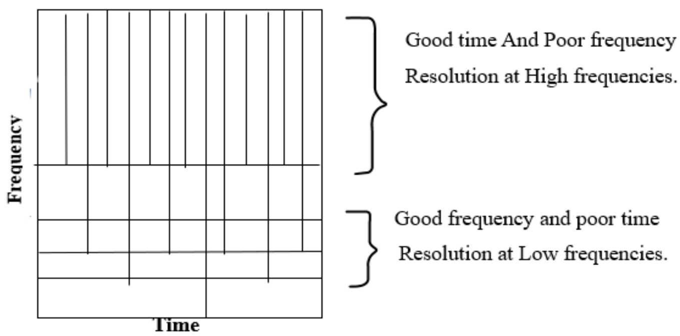


Fig.1.1 Wavelet transform

It is similar as Fourier transforms (FT) but have different time localization with various frequency component of exact signal. In HF (low frequency) and (LF) low frequency components, analyzing & detecting the signal prissily to decompose the signal into multiple lower resolution levels, each have controlling by scaling and shifting factors of a single wavelet function.

Having a high frequency narrow bandwidth and lower frequency border. transient properties used easy to identifies the transients. Wavelet transforms are used to primarily classify errors, discreate Wavelet (DWT) and continuous wavelet (CWT), It will be discussed in chapter-4.

The following benefits of Wavelet Transforms:

• It's able to extract the local spectral and temporal information.
• WT is used to analysing ECG signal which contain interest of periodic signal transients.
• It is a useful technique for lowering noise in various transmissions.
• It gets aggression of simultaneous localization in time & Frequency domain.

2. BLOCK DIAGRAM OF ANALYSIS THE SIGNAL USING WAVELET TRANSFORM

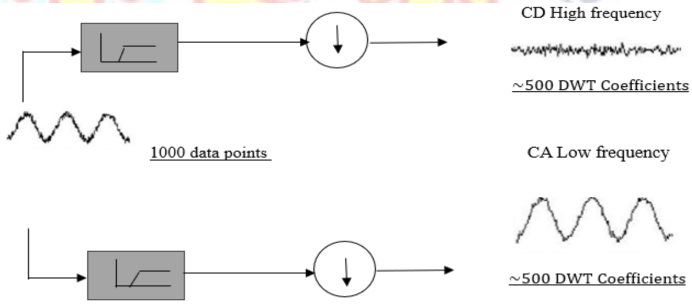


Fig.2.1 shows block diagram of analysis the signal

A bit of analysis methods is to required handle the versatile signals and their localizationin time frequency analysis and signal based frequency. In Fourier analysis-based cosine function not used for transients, because the outcome of this transient analysis has a very broad frequency range. Fourier techniques cannot be used concurrently achieve good localized in frequency and time resolution for transient wave.

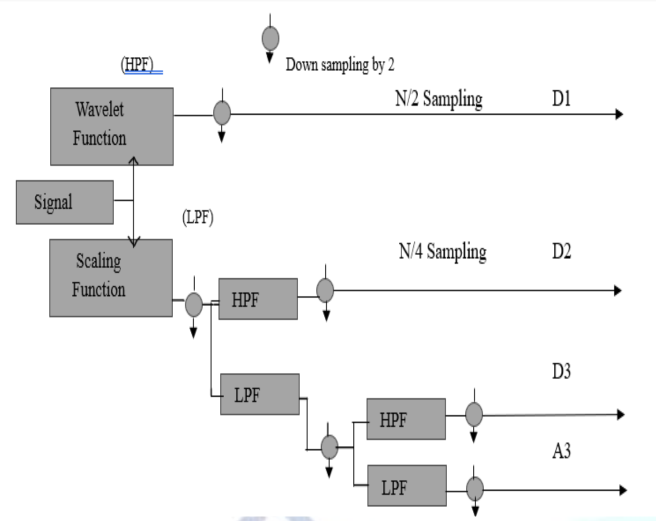


Fig.2.2 Wavelet decomposition

Figure (3) shows the signal decomposition of wavelet into High frequency, The WT decomposes transients into series wavelet components, each having corresponds time domain signal, it covers a specific octave frequency band containing more comprehensive information. Such component appears to be useful for detecting and it feasible in practical to analysing power transients and disturbances. The output is down-sampled by a factor of two using same filters, this will applied to the output of the previous stage of The (LPF) low pass and (HP) high pass filters' message is derived from the mother wavelet, or wavelet function. it measures the certain input having (LP) low pass filter.

Results are effectuated with db4 serving as mother wavelet employed in signal analysis Transient signal wavelet transformation. This is expressed by Multi revolution decomposition algorithm for Wavelet transform of transient signal is expressed by Multi revolution decomposition utilizes fast algorithm. the orthogonal wavelet bases to decompose signal, in to components under different scales. It is equal to recursively filtering the signal with a pair of both (HP)& (LP) filters.

A. Analysis of voltage swell, sag and impulse voltage Generator

Difficulties with power quality wide variety of disruptions are produced, including voltage sag, swell, hormonal distortion, and impulse voltage fluctuations, below figure represent simulation diagram for analysis of voltage sagging and swelling using Mat lab Simulation.

Voltage sag: It occur any movement of time with a length spanning from half a cycle to a minute and an amplitude rang of 10%-90%. RMS voltage or current, voltage sag rules. between 0.1 p. u 0.9 p u at high frequency for 0.5 to 1 minute periods.

Voltage swell: A swell is defined an increase the RMS Voltage or Current at power frequency duration from 0-1 minute. The swell size is determined by the remaining voltages, it is not important because they are less frequent in distribution networks than voltage sag. These two can causes
equipment sensitive, such as it failing in (chemical or semiconductor plants), it will creates significant current imbalance that might trip breakers or burst fuses. These consequences, which can include lost production time, slight quality changes, and equipment damage, can be quite costly for the consumer.

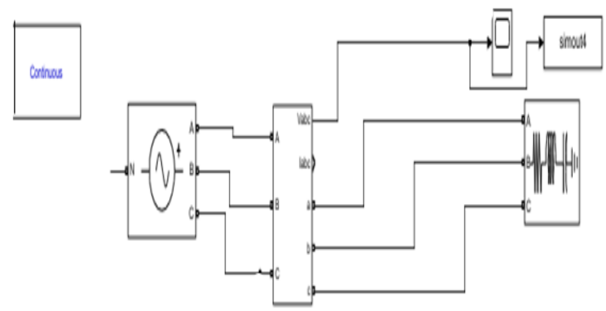


Fig. 2.3 Simulation circuit for Volage sagging and swelling

B. Impulse volage Generator

An impulse voltage generator Capacitor charged to required voltage and discharge through the circuit. Thess parameter can adjust to the given of an impulse voltage, the desired shape and Capacitor charge from dc source. These made of network capacitors and resistors.

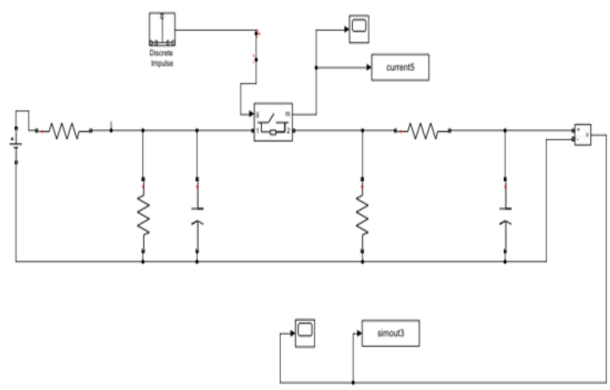


Fig.2.4 1Implementation circuit of impulse Voltage

generator

Above simulation circuit represent an impulse voltage generator. In this circuit four resistor and two capacitors used. This model circuit used to generate impulse volage. Above circuit includes:

1.The main capacitor is always larger than output capacitor by adding the capacitor valve (5e-6). This will connect to high voltage DC source through a Limiting resistor.

2.Output capacitor valve (1e-6), the test object capacitance are (power equipment, dielectric material, etc.) an additional capacitor these element must be lower than the main capacitor.

3. The first stage resistor 24 k ohm, connected in series with the main capacitor and ideal switch. When switch is closed, the current flows through resistance. The Resistance 3 is connected parallel to the main capacitor. Load resistance 1.2 kΩ to limit initial charging current. LR is high value no current flows.

3. PROPOSED SYSTEM METHODOLOGY

Wavelet-based fault detection of transmission lines in three-phase power systems, it is based on analysis and identification of faults of voltage sag, swell and impulse voltage generator by using MAT LAB/ SIMULINK software. Different types wavelet is their but within this. a project that analyses faults
using discrete wavelet transforms. It provides speedy findings for fault analysis and problem identification. on transmission line. DWT is an effective tool in the area of signal processing and image compression and analysis of transients. Separate simulation diagram is used in model to analysis of voltage sag, swell, and impulse voltage.

A. Discrete wavelet transform for fault analysis

In 1989, Mallet's typically implemented the discrete wavelet transform. 1988 saw Daubechies and other things. DWT was first formulated in the year of 1980s and it's algorithm formulation is related to Multiresolution analysis of theory. A function of a continuous variable is mapped into a list of coefficients via a series expansion. the extended function represented by a series of numbers. like samples of a continuous function f(x), the resulting coefficient are called (DWT) discrete wavelet transform.

DWT is a method for converting picture pixels into Wavelets, which may then be utilized for wavelet coding and compression.

As described by the Discreate Wavelet Transform (DWT):

$$w\varphi(j0,k) = 1\sqrt{M}\sum_{x} f(x)\varphi j0,k(x)$$

$$w\psi(j,k) = 1\sqrt{M}\sum_{x} f(x)\psi j,k(x) \quad \text{for } j \geq j0$$

The definition of inverse discrete wavelet transform (IDWT) is

$$f(x) = 1\sqrt{M}\sum_{x} w\psi(j0,k)\,\varphi j0,k(x) + 1\sqrt{M}\sum_{j=j0}^{\infty}\sum_{x} w\psi(j0,k)\,\psi j,k(x)$$

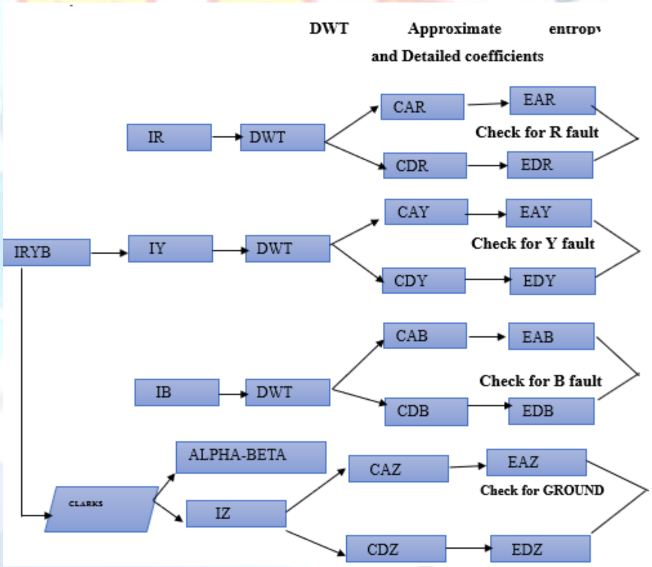


Fig.3.1 Block diagram of DWT based on fault analysis

More fault information processing included in the transient components and it can be used to attribute the faults in the system. It compact with the fault analysis and its reason.

The transient signals having some characteristics functioning as high frequency and instant break. it's having adopted of revealing the position of data in other signal analysis techniques absence and it amuse need of electric transient signals.

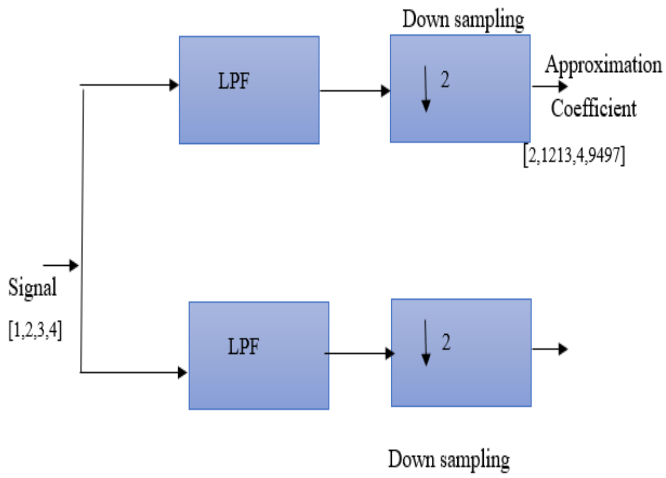


Fig.3.2. Discreate wavelet transform

Detailed coefficients and low frequency approximate coefficients, after each level of decomposition, frequency sampling is reduced by half. Then recursively decompose the low-pass filter outputs (approximations), to originated components of the next stage. Given a discrete signal x (n), being fast transformed at insistent k and scale j, it has a high-frequency and a low-frequency component coefficients. The information frequency band contained in signal components. it's long with to this technique.

which can be well formulated to implement by using two filters, one high pass(HP) and one low pass filter(LP) at level of (k), which fundamental components generate. line having three phase R,Y,B phase and one ground connection point. DWT used to analysis of faults to check for R phase CAR and CDR, EAR and EDR analysis for R phase. Y phase CAY-CDY and EAY – EDY analysis for Y phase and check for B phase CAB-CDB and EAB and EDB for analysis of line three, to check the ground fault by using Clark's transformation to check the ground fault current impedance IZ, CAZ-CDZ and EAZ-EDZ.

Although practical distribution systems do not satisfy the aforementioned conditions, a frequency-independent real transformation matrix can be used to obtain some what decoupled signals that can be advantageous in transient based fault location.

B. SYSTEM PARAMERS/ALGORITHMS

In power system simulation model consisting of various of faults on transmission line in three phases. Distribution parameters of line connecting three phases, distance between the two transmission line is 50km, fault occurs when signal momentarily connects the component of the power of distribution system. Below table shows the simulation model parameters in transmission line.

the 3- phase line parameter with 50Hz useful for the specification of RLC in the line to match up with these phase parameter, sequence of the impedance are specified because the line repose of symmetrical components. Its very decisive property for power lines it's have to confess the operation for analysis the power system during unbalanced states. the sake of this simulation, the usual parameter values used in the Simulink model are employed.

SI.NO	Name of the parameters	Sequence's/ ranges
1	Resistance/ unit length (Ohms/km)	0.01273 0.3864
2	Inductance/unit length (H/km)	0.9337e 4.1264e-3
3	Capacitance/unit length (F/km)	12.74e-9 7.751e-9
4	Number of phases	N-three phase
5	Lenth of the line	50km
6	Frequency in (Hz)	50

Table 1: Distributed Parameters of transmission line in three phaseparameters of two winding three phase transformerIn simulation system to build model two winding transformer block is used, By combining three single-phase transformers, this block creates a three-phase transformer. If you wish to reach the Wye's neutral point, set the winding connection to 'Yn'.

SI.NO	Parameters	Range/valve
1	Nominal power and frequency [P n (VA), f n Hz)	100e-6
2	Winding 1 parameters [V1 Ph-Ph (Vrms), R1(pu), L1 (pu)	11e-3, 0.02,0.08

3	Winding 2 parameters [V2 Ph-Ph (Vrms), R2(pu), L2 (pu)	0.4e3, 0.02, 0.08
4	Magnetizing resistance Rm (pu)	500
5	Magnetizing inductance Lm (pu)	500

Table-2: three phase transformer (two winding) parameters

4. MATLAB/SIMULATION AND ANALYSIS RESULTS

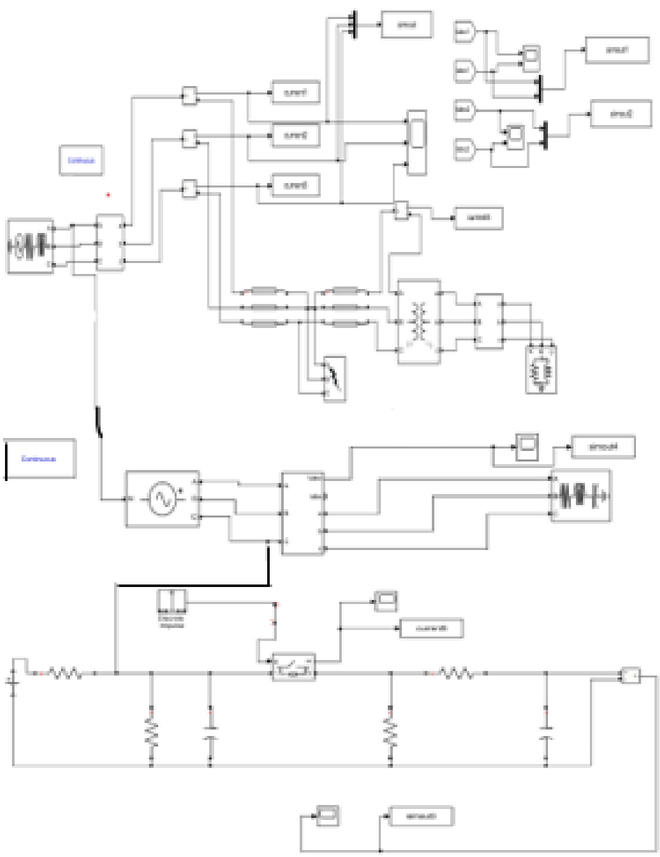


Fig.4.1. Power system simulation Model

Transmission in three phases line faults:

Transmission line protection is a crucial concern in the design of power systems. Becouse of 85% to 87% Problems in the electrical system are present on overhead transmission lines. Let's examine the many flaws in transmission lines.Short circuit faults are the most dangerous sort of faults (LLL or LLLG) if it remains uncleard.

A. Simulation Results for Fault Cases

Normal Condition

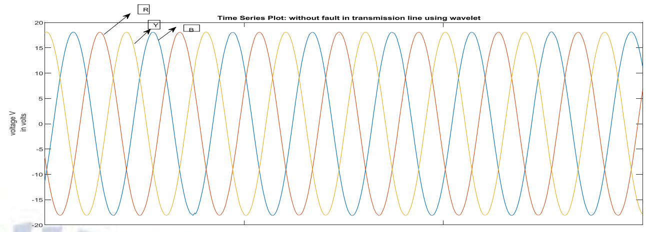


Fig.4.2 (a) transmission line without fault

Three phase lines are represented by three slandered color (A- red, B- blue and C- yellow) power transferring under normal condition equal amount of V or I flowing through in each phase, there are no transmission line problems.

B. Single line to ground (LG) Fault

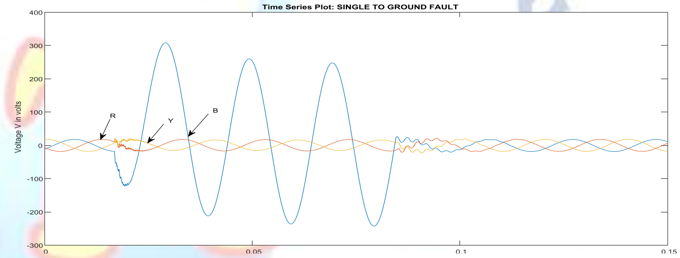


Fig4.3(b) single phase to ground fault

One phase of the transmission line system experiences an L-G fault when it contacts the ground, remaining two phases normal current Voltage are flowing Y and B phases. For Ex: This takes into account R-G fault. The voltage and current waveforms of the R-G fault system are shown in the image. There are more transients in the R phase signals than in the other two phases.

C. Dubble Line to Ground (LLG) Fault

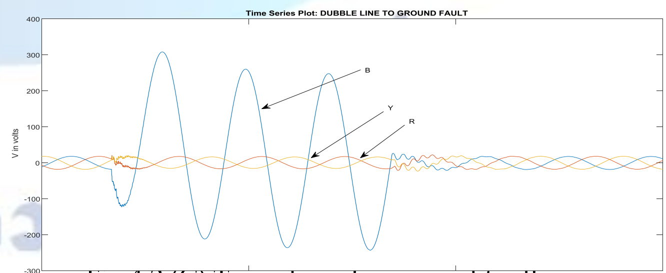


Fig.4.2 (C) Two phase-to- ground fault

The R-Y fault, R-B fault, and Y-B fault are the L-L-G faults that affect the transmission system. For example this takes into account the Y-B fault. Waveforms of voltage and ırrent in the Y-B fault system. There are more transients in the Y and B phase signals than the other Phases R and Y. voltage Signals are varying.

D.Three Phase to Ground (LLLG) fault

Transmission problems with three phases can happen. are R, Y, and B faults, as well as R-Y and B-G faults. Simulation results in both situations are covered. Voltage and current waveforms of the R-Y-B fault system are shown in this picture. Signals in the R, Y, and Compared to other phases, B phases are more transient. Signals with fluctuating voltage and current are faulty phases.

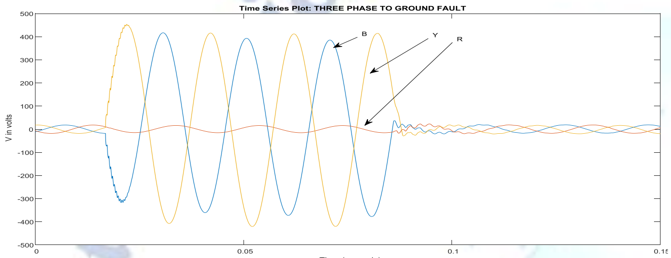


Fig.3.2(d) Three phase-to-ground fault

E. Vabc1 & Iabc1 Simulation output during Normal Condition

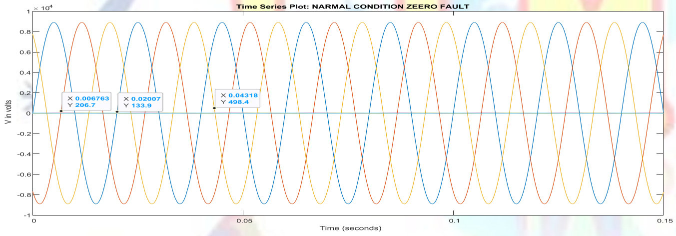


Fig.3.2 (e) Voltage and Current waveform Vabc1 and Iabc1

F. Vabc2 &Iabc2 Simulation output during Faulted Conditions

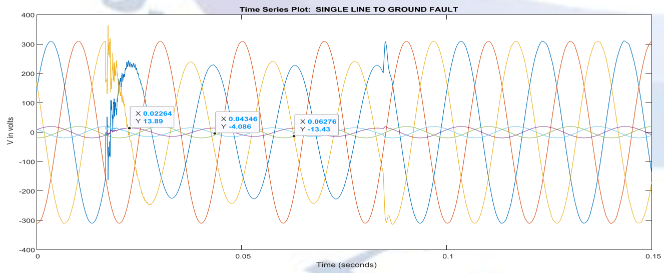
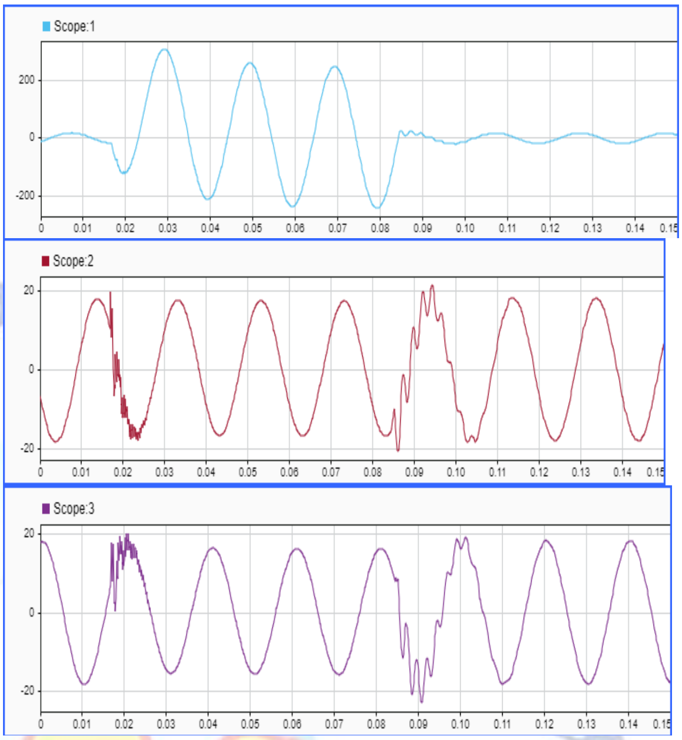


Fig.3.2 (b) current and voltage signal in faulted condition

Above figure shows 10 (a) and (b) fig(a) Vabc1 and Iabc1 shows normal operating condition all three phase voltage and current became equal in each phase fig(b) Vabc2 and Iabc2 represent faults in transmission line's Transients goes on increasing when fault occurs on the line, voltage and current Signal varying in each phase, it's having a more transients compare to other phases.

G. Individual Scope outputs



3.2(g) individual scop data outputs

H. All output Signal in one Scope

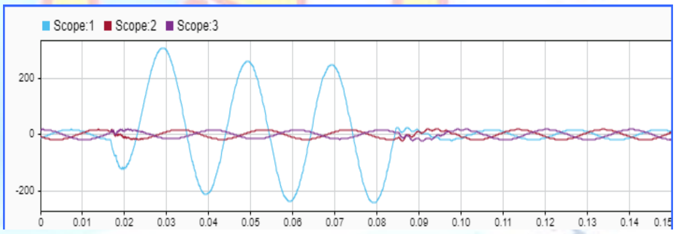


Fig.3.2(h). Scop data outputs

See the figure output results of individual scop data under faulted condition, when fault occur on transmission line R Y and B phase Voltage and Current variation in the output signal, transients occur goes on increasing on transmission line, when fault occur in transmission line.

4.1 Simultaneous, output voltage from sag, swell, and impulse voltage.

A. Sagging Voltage

The three phase voltage sag is seen in the first simulation result. As illustrated in Figure 12, the simulation began with the supply voltage 50% lower than normal. show, A 50% voltage sag began at 0.15 seconds and continued until 0.35 seconds, lasting 0.2 seconds overall.

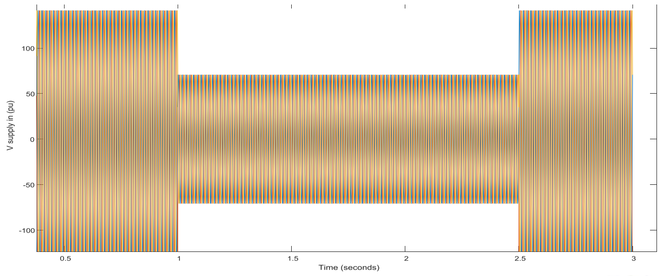


Fig .4.1.1 Voltage sagging

B. Voltage Swelling

The performance under the voltage swell scenario is depicted in the second simulation diagram. The simulation began by generating a swell at the supply voltage, as seen in Figure 13. This graphic shows that the supply voltage's amplitude has risen from its nominal value by around 25%.

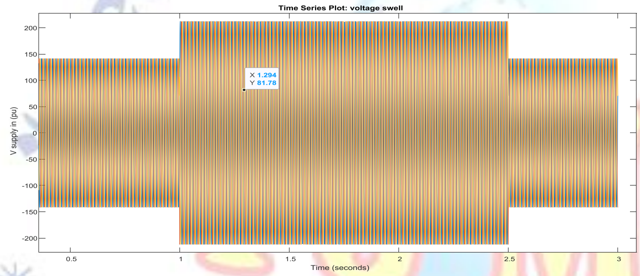


Fig.4.1.2 Voltage Swelling

These findings show that the load voltage is maintained at its nominal value and that it It responds swiftly to inject the proper voltage component (negative voltage magnitude), much like voltage sag. Correct supply voltage. see all the output directly in workspace. In this simulation we will see how each scope is related to the person and the workplace.

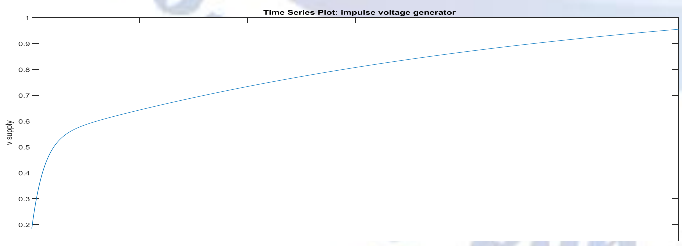


Fig. 4.1.3 impulse Voltage generator \

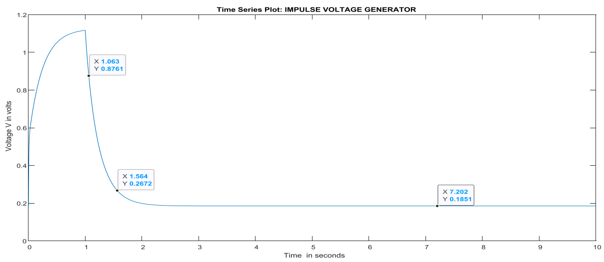


Fig.4.1.4 impulse voltage varying with time

See the figure.1 shows the impulse Voltage generator in this output results represent wave shape, impulse voltage is essentially consists of capacitor which charged to required voltage and discharge through a circuit by 1.2/50 μs duration with a peak voltage and its magnitude is 50.This will suddenly raising from 0 to 0.6 that is voltage raise time and it false to 0 sec false 0.25 seconds t0 -t2 raise time and t2-t4 false tome. These figure represent impulse voltage magnitude varying with respect to time.

5. CONCLUSION

The effective Work is done in this paper on effect of faults in the transmission line in power system Model and Wavelet transform is achieved for detecting, Analyzing faults and analysis of Voltage Sag, Swell and Impulse voltage, Voltage sag decrees the RMS voltage or current in between 0.1 p. u- 0.9 pu at high frequency for duration of 0.5 cycle to 1 minute. Voltage swelling is to increase the RMS voltage or current between 1.1pu. and 1.8 pu at the Power frequency duration, but it's frequency will be varying. Transmission line fault detection Starting from the fault time 0.15 sec and it is removal time is 0.1 sec

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

REFERENCES

[1] T. B. Littler and D. J. Morrow. "The Wavelets. for Analysis and Compression of Power System. Disturbances", 14, April 1999, IEEE Transactions on Power Delivery.

[2] "O. A. S. Youssef "Fault Classification Based On Wavelet Transform, IEEE T&D Conference, Atlanta, October 28–November 2001.

[3] D. Chanda, N. K. Kishore, A. K. Sinha, "Wavelet multi-resolution application. Analysis for the Location of Transmission Line Faults" Proceeding of TENCON 2003.

[4] H. Awad, J. Svensson, M. Bollen, "Mitigation of Unbalanced Voltage Dips Using Static Series Compensator", IEEE Trans. On Power Elec., Vol. 19, No. 13, May 2004.

[5] T. M. Lai, L. A. Snider, E. Lo, and D. Sutanto, "High-Impedance. Fault Detection Using. Discrete Wavelet Transform and Frequency. Range and RMS Conversion", IEEE Transactions. on Power Delivery, January 2005.

[6] D. Das, N. K. Singh, and A. K. Singh, "A Comparison of Fourier Transform and Wavelet Transform Methods for Detection and Classification of Faults on Transmission Lines", IEEE Power India Conference, New Delhi, April 2006.

[7] Kim C.H., Aggarwal," Wavelet. transform in Power. Systems", IET Power Engineering Journal vol. 15. Aug. 2009.
[8] T. M. Lai, L. A. Snider, E. Lo, and D. Sutanto, High-Impedance Fault Detection Using Discrete Wavelet Transform and Frequency
[9] M. Solanki, Y. H. Song, S. Potts, A. Perks, "Transient protection of transmission line using wavelet transforms", Developments in power system protection, conference publication No.479, IEEE 2001, pp.299-302.