ENHANCED APPLICATION FOR PROTECTION AND DETECTION OF ARC FAULT DURING POWER SWING

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Abstract : **Stresses exerted on the electrical equipment due to disturbances are appearing in the form of either over voltages or over currents. The over voltages behaviour is an impulsive increase in the system voltage. Suppression devices are used to protect the electrical networks against these over voltages.**

The over currents behaviour is an unexpected increase in the current due faults when they are shunt faults. The protection against such faults is challenging. Over the years, conventional protection schemes have been successfully used to detect and to protect against the low impedance faults where a small resistance only limits the fault current.When the resistance of the fault path is very high and therefore the fault current cannot be easily recognized, it is called a high impedance fault.Such fault case cannot be reliably detected, in particular in distribution systems, using the conventional relays because its current is very small. One of the main features of this fault type is that it is associated with arcs.Our main goal is that to identify the arcing fault during power swing. We already know that power swing take place only in EHV networks only.

***IndexTerms* - wavelet transforms Power Systems faults, power systems protection.**

I. INTRODUCTION

The over voltages behavior is an impulsive increase in the system voltage. The protection against such faults is more challenging because it requires intelligent discriminators to isolate them quickly before catastrophic failures. Over the years, conventional protection schemes have been successfully used to detect and to protect against the low impedance faults where a small resistance only limits the fault current. However, when the resistance of the fault path is very high and therefore the fault current cannot be easily recognized, it is called a high impedance fault. Such fault case cannot be reliably detected, in particular in distribution systems, using the conventional relays because its current is very small. The measured voltage and current signals are preprocessed first and then decomposed using wavelet multi-resolution analysis to obtain the high frequency details and low frequency approximations.

The Discrete Wavelet Transform:

It is used to that the network waveforms are not stationary due to disturbances. Therefore, FFT is not suitable for well-timed tracking and it is important to use an appropriate signal processing technique such as WT. Recently, wavelet analysis has been used in several applications in the power systems. For example in a power quality research area, it is applied for monitoring and for analyzing power system disturbances.

All the wavelet functions used in the transformation are derived from the mother wavelet through translation (shifting) and scaling (dilation or compression).

$$X_{WT}(\tau, s) = \frac{1}{\sqrt{|s|}} \int x(t) \cdot \Psi * \left(\frac{(t-\tau)}{s} \right) dt$$

Fig a Fig b

Figure.1.1 Demonstration of (a) a Wave and (b) a Wavelet

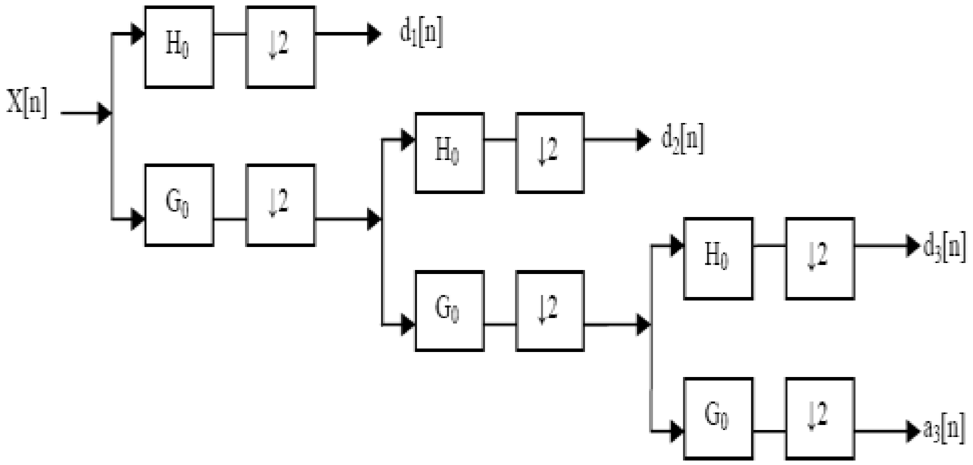


Figure 1.2 Three-level wavelet decomposition trees.

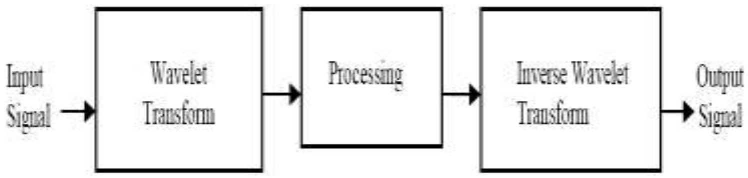
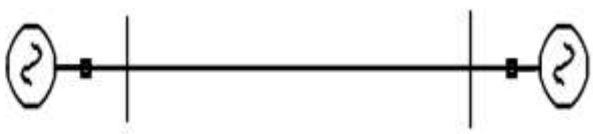


Figure 1.3 Signal processing application using Wavelet Transform

II . Modeling of arc fault:

Accurate modeling of the transient responses of EHV transmission systems caused by arcing faults having very much important accurate knowledge of the parameters of the arc model is important; the system transients are sensitive to the parameters. Experimental data's are used to determine empirical relation between parameters and fault current. The arc recovery characteristics, together with the arc conducting characteristics, thus play a very significant part in determining the time of arc extinction.



Sending End Receiving End

Figure2.1 A single-circuit system

III. Matlab Model For Fault protection during power swing:

After clearing of a fault on an extra high voltage line of a power system network, the line is isolated and power swing may occur. Power system faults, line switching, generator disconnection, and the loss or application of large blocks of load result in sudden changes to electrical power, whereas the mechanical power input to generators remains relatively constant. These system disturbances cause oscillations in machine rotor angles and can result in severe power flow swings. Power swings are variations in power flow that occur when the internal voltages of generators at different locations of the power system slip relative to each other. Large power swings, stable or unstable, can cause unwanted relay operations at different network locations, which can aggravate the power-system disturbance and cause major power outages or power blackouts.
Since the system frequency is a function of rotor speed, the frequency of voltages and currents during power swings is not constant. The slip frequency can be as low as 1–3 Hz (slow swing) and as high as 4–7 Hz (fast swing).

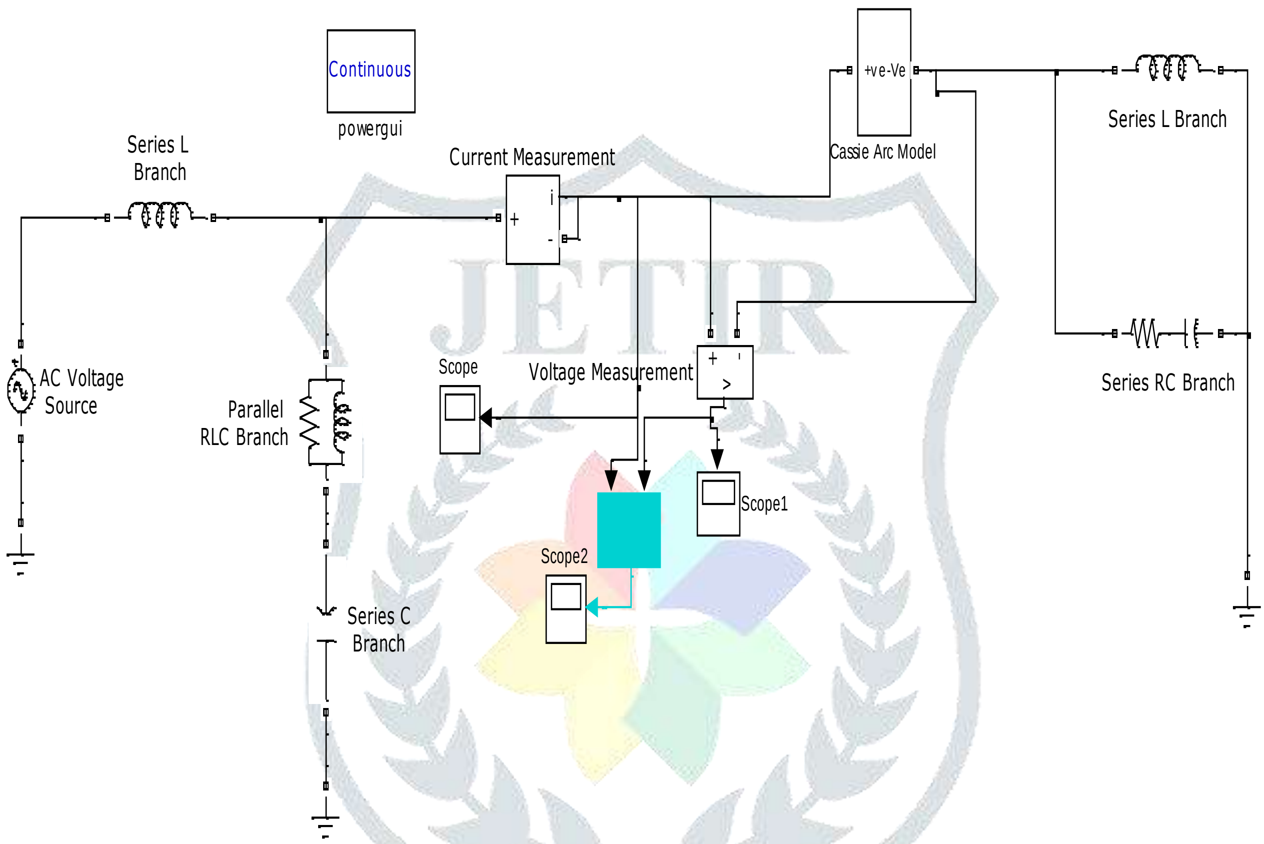


Fig.3.1 Network Cassie arc model.

Out of step blocking function is provided in distance relays to detect a power swing and block the operation of a distance relay due to the power swing. However, if there is a fault during a power swing, this function must "unblock" and let the relay trip.

IV. Simulation and Results :

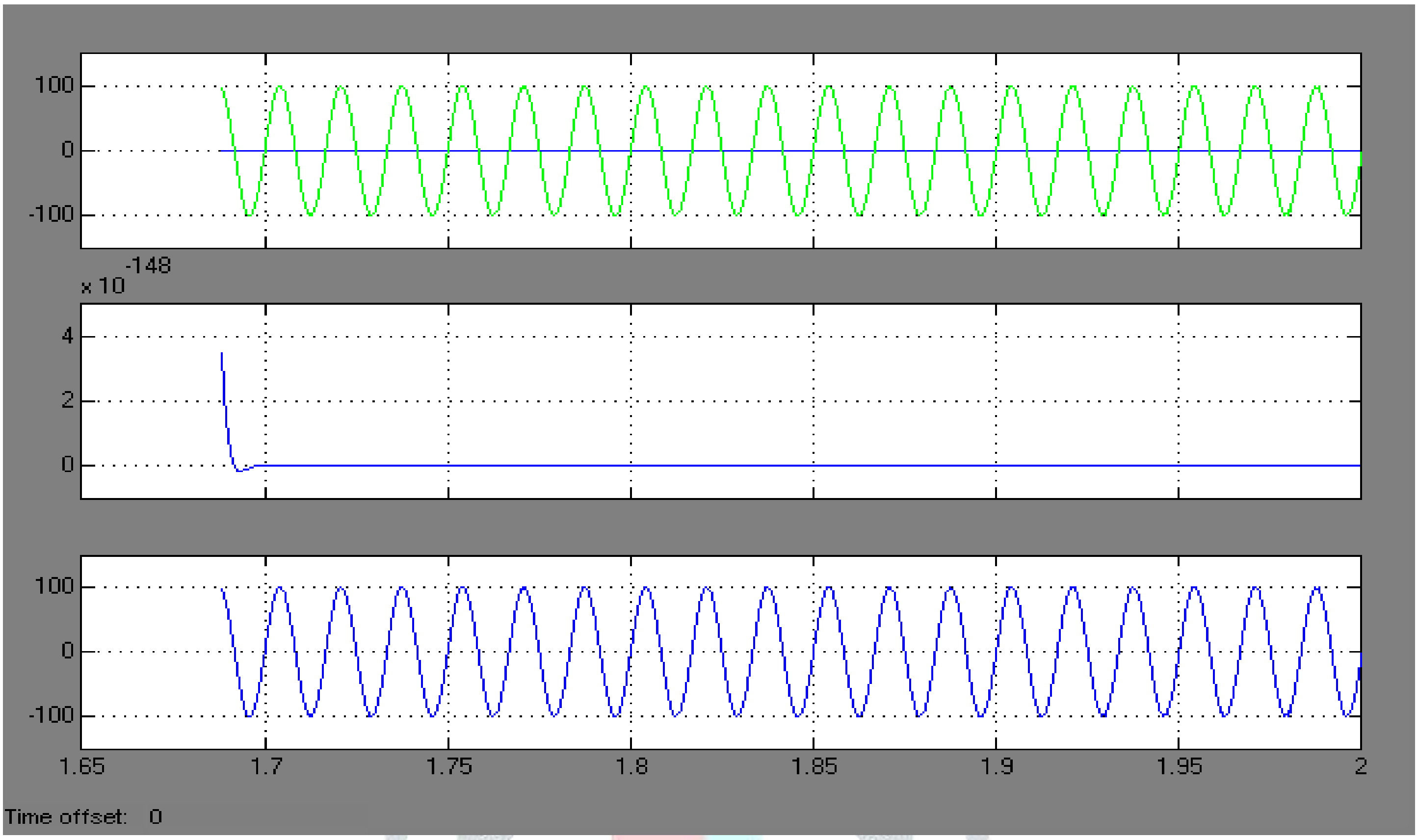


Fig4.1 Typical current and voltage waveforms during a power swing with the arc model

Numerical relays are fast replacing conventional relays for protection of transmission lines. The technique used for this is Fast Fourier Transform (FFT).Discrete Wavelet Transform (DWT) technique is being used increasingly in place of FFT, for better discrimination in time and frequency domain. High Impedance Arcing Faults (HIAF) is difficult to detect by presently available techniques. It is used to propose Wavelet Transform to detect HIAFs on MV and EHV transmission lines. Arc models for MV and EHV has been tested and applied for simulation of arcs in respective systems.
Detection of arcing faults in EHV system during power swing condition has been simulated for successful detection of fault. The features of reach limitation and directionality couldn't be incorporated.

V. Conclusion:

This paper has presented the application of wavelet transform for distance protection of transmission lines. Specifically, DWT is used to extract the fundamental frequency components of the voltage and current signals measured by the digital relay.
A comprehensive protection scheme is designed and the properties of the proposed scheme are:
• The signal preprocessing stage eliminates most of the influences from pre-fault loads, system conditions and power swings.
• The wavelet transform provides an efficient way to extract signal components at different frequency bands.

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