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Transmission Line Protection with Distance Relay

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Abstract

With the development in science and engineering the power system protection field also get advanced which includes the development of relays .the relays journey started by electromechanical then solid state and now digital and numerical relays .An economical and feasible solutionto investigate the performance of relays and protection system offered by modeling of protective relays .Distance relay is one of the effective protective relays that are used for the protection of extra high voltage transmission lines. Distance relays are considered of the high speed class and can provide protection. To detect the fault on transmission lines many distance relays are used but for long transmission line mho relay is most suited. The proposed work is about designing of numerical mho relay in MATLAB / SIMULINK to be used for distance protection schemes of long distance transmission lines with better result and characteristics. The required mho relay algorithm is evaluated by using MATLAB to model the power system under different fault condition andsimulate it by using phasor based method available in MATLAB simulation. Thus the modeling and simulation of numerical mho relay gives the improved result and greatly enhance the performance of mho relay

Keywords:*Distance protection, Numerical relays, Matlab/Simulink*

INTRODUCTION

Electric power systems are made up of facilities and equipment that generate, transmit and distribute electrical energy with the purpose to provide energy for human in a secure, reliable and economic

manner. It is one of the biggest and most complex systems have ever been built by mankind. The importance of the services carried out by power systems together with the huge investment for its facilities and equipment make the sustainable operation of power system is very critical to the society. To maintain sustainability of power systems against faults that normally occur in the power systems, an additional protection system that is able to take corrective actions against such faults have to be applied. This system consists of transformer, relays and circuit breakers. The purpose of the protection system is to disconnect the faulted element in the power system and re-establish its services.At present, the transmission system are predominantly using overhead lines which is prone to disturbances caused by lightning that either directly strikes the lines or indirectly strikes the branches of tree in the vicinity of the lines. Statistics shows that 5-10% of lightning-caused faults are thought to cause permanent damage to equipment. Great amount of energy involved in a fault represents a serious threat to the power system equipment. The high requirement of protection systems is a big challenge for the protection engineers. Measuring transient behavior of protection system is very important to ensure its successful operation during the faults. Protective relays serve as a backbone and play an important role in power system .With the development in technology the protective technique has transformed itself into fourth generation technology.

There are different techniques with the help of which the numerical mho relay can be modified but these techniques does not fulfill all the requirement and contains some limitation or drawbacks . So to overcome such limitations we are developing a new model of numerical mho relay .As MATLAB programming language was widely used as a simulation programming language to design the numerical and digital relay models ,it is capable of modeling digital relays by providing detailed models of common components of numerical relays. The power system block set toolbox, available in the MATLAB environment provides a tool for relay modeling. The information on which such models are based is either available from manufacturer leaflets, patents, or from technical papers describing the relay performance. Numerical relay models can be divided into two categories. First, the "Phasor-based models", in which only the fundamental frequency component of voltages and currents are used and were

the first to be widely used by industry and academics to design relays and check their performance. The second category models, "Transient relay model", take into consideration the high frequency and decaying DC component of voltages and currents, in addition to the fundamental frequency components; this type is rarely used as it needs sophisticated filters in order to remove the DC and high frequency components

LITERATURE REVIEW

Authors suggested the new positive sequence direction element to use in numerical distance relay, which is based on the incremental positive sequence signals, has been implemented on a numerical distance relay. They performed the experiment of numerical distance relay with positive sequence direction element on Manitoba hydro network and get the successful result on numerical relay. The test is also performed on real time digital simulator (RTDS) and they get the expected results. This gives the accurate relay model to extend or to explore relay operation in complex networks which are beyond capability [1].

The research work shows the use of relay in past time and in coming time, on that basis to developed software model of relay various models required data is checked which helps to develop such model of relay. The software model performance is checked against the performance of actual relay. Software model can be used iff required assumptions are made. [2]

Authors suggest the protection scheme based on wavelet transform. This detects the discrete frequency band which contains transient fault current wave. This detected signal is being checked by the mother wavelet and check if the fault is internal or external. This approach gives good selectivity and sensitivity. It is reliable and feasible to the time .This scheme of protection is the improved version of traditional protection systems. [3]

This Author suggested a new technique of impedance's trajectory after faults represents numerical output of the impedance calculation. The output results show the behavior of the developed model under various fault locations and at different arc resistances. The simulation study presented in this paper assist in demonstrating the importance of and need for accurate dynamic modeling of distance protection relays. For the particular system studied it was found that the three-zone protection would not see a fault at the reach setting, resistive fault causes the

relay to under-reach. The exact and misjudgment of the fault location in the cases demonstrated in this paper reflects the accuracy of the developed model. The distance relay model may be used as a training tool to help users understand how the relay works. The distance relay model offers an inexpensive alternative to evaluating a relay on a test set and generally will involve significantly less time and effort. [4, 5]

PROPOSED MODELLING:

The proposed strategy of operation is mainly to design the numerical distance mho relay by using proper modeling method or strategies so that to enhance its performance to protect the transmission line. A standard system is considered where the developed different models are tested for different fault conditions. The method which gives best result is selected for transmission line protection.

Distance Protection: Distance relays, as the name suggest us, should measure distance. Number of distance relays is mounted on transmission-line-which measures the impedance between the relay point and the fault location. The measured impedance is proportional to the length of the conductor that is between relay and point where fault occurs As the measured quantity is proportional to the distance along the line relay is called distance relay. There are various types of distance relay used for the protection of transmission line. Here we are using numerical mho relay for advanced protection.

MHO Relay: A mho Relay is a high-speed relay and is also known as the admittance relay. In this relay operating torque is obtained by the volt-amperes element and the controlling element is developed due to the voltage element. It means a mho relay is a voltage controlled directional relay. A mho relay using the induction cup structure is shown in the figure below. The operating torque is developed by the interaction of fluxes due to pole 2, 3, and the controlling torque is developed due to poles 1, 2

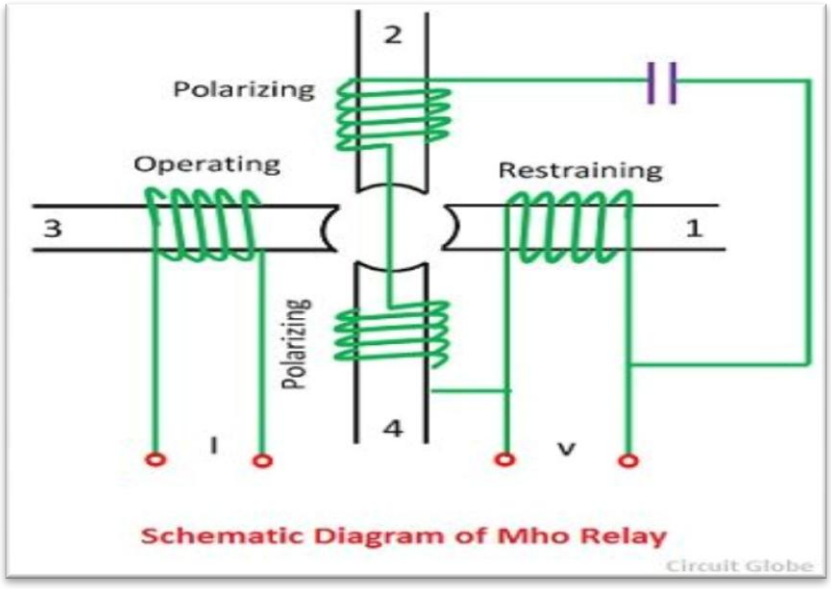

Figure: 1

Numerical MHO Relay: Since their introduction on 1920, Classic distance relays based on electro-mechanical and then on static technology are still in wide use. However due to the booming in digital techniques, microprocessor–based relays were introduced. It is quite common to use term digital relay instead of numerical relay as the distinction between both rests on fine technical details. Others see numerical relays as natural developments of digital relays as a result of advances in technology.

However, the term (digital distance protection) has always been used in the meaning of (numerical distance protection) A general view of the typical digital relay is shown in figure below .The generalized numerical relay concept is directly derived from open system relaying Different relay functions can be obtained from the same hardware just by modifying Microprocessor programming.

MODELING TRANSMISSION LINE AND DISTANCE RELAY:

Here phasor based estimation algorithm is used to model the relay with the help of MATLAB simulink. The estimated phasors of voltages and currents are used in the implementation of protection algorithms in numerical relays. The ratio of appropriate voltages and currents then provide the impedance to the fault. The performance of all of these algorithms is dependent on obtaining accurate estimate of the fundamental frequency component of a signal from a few samples.

The inputs for phasor based model are fundamental frequency components. The structure of phase and ground relay model of 3-zone is developed by using.

MATLAB/SIMULINK

The model of numerical mho relay made up of

a)Phase element model and

b)Ground element model

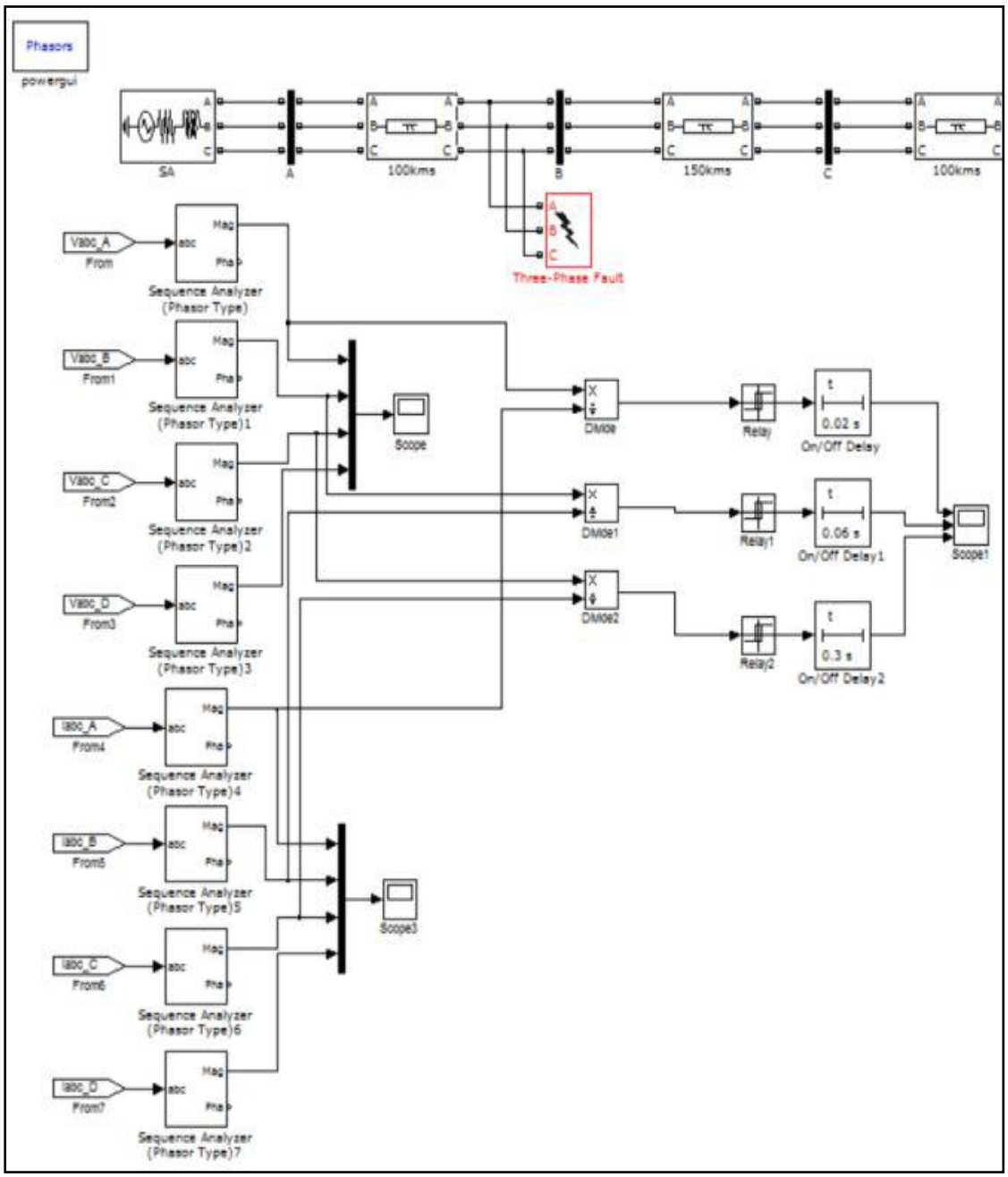

Figure: 2

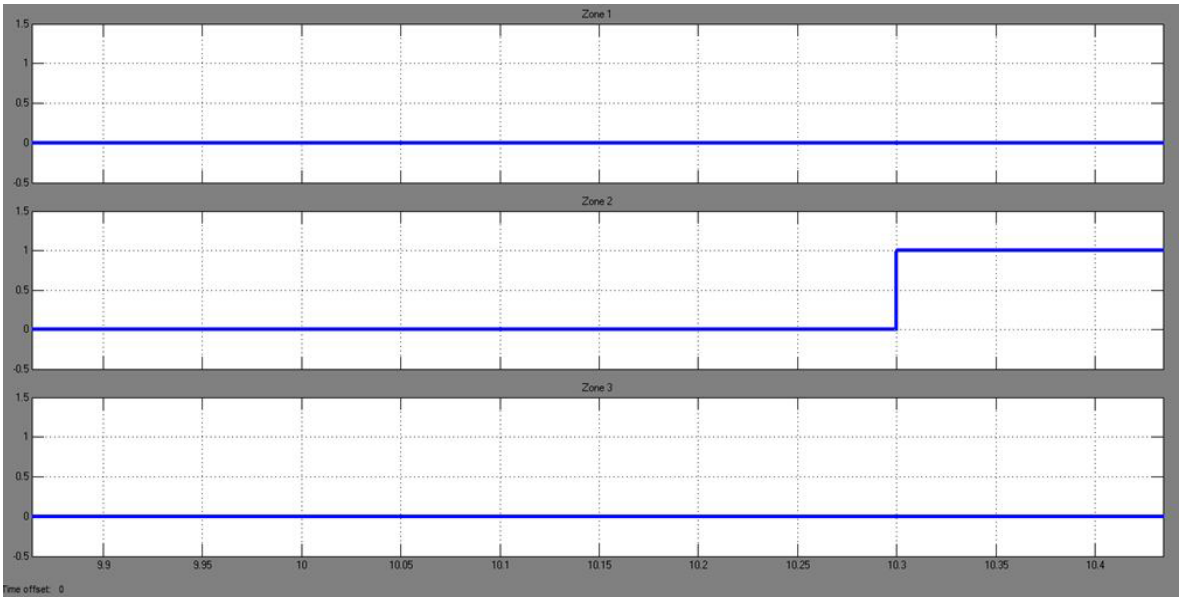

Figure: 3

CONCLUSIONS

This work presents a detailed phasor model for a distance relay of mho characteristics. Mho relays are inherently directional so there is no need for directional elements in the relay model. Here the developed simulation is evaluated for line to line fault on the system, and the results found as Simulation results of different faults regarding type and position show clearly the accurate performance of the developed distance relay model. From results it is seen that speed of operation of numerical mho relay is faster than impedance relay. The model versatility, adaptability and applicability promote it for use in power system simulators. Also, it can be used as a training tool to help users understand how a distance relay works and how settings are performed.

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