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A NEW ADAPTIVE HYBRID NEURAL NETWORK AND FUZZY LOGIC BASED FAULT CLASSIFICATION APPROACH FOR TRANSMISSION LINES PROTECTION

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Abstract: Dynamic neural networks have been applied in system identification and control for those systems for last few years. A wide class of nonlinear physical systems contains slow and fast dynamic processes that occur at different moments. An adaptive hybrid neural networks and fuzzy logic based algorithm is proposed in this research to classify fault types in transmission lines. The proposed method is able to identify all the available shunt faults in transmission lines with high level of robustness against variable conditions such as measured amplitudes and fault resistance. In this method, a two-end unsynchronized measurement of the signals is used which can be incorporated in digital distance relays that are able to be programmed, it can also be shared and discourse data with all protective and monitoring device. The process has been carried over by a number of simulations using in MATLAB software.

Key words: Fuzzy Logic System, Adaptive Artificial Neural Networks, Transmission Lines Protection.

I INTRODUCTION

The continuous growth of the demand for a reliable power supply results in a greater emphasis on the efficient operations of power systems. Therefore, the issues related to reduction in the duration of power supply interruptions are being raised more and more. In this regards, when a fault occurs in transmission networks, it is important to estimate the fault section quickly in order to restore the stable power supply as soon as possible .So, accurate, fast, and reliable fault classification technique is an important operational requirement in modern power transmission systems.

The protection of transmission lines is very significant because large amounts of power are commonly shipped across a transmission system. Although the fundamentals of transmission lines protection were considered many years ago theoretical principles as well as practical applications are still common topics of investigation. With digital technology and advanced control strategies being ever increasingly adopted in power substations, more particularly in the protection field, protective relays have experienced some improvements, mainly related to efficient filtering methods (such as Fourier, Kalman, …etc.). As a consequence, shorter decision time has been the main objective, and was achieved in many researches.

This research work employs Adaptive Neuro Fuzzy Inference System (ANFIS). This adaptive-network-based fuzzy inference system is used mainly here for fault classification in the transmission lines. Neural network has the shortcoming of implicit knowledge representation, whereas, fuzzy logic systems are subjective and heuristic. The determination of fuzzy rules, input and output scaling factors and choice of membership functions depend on trial and error that makes the design of fuzzy logic system a time consuming task. These drawbacks of neural network and fuzzy logic systems are overcome by the integration between the neural network technology and the fuzzy logic systems.

II Design of the Proposed ANFIS for Fault Location

A parallel-series ANFIS block is designed by using the MATLAB/SIMULINK software program according to the types of fault, as shown in Fig. 2. The design consists of 10 parallel main blocks represented by integers 1 to 10 for all

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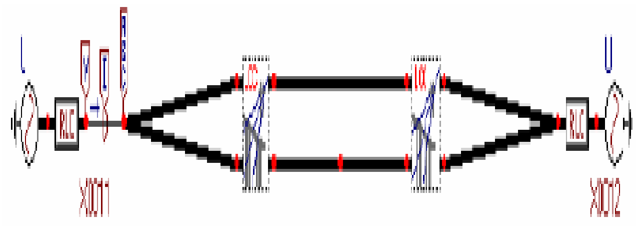
types of faults, namely, phase A to ground (AG) , phase B to ground (BG), phase C to ground (CG), three-phase (3P), phase A to phase B (AB), phase B to phase C (BC), phase C to phase A (CA), phase A and B to ground (ABG), phase B and C to ground (BCG), and phase C and A to ground faults (CAG). Each main block includes 3 parallel ANFIS blocks for fault type, point X and point Y, respectively, and it also has series ANFIS blocks for each category.

The series block is added to the design for the purpose of minimizing the percentage error. From the last series blocks, the outputs of the design are determined. The outputs are represented by the X and Y coordinates of the fault point and the type of fault as a number. There are 10 types of faults and a corresponding two-dimensional layout for the test distribution network, as depicted in Fig. 3. Therefore, the design has 30 outputs with 10 parallel main blocks and 3 parallel ANFIS blocks. For example, AG fault-1, point X for AG fault and point Y for AG fault are classified as output 1, output 2 and output 3, respectively, for the first main block. Similarly, the last (tenth) main block involves CAG fault - 10, point X for CAG fault and point Y for CAG fault, which are identified as output 28, output 29 and output 30, respectively

Fault Location for Transmission Lines Tamed with a Source of Generator The procedures for accurate fault location for transmission line tapped with a source of generator are presented in this section. The proposed fault location algorithm is based on the algorithm mentioned at section and focus on eliminating the error caused by the tapped lines. The flowchart of the proposed method is shown in. The pharos measurement units installed at both ends of the protected transmission line has been built with **'Global Synchronism Clock Generator *(GSCG)'*** to provide an extremely accurate and reliable external reference clock

III THE PROTECTION SCHEME

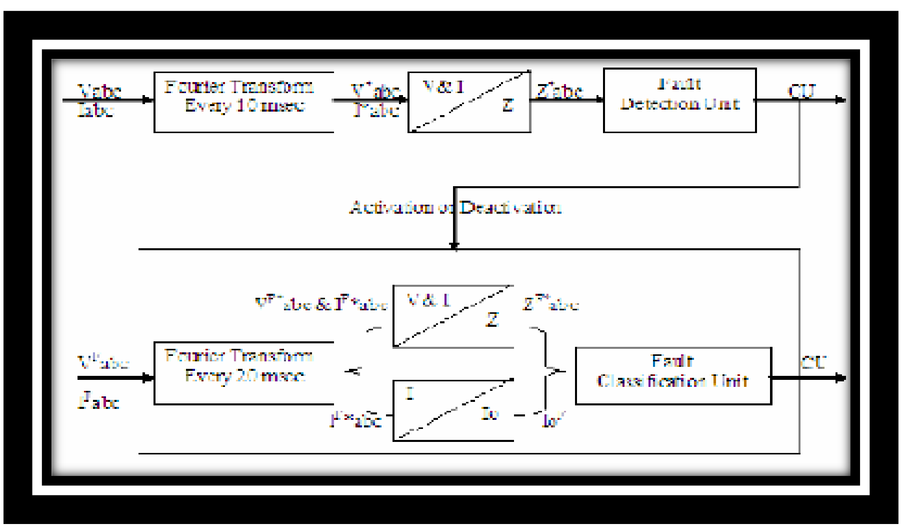


A single line diagram for the protected transmission line (T.L) is illustrated in Figure. It consists of two circuits of 80 km length, 66 kV voltage level and 2 GVA short circuit level.

The overall protection scheme can be demonstrated as :

- Vabc (V^Fabc) and Iabc (I^Fabc) are the instantaneous values of the three phase's voltage and current respectively (at fault condition).
- V*abc (V^{F*}abc) and I^*abc (I^{F*}abc) are the fundamental components (peak values and the phases) of the three phases voltage and current respectively after Fourier transformation (at fault condition).
- Z*abc (Z^{F*}abc) are the fundemantal components (magnitudes and the phases) of the three phases impedances (at fault condition).
- $_o^F$ is the zero sequence current at fault condition.
- CU is the control unit that receives the outcomes of the two units and only activates the fault classifier

IV THE PROPOSED PROTECTION SCHEME



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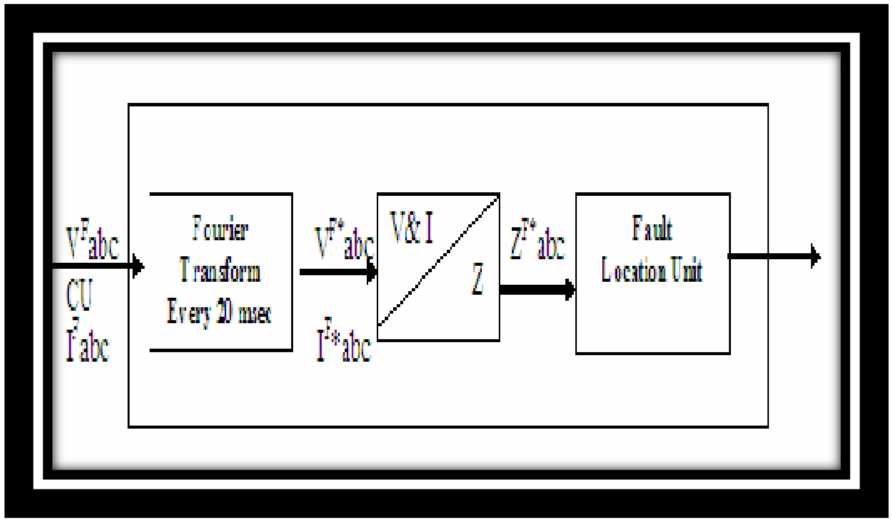
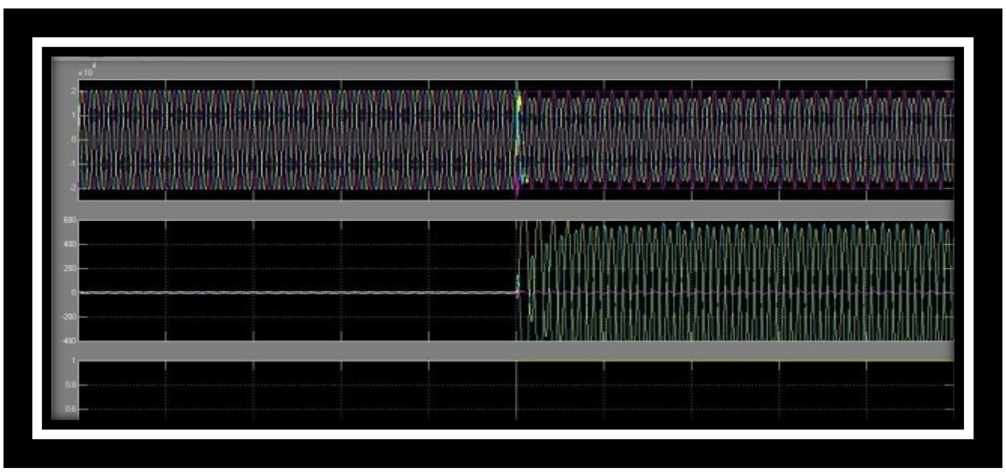
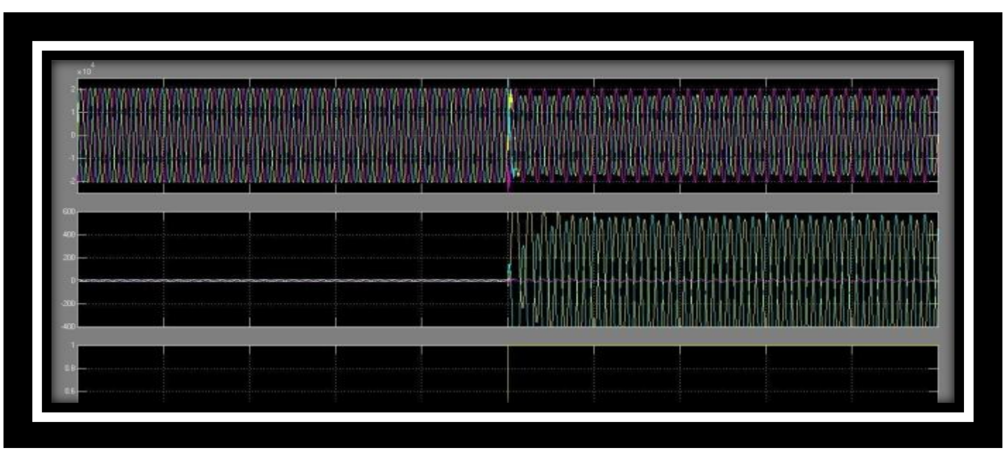
V THE PROPOSED PROTECTION LAYOUT



VI SIMULATION RESULTS





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VII CONCLUSION

This paper presents a new technique to classify fault types in transmission lines base on hybrid process of Fuzzy Inference System (FIS) and ADALINE structure. The role of the two layers ADALINE structure is first to extract fundamental frequency components of voltage and current signals and, secondly, to estimate the synchronization angle under conditions that faults occur in transmission system. To classify fault types, a FIS is developed that uses a combinations of extracted parameters by ADALINE as its inputs. Output of the FIS is a binary code that shows the fault type. The main advantage of the proposed method is that fault type classification is based on adaptive estimation of parameters that are not dependent upon fault location, fault impedance and, consequently, amplitude of measured signals at the measurement point. The simulation results evaluate performance of the proposed ADALNE-FIS fault classifier under different fault conditions

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