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Mitigating Faults and Revenue Losses Using Fault Detectors at Trans Amadi Industrial Layout, Port Harcourt Rivers State

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Abstract:** Transmission line fault detection is an important aspect of monitoring the health of a power plant since it indicates when suspected faults could lead to catastrophic equipment failure. This research looks at how to detect generator and transmission line failures early and investigates fault detection methods using Artificial Neural Network approaches. Monitoring generator voltages and currents, as well as transmission line performance metrics, is a key monitoring criterion in big power systems. Failures result in system downtime, equipment damage, and a high danger to the power system's integrity, as well as a negative impact on the network's operability and dependability. As a result, from a simulation standpoint, this study looks at fault detection on the Trans Amadi Industrial Layout lines. In the proposed approach, one end's three phase currents and voltages are used as inputs. For the examination of each of the three stages involved in the process, a feed forward neural network with a back propagation algorithm has been used for defect detection and classification. To validate the neural network selection, a detailed analysis with varied numbers of hidden layers was carried out. Between transmission lines and power customers, electrical breakdowns have always been a source of contention. This dissertation discusses the use of Artificial Neural Networks to detect defects in transmission lines. The ANN is used to model and anticipate the occurrence of transmission line faults, as well as classify them based on their transient characteristics. The results revealed that, with proper issue setup and training, the ANN can properly discover and classify defects. The method's adaptability is tested by simulating various defects with various parameters. The proposed method can be applied to the power system's transmission and distribution networks. The MATLAB environment is used for numerous simulations and signal analysis. The study's main contribution is the use of artificial neural networks to detect transmission line faults.
***Keywords:** Faults and Revenue Losses*

I. INTRODUCTION

Electric energy distribution should take place in such a way that the user gets a continuous service with a voltage value sufficient for the electrical equipment to work appropriately without interruption. However, power outages induced by defects are not unheard of in the Electrical Distribution Systems (EDS). The length of a service interruption is determined The defect identification, its opening and clearing, the position of the flaw and the repair necessary to restore the service by the protective device. The topology, namely the feeder's length and the number and length of branches and the location geographic features all impact the defect detection process and can make fault location difficult (Jie & Nan Miu, 2002). The distribution networks of electricity are responsible for providing residential, commercial and small industrial customers with secure, reliable and affordable energy. This is achieved by a constant voltage, a reactive compensation for the power factor and the provision of continuous service as near as possible to meet demand. Interruptions of service should be avoided, even if they are sometimes unavoidable. The focus of this thesis, however, is on unplanned outage situations. The most frequent forms of distribution system problems are single and double-phase faults. If one or more phases come into contact, the ground or the two might acquire these defects, resulting in disruptions of temporary or permanent service. All the important reasons for service outages include lightning strikes, animals, tree extremities, and bad weather, such as high wind and rain. Whether a failure creates a temporary or permanent failure in service depends on whether drivers, towers or other parts of the infrastructure are damaged in such an incident. It is advantageous, then, to detect and identify error occurrences as soon as possible so that appropriate steps are taken in order to reduce revenue losses.

Fault occurrences in power distribution systems are almost unavoidable and when it occurs, results to major challenges such as waste of time, stress, increase cost compulsory to locate and diagnose fault, and then do the needed repair before returning the line to service. In typical power distribution systems, various kinds of faults occur at different times for different reasons/causes such as insulation failures, short circuit conditions etc.

Early detection and location of network faults has been a major difficulty in power systems engineering, as it results in energy loss, income loss, and equipment and facility damage.

In Nigeria, the location of the defect is determined via trial and error and in most cases is dependent on the information provided by customer(s). This information in some cases result in energizing the line, piece by unit, until the defense transmit trips the tour breaker connected to the line, revealing the problematic part and then isolated. This method can be repeated as needed severally, thus subjecting these equipment to stresses and time wastage most especially if the customers report is/are technically wrong. As a result, it is critical that fault analysis and detection be completed promptly in order to restore the system quickly through various improved intelligent techniques. A better approach to Artificial Intelligent (AI) techniques such as Faster learning, fault tolerance, ability to deliver proper output in the case of partial input, and ability to distinguish variable patterns of learning and behaviours, where exact functional relationships are not well defined or easily computed are just the same as those that are used to identify faulty distribution networks (ANN).

This research demonstrated how ANN is used to detect and diagnose power distribution system failures. The detection and diagnosis of faults in power distribution network could be time consuming. The aim of using ANN is to provide faster, easier and less costly means of fault detection and diagnosis in order to increase system reliability and security. Distribution network in Trans Amadi Industrial Layout in Rivers State, Nigeria is used as a case study. Real-time line parameters will be obtained and various fault computations will be analyzed.

II. METHODOLOGY

The method adopted for this study include the development of a functional NN program in Matlab environment to detect and diagnose faults including flow chart of the fault analysis. Also test run of the program for different fault values. This were achieved by inputting patterns which contain root mean square (rms) voltage and current values before circuit breakers are activated in the event of a fault are fed into the ANN program using Matlab.

III. RESULTS AND DISCUSSIONS

A. Fault Detection

Throughout the shortcoming discovery strategy, the neural organization is given six information sources. Three voltages and three flows from every one of the three stages are utilized as sources of info. Information voltages and flows are standardized to their pre-issue esteems. The informational collection was formed considering every one of the 10 sorts of deformities just as the no shortcoming circumstance. The preparation set contains an aggregate of 8,712 info and yield tests (792 for every one of the ten deficiencies and 792 for the no-issue case), bringing about a bunch of six information sources and one yield for each info yield design. The neural organization's yield is an essential yes or no arrangement, for example 1 or 0, demonstrating whether the issue has occurred. The counterfeit neural organization engineering that was planned contains an aggregate of five layers. A 6-10-5-3-1 neural organization engineering was picked after various reenactments, for example it incorporates three secret layers of 10, 5, and 3 neurons as needs be ([5]; [4]; [2]). The straight, tansig, tansig, and log sig move capacities are utilized for layer 1, layer 2, layer 3, and layer 4, individually, and produce the best outcomes ([3]; [6]). It is clear from the preparation results that the neural organization's preparation results are agreeable. The prepared neural organization's general mean square mistake is under 0.0001, which is the foreordained worth. At the finish of the organization's preparation, the mean square blunder was 5.8095e005. Accordingly, with the predetermined information and yield, this plan is picked as awesome. The information in this set is utilized to prepare ANNs. The exhibition of the neural organization is assessed whenever it has been prepared by plotting the direct relapse plot (remembered for the tool stash) that co-relates the objectives to the yields, as shown in Figure 1. The relationship coefficient (r) shows how well the neural organization's objectives can follow changes in the yields (0 being no connection at all and 1 being finished connection). In the present circumstance, the relationship coefficient was 0.99982, demonstrating high connection.

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The quantity of cases effectively arranged by the neural organization is shown by the green slanting cells, while the quantity of cases erroneously grouped by the neural organization is demonstrated by the red off-corner to corner cells. In every one of the lattices, the last blue cell addresses the general extent of cases that have been accurately ordered in green as well as the other way around in red. It tends to be shown that the picked neural organization has an issue recognition exactness of 100%.

B. Performance of the ANN

The association amid the Drill Data Customary and the Authentication Data Set is shown in Figure 1. The link is strong, as can be shown. This indicates that the ANN's performance in correctly recognizing defects is good. Figures 2 and 3 show the Relapse FIT of the yields vs. bulls for the network, as well as the Error Histogram, which show satisfactory presentation.

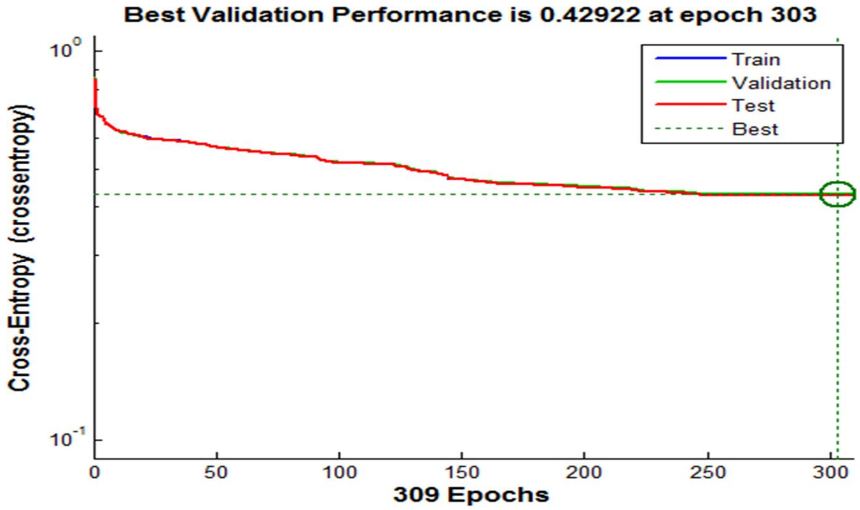

Figure 1: Performance of the Training Process

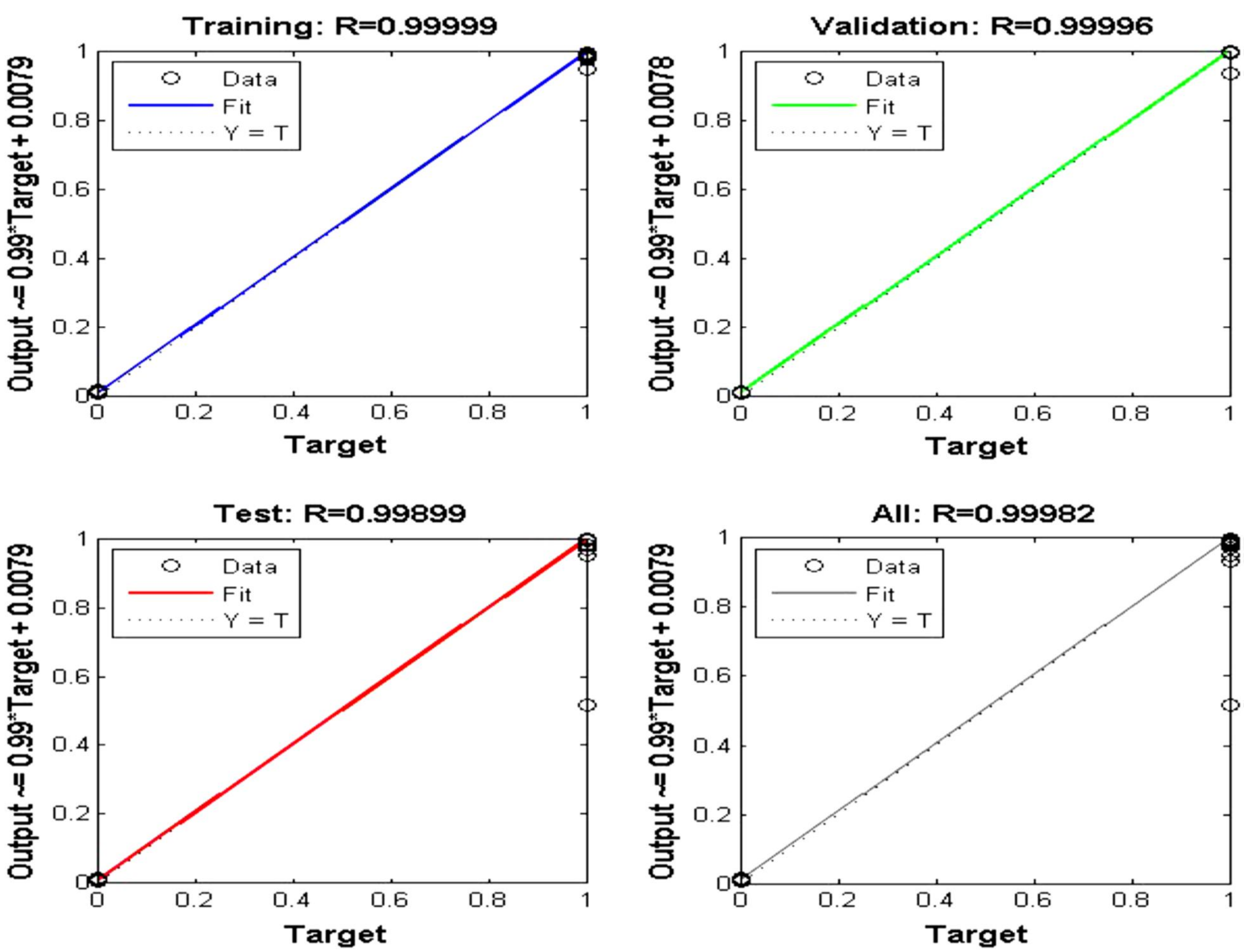

Figure 2: Regression FIT of the Outputs vs. Targets for the Network

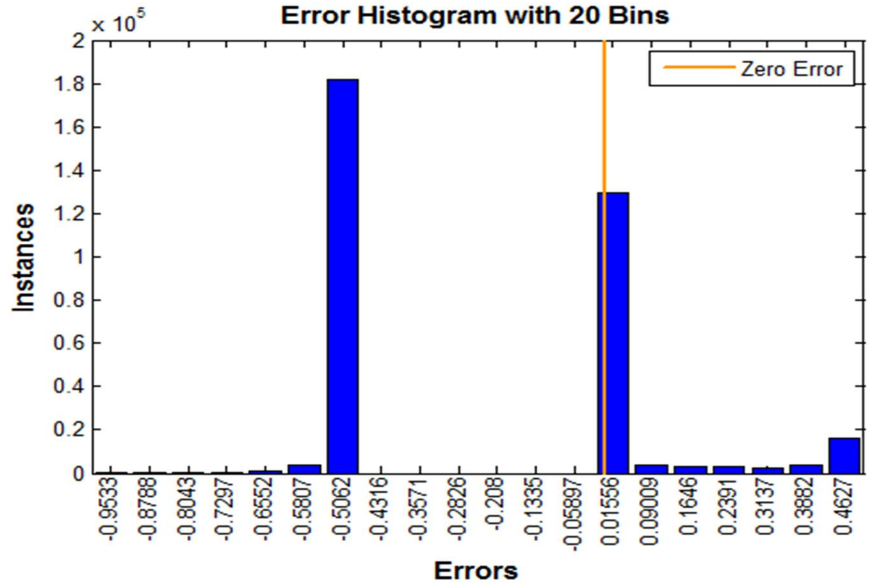

Figure 3: Performance of ANN, Showing Error

C. Simulink Simulation of the Transmission Line Power System

This part is intended to display simulation results regarding ANN Fault Detector's performance.

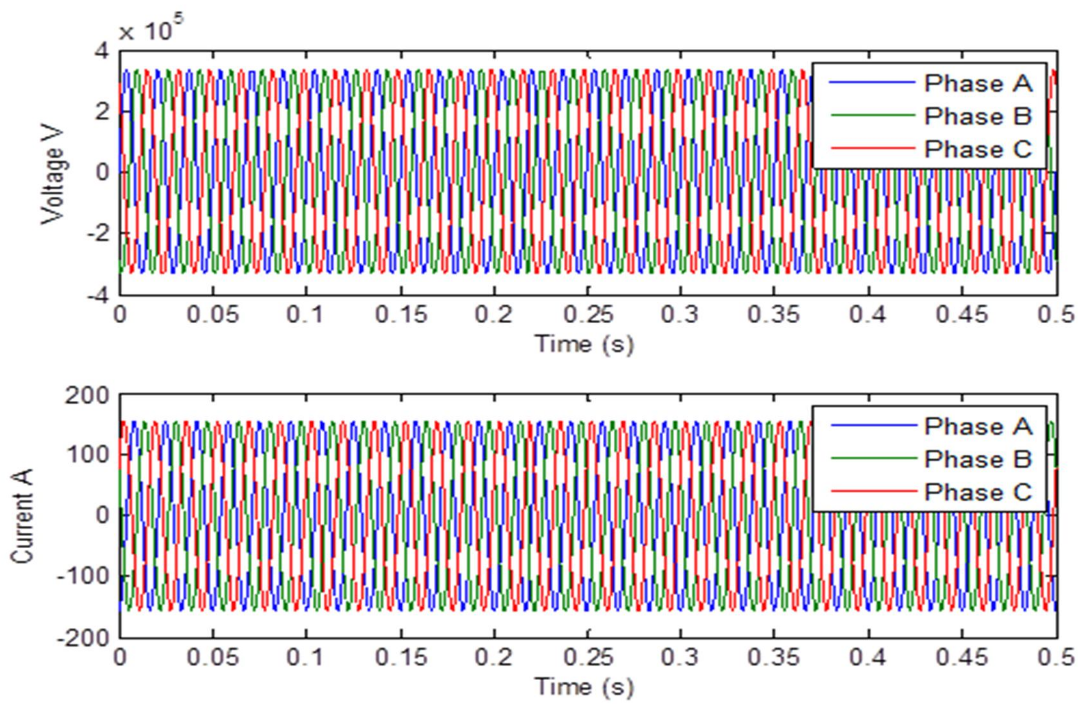

Figure 4: A Three-phase System's Typical Voltage and Current Waveforms with no Malfunction

The voltages and currents of a three-phase transmission line with no fault are shown in Figure 4. As can be observed, the oscillation frequency is 50Hz, and the voltage and current phases are 120 degrees out of phase. The output of the RMS conversion, which scales and filters the AC values, is shown in Figure 4.5. For all voltages and phases, these signals serve as inputs to the ANN.

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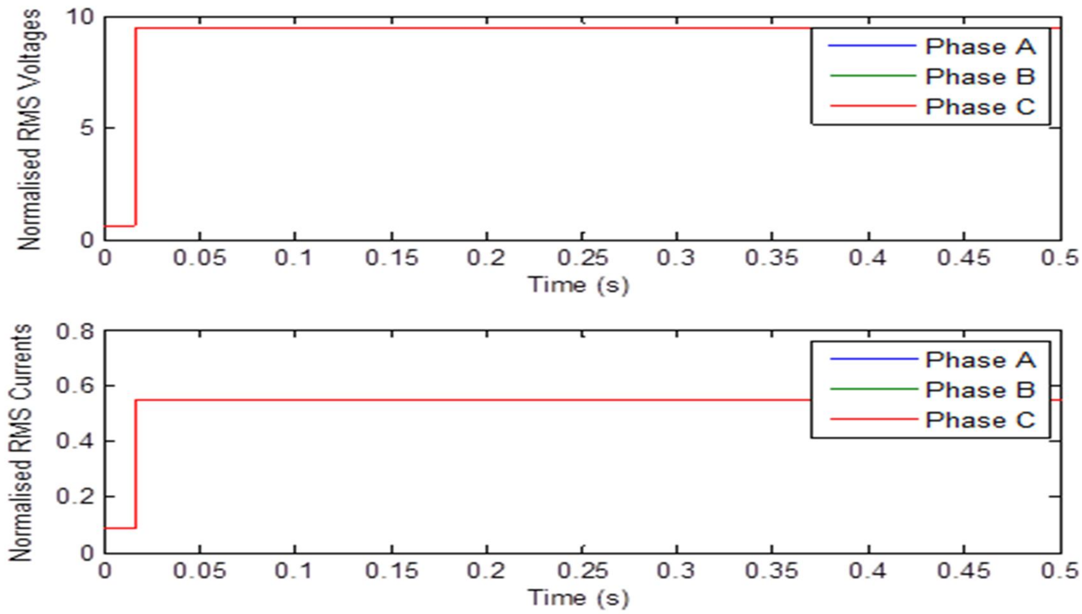

Figure 5: With no Fault, the Voltage and Current RMS Values

D. A Fault is Found in a Three-Phase System

Simulations examined various combinations of faults on transmission lines. Different forms of short-circuit defects, including line-ground (A-G), line-ground (A-B-G), and line-line-line-ground, are examined for each combination (A-B-C-G). The current and voltage waves for a phase A ground failure are shown in Figure 6. As can be observed, the Phase A voltage falls as the currents in all phases grow.

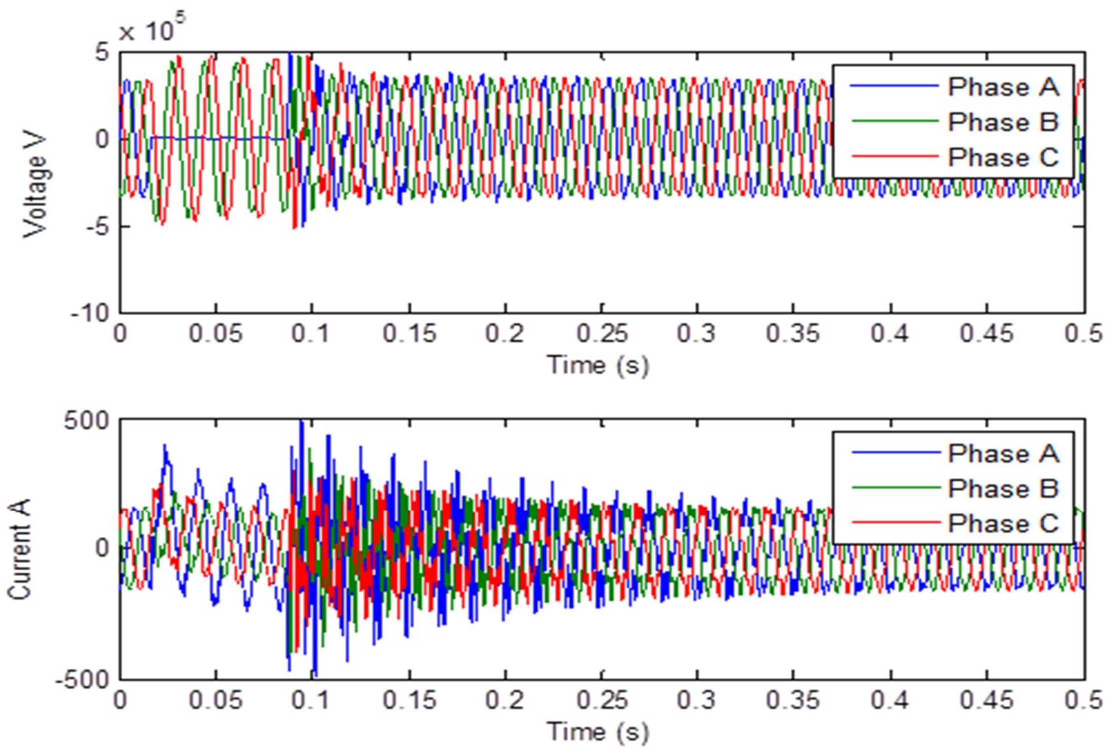

Figure 6: The Voltage and Current Waveforms for a Phase A Ground Fault with a Length of 100 Kilometers

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The ground fault's transitory impact on the performance of the AC Voltages and Currents is also noted. The signature of the transient waveforms differs for each type of fault, and this variation serves as a characteristic discriminator in ANN's classification and interpretation of fault location (see Figure 7).

Much of the flaws are illustrated in the appendix. Each error is distinctively different from the others, and these differences are aggregated to create training data sets for the ANN training process.

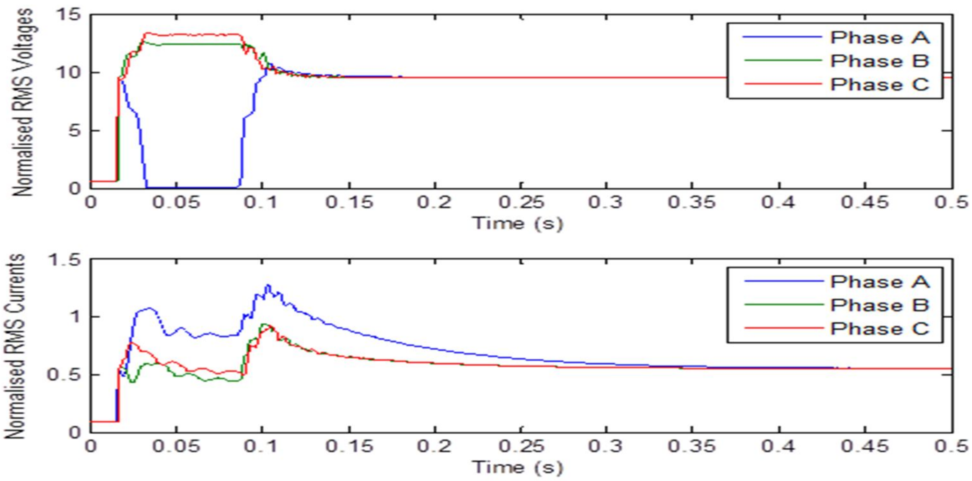

Figure 7: The RMS Voltage and Current Waveforms for a Phase A Ground Fault with a Distance of 100 Kilometers

E. The ANN Fault Detector's Performance

The ANN defect detector is shown in Figure 8. Voltage and Current inputs are normalized, filtered, and converted to RMS, as can be seen (or equivalent DC). The ANN defect detector receives these signals as inputs (area highlighted). The accuracy of the ANN fault detector is demonstrated through simulations (Figure 9).

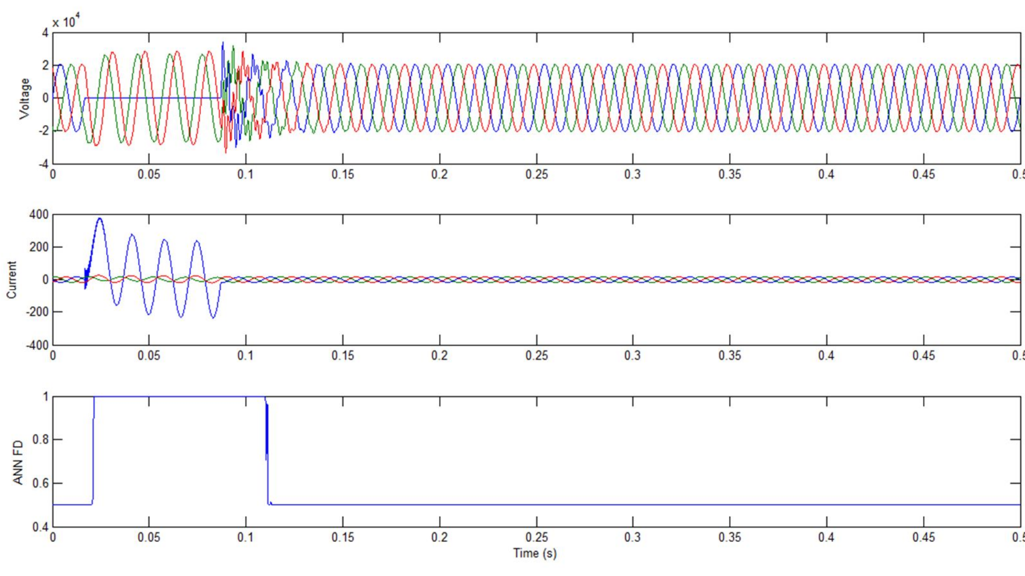

Figure 8: ANN's Reaction to a Phase A Fault

The ANN Defect Detector (ANN FD) correctly recognized the fault, as shown in Figure 9 (bottom graph). As a result, ANN is a good method for pattern identification, such as fault detection. The accuracy of the ANN FD is mostly determined by the training data and the precision of the ANN's target replies. Figures 9, 10, and 11 show more results on the ANN's performance for various defects. The ANN accurately recognizes the defect, as can be seen. Improved training data may also help to increase performance.

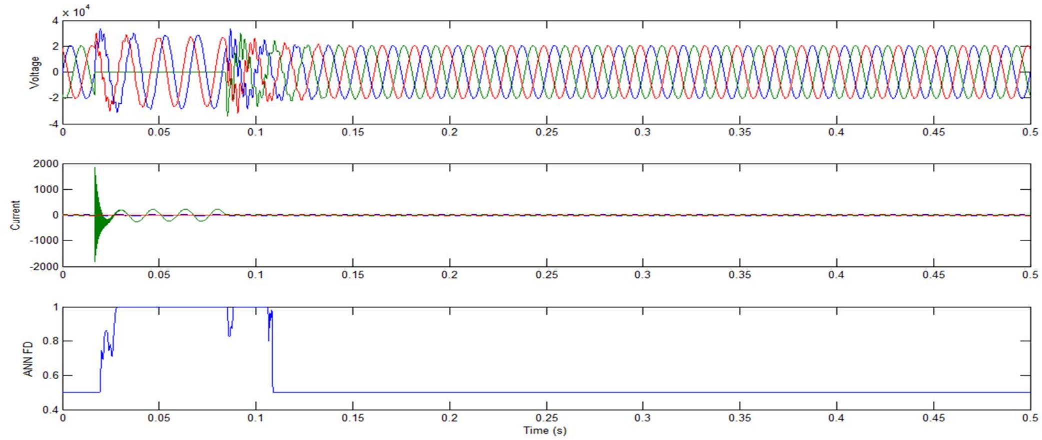

Figure 9: ANN Response to Phase B Fault

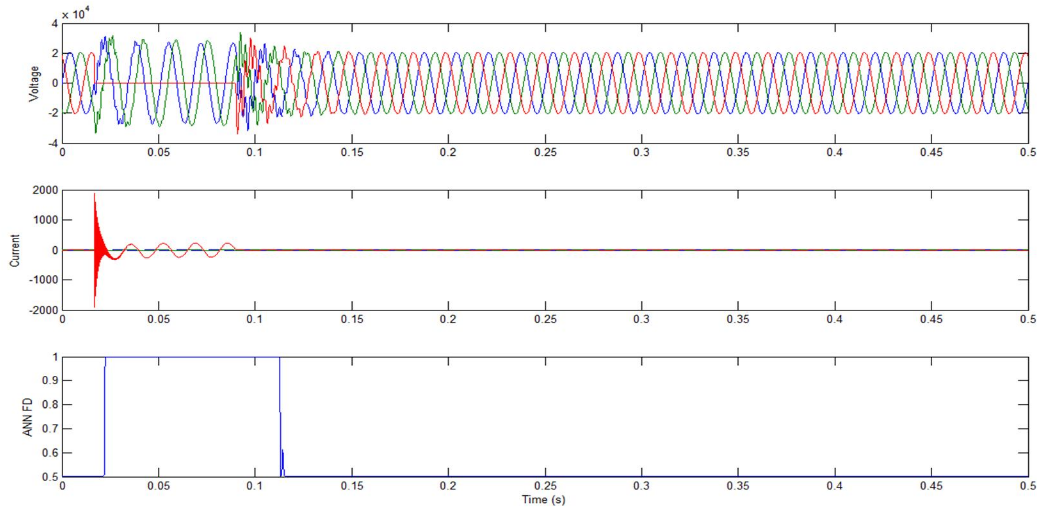

Figure 10: ANN Response to Phase C Fault

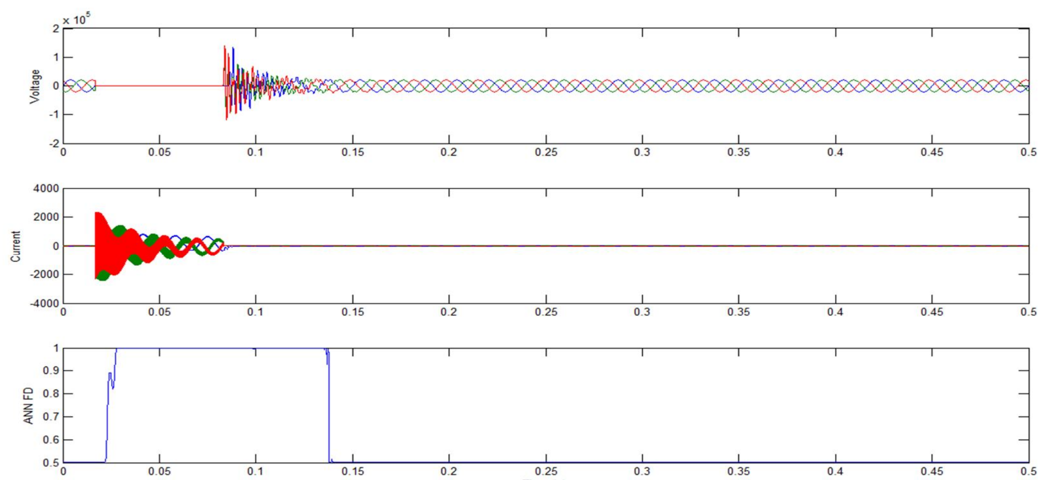

Figure 11: ANN Response to ABC Fault

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IV. CONCLUSION AND RECOMMENDATION

Because the ANN fault detector detected problems effectively and quickly, the chances of the transmission line's equipment being safeguarded are high. Furthermore, the ANN fault detection approach was put to the test and found to be accurate for all fault kinds. These findings showed that the ANN output values are precise, unaffected by point voltages or currents, and unaffected by incidence variations. We were unable to complete all of the tasks listed, particularly the location determination, which was one of the most difficult problems we faced. The basic premise of using ANN to detect transmission line faults, as well as how it is used to classify defects, has been demonstrated. Extending these findings to fault location identification would entail Prepare adequate data based on simulated fault distance and train ANN appropriately. Results indicate that recursive neural systems can be used to detect and diagnose transmission line faults.

REFERENCES

[1] Jie, W. and Nan Miu, K. (2002). A zonal-load estimation method for unbalanced, radial distribution networks. Power Delivery, IEEE Transactions on, 17, 1106 1112.
[2] Mo, Y., & Sinopoli, B. (2015). On the performance degradation of cyber-physical systems under stealthy integrity attacks. IEEE Transactions on Automatic Control, (99), 1.
[3] Lefebvre, D. (2014). Fault diagnosis and prognosis with partially observed petri nets. IEEE Transactions on Systems, Man, and Cybernetics: Systems, 44(10).
[4] Rajveer, S. (2012). Fault Detection of Electric Power Transmission Line by Using Neural Network, International Journal of Emerging Technology and Advanced Engineering, 2(12), 530 -538.
[5] Reddy M. J. and Mohanta D. K. A. (2013). Comparative study of artificial neural network (ANN) and fuzzy information system (FIS) approach for digital relaying of transmission line faults, AIML Journal, 6(4), 1-7.
[6] Rios, H., Edwards, C., Davila, J., & Fridman, L. (2015). Fault detection and isolation for nonlinear systems via highorder-sliding-mode multiple-observer. International Journal of Robust and Nonlinear Control, 25(16), 2871-2893.