International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 06 Issue: 04 | April - 2022 Impact Factor: 7.185 ISSN: 2582-3930

AN EFFICIENT FAULT CLASSIFICATION APPROACH FOR HVDC TRANSMISSION LINES : A REVIEW

Kaushlendra Pal
M.E Research Scholar Dept of Electrical
Rajasthan Institute of Engg. And Tech. Jaipur

Dolly Murodia
Assistant Professor Dept of Electrical
Rajasthan Institute of Engg. And Tech. Jaipur

Abstract: Nowadays, transmission system is an important network for meeting high load demand due to contact with the surrounding grid. Therefore, it is also essential to preserve the transmission network. Because of lesser known methods, safety of the transmission network is very difficult matter. HVDC transmission is also an essential aspect of the transmission lei. Therefore, many protection approaches explicitly for fault classification are used for the protection of the HVDC system. This paper demonstrates the use of Neural systems in HVDC framework for lack of discovery and field with their benefits and drawback that is further helpful for researcher.

Keywords: Fault Classification, HVDC, Back propagation neural network, Power system

I.INTRODUCTION

One of the critical segments in the electric powered system is a transmission line that provides a way to transfer management from age to stack. HVDC stands high voltage direct current, a wonderfully validated invention used to transmit power over significant distances using overhead transmission strains or submarine hyperlinks[1]. In an HVDC system , electrical power is taken from one point in a three-stage AC structure, converted to DC in a converter station, transferred to the receiving factor via an overhead line or link, and then switched back to AC in the other converter station and injected into the approving AC set-up. In a daily basis, an HVDC transmission has an average depth[2] of over one hundred MW and lots are in the range of 1000 – 3000 MW. In common implementations, there are also several problems that are a challenge for consumption. The high cost of converter stations[3], the difficulty of control, the generation of harmonics throughout conversion AC to DC and reactive power needs at converter stations, operational challenges in the multi-terminal system are the significant issues in DC transmission[4].

Figure 1: HVDC Transmission lines at high voltages[2]

While the main safety system for HVDC transmission is passing wave protection, the protection of derivatives and differentials is history. HVDC 's benefit is that its long-distance, point-to-point HVDC transmission implementation of information has lower total maintenance rates and reduced losses than an equivalent AC transmission system. HVDC conversion equipment at terminal stations is expensive, but the overall cost of the DC transmission-line over long distances is smaller than that for the same distance AC

line[5]. HVDC needs lesser conductor per unit distance than an AC line, as 3 components do not need to be assisted and flux density is not present.

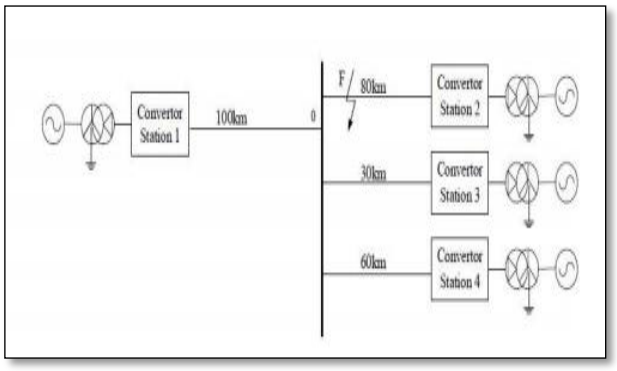

Figure 2: HVDC System Model[5]

The following is how this paper is structured. Section II describes HVDC Transmission Lines neural network. Section III and section IV analysis of literature reviews and explaining Conclusion.

II. NEURAL NETWORK IN HVDC TRANSMISSION LINE

Neural Framework is a guided learning approach, periodically. This means a set of configurations is in proximity[7]. The key aim of the ANN strategy was to deal with the problems that a human cerebrum can do comparably. In spite of this, after some time, attention passed to conduct express endeavors, triggering deviations from science. In a category of projects, bogus neural constructs were used, like PC vision, speech affirmation, device elucidation, relational interaction isolation, playing board and PC games, and psychological assurance. Neural Framework is a directed learning tool, frequently. This infers there is closeness of an arrangement set [7]. The key aim of the ANN strategy was also to resolve problems that a human cerebrum would have. In a category of tasks, counterfeit neural constructs were used, like PC vision, speech confirmation, computer translation, relational interaction isolation, board play and PC games, and helpful protection.

- **Feedforward Network :** A feedforward neural system is a computation of portrayals which is obviously convinced. It includes a (possibly huge) number of significant neuron-like ready-to-get units, dealing with in layers. In the past layer, each unit in a layer is connected to all of the units. Not all of these associations are elevated and each association may have a replacement rating or weight. The heaps on these affiliations encode frame data. The modules in a neural system are usually called centers in the same way.
- **ANN Structure:** Neural systems were developed in a wide variety of designs, in which each of them has its own individual attributes, key elements and disadvantages. Among these designs is the organization of the multi-layer feedforward that exceeds over another[8]. As a reaction to any data design it generates a yield design. Once trained, its reaction to a given knowledge will be the same paying little attention to the activity in any past method. It told it system would reveal no true causes, so there would be no intensity problems along those strains. Typically a neural network was used to refer to natural neurons as a system or circuit, but today's use of the time span frequently refers to ANN. This is a theoretical version or analytical model, for example, a statistical handling of worldview stimulated by the way natural sensory device, such as the cerebral knowledge system. ANN is made by interconnecting falsified neurons that could be modified to create artificial neuron residences. Such neurons work as one to look after particular concerns. ANN is designed to resolve problems of man-made concern without producing a replica of the authentic natural environment. ANN is used to consider dialogue, examine images, handle flexibly, and so on. These packages are achieved by means of a learning strategy that involves mastering in herbal setting, which requires altering neurons by

synaptic association[9]. Below are a couple of the Neural Networks (NN) benefits[12]

- Store information in the Network
- Ability to work with insufficient awareness
- Is tolerant of faults
- Get Memory Distributed
- Staggering corruption
- Power to train system
- The capacity to work in parallel.

Neural Network Drawbacks [16](NN)

- Focus on Hardware
- Unclear how the network functions
- The challenge of explaining the network issue

III.LITERATURE SURVEY

Kesari et Al.,[10] This paper describes the design of the classification method centered on support vector machine (SVM) for fault estimation in the HVDC transmission network. Improved classification efficiency in the feature space must be considered in the ideal hyper-plane. Thus the optimal hyper-plane is to be defined by discovering the optimization theory and supplying the important information through statistical learning theory. Thus, SVM classifier has the ability to prevent a large featured vector of space. And the suggested solution has the capacity to help in the classification of faults, as there is no limit on the number of features.

Mobarrez et al.,[11] In this paper three distinct configurations for safety reasons of solid state dc circuit breakers (CB) are examined. In addition , a new control methodology is presented to support the VSCs toward dc side fault, the new technique allows to interrupt dc fault current with existing ac breakers on the ac side or with lower solid state (SS) DCCBs. Real Time Digital Simulator (RTDS) is used to evaluate and monitor of the SS DCCBs and the new framework. Using the suggested control process, VSCs can be secured using traditional ac breakers or lower rating DCCBs, which will greatly decrease the cost of the VSC MTDC system.

Kumar et al.,[12] This article offers the identification and classification of various faults that can arise in an LCC-HVDC system, using the training algorithm approach of an artificial neural network (ANN). A full model of a 12-pulse LCC-HVDC system along with an Ann network is developed in numerical simulation software. The ANN performance will determine the change in the correct firing angle needed for the HVDC rectifier device under normal steady-state activity and different fault situations. A collection of simulation results is presented to demonstrate the efficacy of the ANN methodology that has been subjected to established fault location.

Julio ET AL., [13] This research introduces a new protection mechanism in Multi-Terminal Direct Current (MTDC) framework focusing on Artificial Neural Networks (ANNs) and Wavelet Transform (WT) for detection and tracking of faults. Assuming a generalized four terminal MTDC model with two DC lines, the suggested solution is presented and then tested against by the three-terminal MTDC network depend on the CIGRE B4 DC test system. For the production and testing of the suggested approach specific fault positions and fault resistances were introduced. The MTDC structures were developed in ATP-Draw and PSCAD, while the suggested algorithm was developed in MATLAB. The findings show that, within a few milliseconds, the suggested technique can accurately identify, recognize and locate defects.

Rohani et al.,[14] Time and Frequency Domain obtained features in the suggested protocol to enhance the precision of ANFIS output and location of faults. In addition, CDWPSO method used for ANFIS training rather than traditional approach, LS+BP. The output of CDWPSO-based ANFIS and standard ANFIS evaluated using two types of inputs in the first study: raw data (initial signal) and suggested features (six extracted features from the current signal using HH transform); The value of MSE for regular ANFIS utilizing raw data and suggested functions was approximately 0.8774 and 0.1839. Moreover, the value of MSE for ANFIS based on CDWPSO considering raw data and suggested features was

0.5128 and 0.0592, accordingly. The present work describes the high impact of both form of input and algorithm of learning. In addition, the efficacy of the suggested approach is much greater than other related fault location approaches in VSC-HVDC systems.

Li et al.,[15] This paper collects the amplitude and frequency of natural frequency as sample attributes, and suggests a fault position method for the neural network-based multi-terminal HVDC line transmission. Firstly, the branch line where the fault occurs is accomplished by the magnitude of the dominant frequency in the natural frequency spectrum, and then the faulted range is conducted using the distributed hierarchical neural network. The particle swarm optimization algorithm is used to determine the weight and threshold of BP neural network, and the network training performance is increased, and the convergence speed is accelerated. The simulation results of PSCAD and MATLAB demonstrate that the fault location method has high reliability and accuracy.

Ankar et al.,[16] The suggested work introduced an accurate way to estimate the fault location for bipolar Current Source Converter (CSC) focused on High Voltage DC transmission system using ANN with the combination of WT. The suggested approach uses the extracted features of AC sinusoidal voltage, DC voltage and current signals obtained at both poles of the rectifier end in the line. The input signals are sampled at 1 kHz which is less in comparison with the other existing strategies . The numerous simulation outcomes validate the efficiency and stability of the suggested ANN-based strategy to deviation in the fault resistance and various fault locations. The suggested approach estimates the position of fault with mean percentage error of 0.0289 %. The benefit of this technique is that it does not require any telecommunications network, since it uses only rectifier end measurements.

Jenifer et al., [17] Using K-nearest neighbours, implemented a novel fault detection and classification strategy for high voltage DC transmission lines. The technique finds use of AC RMS voltage rectifier top, DC line voltage, and calculated current at both poles. These signals are produced using PSCAD / EMTDC and analyzed and processed further with MATLAB. For identification of faults, the signals are monitored regularly to determine the instant of fault occurrence, while for identification of faults, the standard deviations of the data over a half cycle (with respect to AC signal) are measured before and after the instant fault inception.

IV.CONCLUSION

Classification of faults is essential part needed for the safety of the power system. If problem happens, to minimize the damage to the power grid, it should be marked and found in a short period of time. It can be stated that the NN is fastest of all the known fault classifier to identify the faults of various class. The consistency of classification and detection of faults is most critical in protecting the power system since if fault is misclassified and incorrectly identified, there is a risk that a safe section will be separated from the rest of the system and a defective section will stay in the system that is very dangerous for the entire power system. In this paper, a NN-based development scheme was addressed to identify defects on the AC side as well as DC transmission lines with the rapid advances in microprocessors of the moving wave system in HVDC safety currently being used.

REFERENCES

[1] S. Kumar , R. Singh, “Fault detection and classification in electrical power transmission system using artificial neural network” Springer,Plus, pp. 1- 13, 2015.

[2]F., Sami Ekici, “A Fault Location Technique for HVDC Transmission Lines using Extreme Learning Machines”, ICSG,2017.

[3] S. Zangana, , E., “Enhance Power Quality by HVDC System, Comparison Technique between HVDC and HVAC Transmission Systems”, International Journal of Electrical

Energy Electron Communication ,volume 10, Issue 2, pp. 271–279, 2016.

[4] J. Beerten, O. Gomis-Bellmunt, X. Guillaud, J., , "Modeling and control of HVDC grids: A key challenge for the future power system", Power Systems Computation Conference, PSCC , 2014.

[5] K. Chan-Ki, V. K. Sood, S. J. Lee, HVDC Transmission: Power Conversion Applications in Power Systems, 2009.

[6] I.Baqui, I. Zamora, J.,"High impedance fault detection methodology using wavelet transform and artificial neural networks" Elsevier, pp. 1325–1333, 2011.

[7] A. , Jaya Laxmi, "Fault Identification in HVDC using Artificial Intelligence , Recent Trends and Perspective" IEEE, pp. 1-6, 2012.

[8] Preeti Gupta, R. N. Mahanty, "Artificial Neural Network based Fault Classifier and Locator for Transmission Line Protection", IOSR-JEEE, Volume 11, Issue 1 ,PP 41-53,2016.

[9] F.Dehghani, H. Nezami, "A New Fault Location Technique on Radial Distribution Systems Using Artificial Neural Network", 22nd International Conference on Electricity Distribution, pp. 1-4,2013.

[10] Keshri, J. P., Tiwari, H. , "Fault Classification in VSC-HVDC Transmission System using Machine Learning Approach", 8th International Conference on Power Systems (ICPS),2019.

[11] Mobarrez, M., Bhattacharya, S. , "A Novel Control Approach for Protection of Multiterminal VSC-Based HVDC Transmission System Against DC Faults", IEEE Transactions on Industry Applications, Volume 52,Issue 5,pp. 4108–4116,2016.

[12] Sanjeevikumar, P., Paily, B., Conlon, M. , "Classification of fault analysis of HVDC systems using artificial neural network", 49th International Universities Power Engineering Conference (UPEC),2014.

[13] Julio O., Ricardo S. , "New Method Based on Wavelet Transform and ANN for Multiterminal HVDC System Protection", IEEE,2019.

[14] Rohani, R., Koochaki, A., " A Hybrid Method Based on Optimized Neuro-Fuzzy System and Effective Features for Fault Location in VSC-HVDC Systems", IEEE Access,Volume 8, 2020.

[15] Li, T., Han, Y., Jiao, Z., Mu, Y. , "Fault Location of Hybrid Three-terminal HVDC Transmission Line Based on Neural Network", IEEE 3rd International Electrical and Energy Conference (CIEEC),2019.

[16] Ankar, S., sahu, U., Yadav, A., "Wavelet-ANN Based Fault Location Scheme for Bipolar CSC-Based HVDC Transmission System", First International Conference on Power, Control and Computing Technologies (ICPC2T),2020.

[17] Chen, Mou-Jie, S., "Machine learning based one-terminal fault areas detection in HVDC transmission system", 8th International Conference on Power and Energy Systems (ICPES), pp. 278-282. IEEE, 2018.