

Review: Different Technology for Transmission Line Protection

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Abstract— This paper provides a review of the traits in protection scheme for entire covering of transmission line safety and protection. For an up consequently far electrical power system, selective high-speed clearance of faults on excessive voltage transmission line is critical and this survey indicates the economy constraints and promising implementations for fault detection, classification and fault location in power line protection. The working of this field exhausted this are want processed relays, digital communication technologies and opportunity technical tendencies, to keep away from cascading failure occurs and facilitate safe, stable and reliable electrical power systems. The most important target of this paper is on the main current techniques, like artificial neural network (ANN), mathematical logic, fuzzy-neuro (NFC), mathematical logic judgment rippling based totally and phasor measuring unit-primarily based ideas yet as opportunity standard techniques applied in cable.

Keywords: ANFIS, Wavelet Transform, Transmission Line Protection

I. INTRODUCTION

Transmission strains are a few of the power systems components with the absolute exceptional fault occurrence rate, since they are uncovered to the environment. Line faults due to lightning, storms, vegetation fall, fog and salt spray on grimy insulators are past the control of man. The balanced faults in the course of a cable are three-section shunt and 3 phases to ground circuits. Single line-to-ground, line-to-line, and double line-to-ground faults are unbalanced in nature. On transmission, the protecting relaying system is incorporated to discover the atypical alerts indicating faults and isolate the faulted element from the remainder of the machine with minimal disturbance and device damage.

Methods for fault detection, classification, and location in transmission lines and distribution structures are intensively studied over the years. With the concepts related to the clever grid attracting developing problem among researchers, the importance of building an wise fault tracking and diagnosis system capable of classifying and locating differing sorts of faults can't be overstated.

The beyond 20 years have witnessed the rapid improvement in various fields regarding the detection, classification, and site of faults in power systems. The advances in sign processing strategies, AI and electrical system learning, a global positioning system (GPS) and communications have enabled increasingly more researchers to carry out research with excessive breadth and intensity therein the boundaries of conventional fault protection strategies are often stretched. Furthermore, two essential regulations of on line fault detection and diagnosis systems also are being solved. The first restrict is that the problem in records acquisition. Additionally to standard size equipment

form of a capability transformer, present day transformer and therefore the faraway terminal unit, newly advanced digital devices (IEDs) are being deployed [1] to urge facts at more than one nodes within the grids. Self-powered non-intrusive sensors also are being evolved with the potential to make sensor networks for smart online monitoring of smart grids [2, 3]. With more facts available, researchers are capable of develop intelligent fault diagnosis systems via mining knowledge from the statistics like unique conditions.

The effect of complex and varied network configurations can also be removed when this and voltage indicators are often collected by interspersed sensors which are considerable in number. The second restriction is that the shortage of communication data exchange and computation capability. The capacity of GPS-based synchronized sampling and high-speed broadband communications for IEDs in power grids were stated in [1]. The appliance of phasor measurement devices has additionally received wide attention and a fast introduction of which is located in [4]. These technical enhancements can assure a quick reaction to faulty situations and therefore the proper functioning of on line monitoring systems supported sensor networks. The computational ability of computer systems has additionally rises rapidly. High-performance computing answers like server clusters are able to finish dispensed computing obligations within a genuinely short period of a few time, thus allowing methods with higher computation complexity to be implemented.

II. DIFFERENT TECHNIQUES FOR TRANSMISSION LINE PROTECTION

The presence of series-related FACTS devices like TCSC, TCPST and UPFC etc. Can notably have an effect at the performance of a distance relay at some point of a two-terminal tool linked by the usage of a double-circuit transmission line. The performance characteristics of the series-connected FACTS devices, their places at the transmission line, the fault resistance specially the pinnacle ones make this hassle more extreme and complicated. The fault location concerning the position of the FACTS devices additionally substantially impact the trip boundaries of the transmission line distance relay. For this purpose, the author present supported impedance calculations for relaying of double circuit transmission line with varying parameters [1] of the FACTS gadgets and site. The observe well-known the adaptive nature of the safety scheme that requirements the use of an ANN-primarily based process for the era of adventure barriers throughout fault conditions.

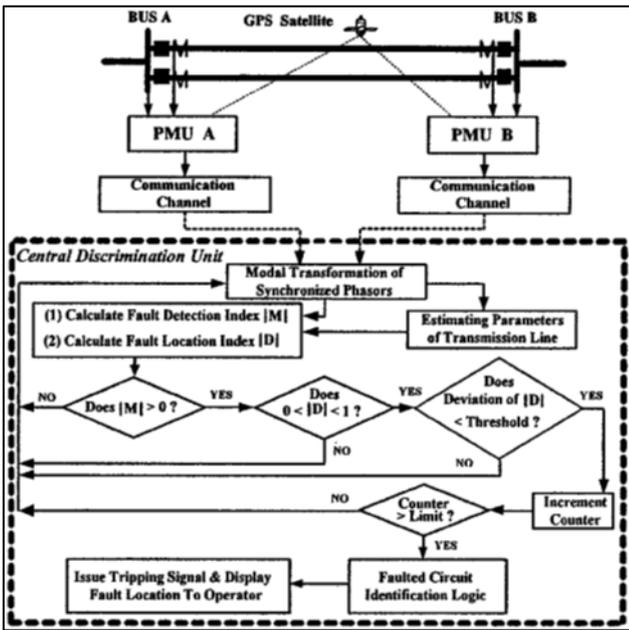


Fig. 2: Phasor measurement unit (PMU) based protection SYSTEM [2]

New adaptive phasor measurement (calibration) unit (PMU) based protection system scheme for every transposed and un-transposed parallel and double circuit transmission lines [2] turn out to be presented. The event of the scheme is predicated on the allocated line version and therefore the synchronized phasor measurements at both ends of lines. By way of Eigen value/Eigen vector idea to decouple the mutual coupling results among parallel lines, the fault detection and place indices are derived. The proposed indices are utilized in coordination such the interior and out of doors external fault activities are regularly remarkable completely. By on line estimating the transmission line parameters under the particular energy grid conditions, the proposed scheme will respond greater as it should be to power grid faults. The system accuracy of the fault area accomplished changed into as a good deal as 99.9%.The proposed protection systems responds properly and fast close to dependability and security.

The truly one in all the approach consists [3] of a preprocessing module supported discrete wavelet transforms (DWTs) together with an synthetic neural network (ANN) for detecting and classifying fault activities. The DWT acts as an extractor of distinctive capabilities within the input signals on the relay region. This information end up then transferred into an ANN for classifying fault conditions. A DWT with quasi ideal overall performance for the preprocessing degree is moreover presented.

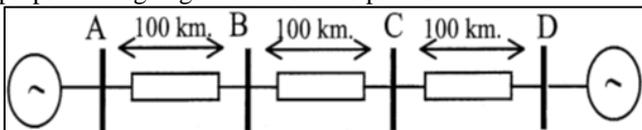


Fig. 2: ANN and wavelet based transmission line protection model [3]

The scheme is based upon at the 3 line voltages and therefore the six line currents [4] of the 2 parallel transmission traces at every end. Fault detection, fault discrimination, and calculation of the phasors of the measured indicators had been done through manner of the

usage of wavelet transform (WT). Internal faults at the parallel strains were often diagnosed by means of evaluating the magnitudes of the estimated current phasors of the corresponding ranges on each transmission line. Also, via calculating the gap info of the levels on which a power system equipments disturbance became detected and having truly small modern-day difference importance can beautify and support the scheme.

One era proposed [5] an integrated actual system time fault detection and assessment device for transmission line. The primary techniques utilized inside the fault analysis tool, fuzzy adaptive resonance theory (ART) neural community and synchronized sampling, gives correct fault detection, classification, internal/out of doors fault differentiation, and fault location. The methodology makes numerous extensions of the twin strategies in order that they will in shape well within the sensible or faulty situations. The hardware configuration and software program implementation are proposed all through this technique. A complete evaluation have a look at is performed to healthful the proposed fault evaluation device with the everyday distance relay. Both dependability and protection of transmission line protection equipments are progressed by the usage of the proposed tool. For this cause one method proposes an advanced analysis supported wavelet remodel and self-organized neural community [6]. The measured voltage and modern-day indicators are preprocessed first then decomposed using wavelet multi resolution evaluation to get the immoderate frequency info and low frequency approximations.

The distinct pattern of records set formed supported high-frequency signal additives are prepared as inputs of neural network #1, whose project is to thing whether or not or now not the fault is internal or external. The patterns shaped using low-frequency approximations are organized as inputs of neural network #2, whose challenge is to factor the right fault type.

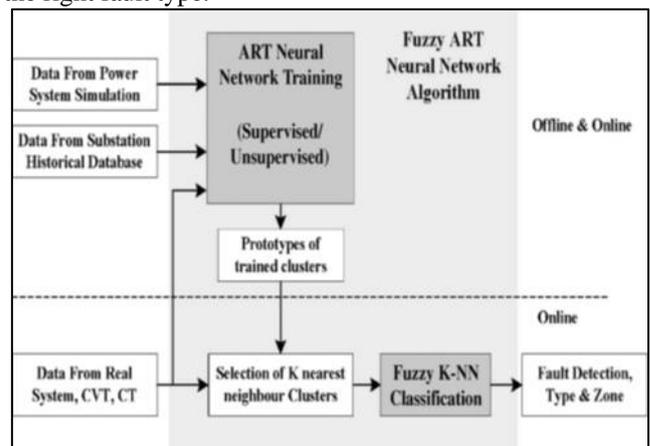


Fig. 4: Application of Fuzzy ART neural network for fault detection and classification

The new method uses each low and high-frequency statistics of the fault signal to apprehend a complex line safety scheme. The proposed method is verified using frequency-set up cable version and consequently the take a look at consequence prove its advanced performance.

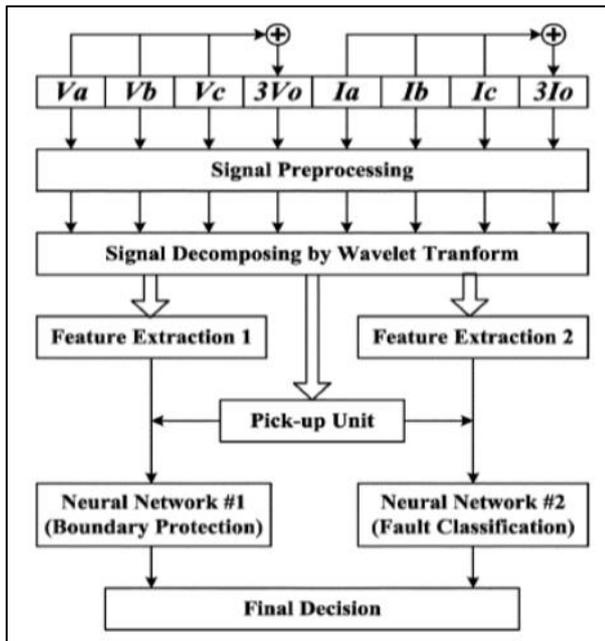


Fig. 5: Overview of the proposed protection scheme using wavelet transform & ANN [8]

The advanced Application of Artificial Intelligent Approaches become delivered nowadays in Protection of cable in electrical strength Systems (EPS). These approaches started out with introducing Fuzzy logic (FL) in the last many years of the remaining century. Furthermore, Artificial Neural Network (ANN) become delivered to tackle special troubles in EPS. One among these critical troubles is that the Protection of cable with precise lengths. In without a doubt one in all proposed research, the device of Adaptive Neuro-Fuzzy Inference System (ANFIS) for Distance Relay Protection for long cable in electric power systems (EPS) [7] was added. The proposed approach specializes in fault detection, classification, and placement in prolonged Transmission lines. Furthermore, of these issues are going to be addressed in details. The ANFIS are often regarded as a fuzzy system, a neural network or fuzzy neural community. The aim of this technique is making use of the ANFIS approach on protection of prolonged Transmission lines. It aims; firstly, to find out the fault incidence in very brief time and isolate the faulty section of the prolonged transmission lines. Secondly to categorise the fault type and deduce which of the 3 degrees are uncovered to the fault. Finally, finding the fault are going to be achieved effects even the manner right here is definitely one in all a type from brief and medium transmission lines. The input report of the ANFIS detection devices are first of all derived from the essential values of the voltage and current measurements (the usage of virtual signal processing through Fourier transform).

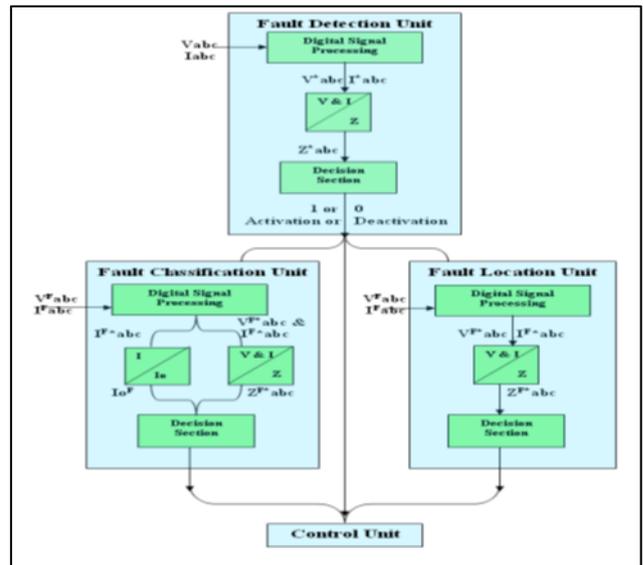


Fig. 6: The Proposed Protection scheme uses ANFIS [7]

Current differential protection relays scheme are widely finished to the protection of electrical equipments to their simplicity, sensitivity and balance for inner and out of system faults (external fault). The proposed concept has the function of unit protection relays to shield high electricity transmission grids supported phasor size units [8]. The precept of the protection scheme relies upon on comparing high-quality collection voltage magnitudes at every bus at some stage in fault situations interior a system safety middle to come across the closest bus to the fault. Then the differences fine sequence contemporary series cutting-edge angles are in comparison for all transmission traces connecting to the prevailing bus to find the faulted line. The new approach relies upon on synchronized phasor measuring generation with immoderate speed conversion device and time switch GPS system. The simulation of the interconnecting power system is performed on 500 kV Egyptian network the usage of Matlab Simulink. The new technique can successfully distinguish between inner and out of external faults for interconnected traces. The new protection scheme works as unit protection system for low voltage transmission lines. The time of fault detection is predicted by way of 5miliseconds for all fault conditions and therefore the relay is evaluated as a back-up relay supported the power exchange pace for records transferring.

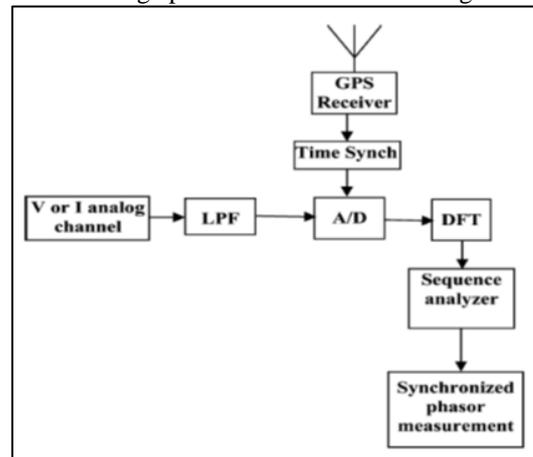


Fig. 7: Synchronized phasor measurement block diagram [9]

A new approach supported blended Wavelet Transform-Extreme Learning Machine (WT-ELM) technique for fault phase identification (whether the fault is earlier than or after the collection capacitor as located from the relay point), elegance and site within the path of a sequence compensated cable [9] turned into presented. This method makes use of the samples of fault currents for half of cycle period from the inception of fault. The competencies of fault currents are extracted by using first stage decomposition of the signals samples using discrete wavelet transform (DWT) and consequently the extracted functions are carried out as inputs to ELMs for fault segment identification, type and site. The feasibility of the proposed technique has been examined on a four hundred kV; three hundred km series compensated lines for all of the ten forms of faults the use of MATLAB simulink. On trying out 28,800 fault times with varying fault resistance, fault inception angle, fault distance, load angle, percentage reimbursement degree level and deliver impedance, the general overall performance of the proposed technique has been located to be quite promising.

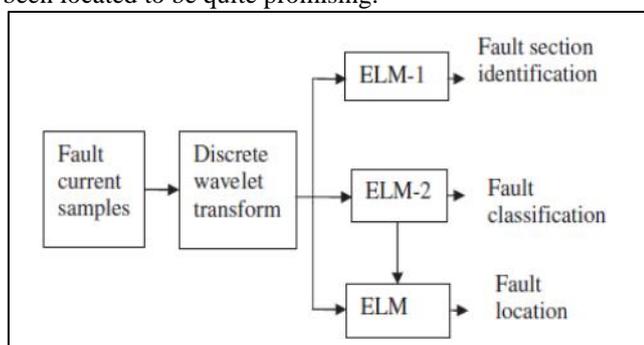


Fig. 8: Block diagram of the proposed method for protection of series compensated transmission line using WT-ELM [9]

Conclusion

A assessment of transmission line safety is completed thru this paper. Since the implementation of digital (microcontroller) relaying, maximum of work has been carried out to beautify the overall performance of digital protection relays, but in the context of reformation inside the power enterprise and operation of transmission lines on the point of the steadiness limits, new system and algorithms are needed to take care of system reliability and safety inside a appropriate level. The ANN, fuzzy logic, genetic algorithm, SVM and wavelet-based strategies are quite successful however are not good enough for this time-varying network configurations, electricity grid operating conditions and events. Therefore, it appears that there can be a large scope of research in AI techniques a good way to simplify the complicated nonlinear systems, realize the cost-effective hardware with right modification inside the mastering approach and preprocessing of input data and which can be computationally a whole lot simpler. Also, the occasion of dependable software and communiqué tool will pave the manner for higher relaying and fault area performance using multi-terminal synchronized phasor measurements supported GPS. This paper is an try to present the maximum comprehensive set of references on the topic of recent strategies in transmission line protection.

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