Ann based Shortcoming Area in HVDC Transmission Line

C. Poongothai, K. Gayathri

Abstract: ***This paper is to ponder the use of Neural systems for shortcoming discovery and area in HVDC framework. The proposed Neural system learns examples and relationship on transient information. The Back-propagation algorithm has the ability to match map complex and nonlinear input - output behavior. A MATLAB model was created for the 500kv,1000MW,12 pulse-based converter-based distribution system and various fault events were simulated. The limitations of AC over long transmission lines has led to the use of DC for bulk transmission over long distances. Fault condition like rectifier fault, inverter faults and transmission line faults are discussed in this paper.***

Keywords **:** ***HVDC, Wavelet, ANN, Faults, Rectifier, Inverter.***.

I. INTRODUCTION

A Transmission line is one of the essential segments in electric powered power framework which offers a way to move manage from age to stack. HVDC represents high voltage direct go with the flow, a nicely-validated innovation used to transmit power over lengthy separations by using overhead transmission strains or submarine hyperlinks. In a HVDC framework, electric power is taken from one point in a three-stage AC organize, changed over to DC in a converter station, transmitted to the getting factor by means of an overhead line or link and afterward changed over lower back to AC in any other converter station and infused into the accepting AC set up. Regularly, a HVDC transmission has an evaluated depth of greater than a hundred MW and lots of are within the 1,000 – 3,000 MW [1].

In producing substation, AC power is created in which it can be changed over into DC by utilizing a rectifier. In HVDC substation or converter substation rectifiers and inverters are set at both the parts of the bargains. The rectifier terminal changes the AC to DC, while the inverter terminal proselytes DC to AC. The DC is streaming with the overhead lines and at the client end again DC is changed over into AC by utilizing inverters, which are put in converter substation. The power continues as before at the sending and getting parts of the bargains. DC is transmitted over long separations since it diminishes the misfortunes and improves the effectiveness.

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C. Poongothai, Pursuing Ph.d in Electrical Engineering Annamalai University,India.
K.Gayathri , Assistant Professor, Annamalai University, India.

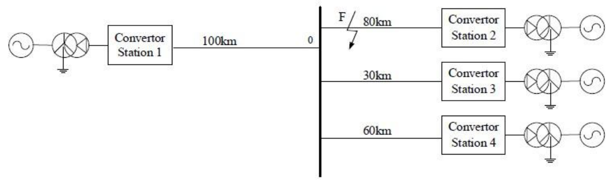

Fig.1. HVDC System Model

DC lines are less expense of DC terminal gear is high when contrasted with AC terminal links (appeared in the diagram underneath) [10-15]. In this manner, the underlying expense is high in HVDC transmission framework, and it is low in the AC framework.

A schematic graph of a four-terminal HVDC framework is regarded in Fig.1 and the reproduction is achieved with MATLAB. The HVDC transmission line contains of 1 overhead line a part of 100 km long and 3 link parts of 80, 30 and 60km.

II. MODELLING OF HVDC SYSTEM

The number one parts of a HVDC transmission framework are converter stations wherein exchange from AC to DC (Rectifier station) and from DC to AC (Inverter station) are performed. A point to point transmission requires converter stations. The process of rectifier and inverter stations can be switched (bringing about strength inversions) by using suitable converter manipulate. In creating substation, AC power is produced which can be changed over into DC by utilizing a rectifier. In HVDC substation or converter substation rectifiers and inverters are put at both the parts of the bargains [20-25]. The DC is streaming with the overhead lines and at the client end again DC is changed over into AC by utilizing inverters, which are set in converter substation. The power continues as before at the sending and getting parts of the bargains. DC is transmitted over long separations since it diminishes the misfortunes and improves the productivity. Fig 2.shows Bipolar link.

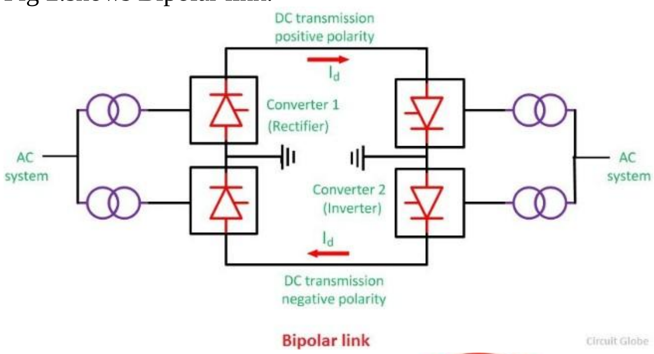

Fig.2.Bipolar link.

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The Bipolar connection has two conductors one is positive, and the other one is negative to the earth. The connection has converter station at each end.

The midpoints of the converter stations are earthed through terminals. The voltage of the earthed anodes is simply a large portion of the voltage of the conductor utilized for transmission the HVDC [16-20]. The most noteworthy favourable position of the bipolar connection is that if any of their connections quit working, the connection is changed over into Monopolar mode due to the ground return framework. The half of the framework proceeds with provisions the power. Such kinds of connections are normally utilized in the HVDC frameworks.

III. NEURAL NETWORK IN HVDC TRANSMISSION LINE

Neural Framework is, regularly, a managed methodology for learning. This suggests there is proximity of an arrangement set. The main target of the ANN approach was to handle issues comparably that a human cerebrum would. Regardless, after some time, thought moved to performing express endeavours, provoking deviations from science. Counterfeit neural frameworks have been used on a grouping of endeavours, including PC vision, talk affirmation, machine elucidation, relational association isolating, playing board and PC games and therapeutic assurance. Neural Framework is, regularly, a directed technique for learning. This infers there is closeness of an arrangement set [2]. The principal goal of the ANN approach was to deal with issues also that a human cerebrum would. Regardless, after some time, thought moved to performing unequivocal tasks, inciting deviations from science. Counterfeit neural frameworks have been used on a grouping of assignments, including PC vision, talk affirmation, machine translation, relational association isolating, playing board and PC games and helpful assurance.

A. Feedforward Network

A feedforward neural framework is a naturally persuaded portrayal computation. It contains a (possibly enormous) number of essential neuron-like getting ready units, dealt with in layers. Every unit in a layer is related with all of the units in the past layer. These affiliations are not all ascent to: each affiliation may have a substitute quality or weight. The heaps on these affiliations encode the data of a framework. Routinely the units in a neural framework are in like manner called centres.

B.ANN Structure

Neural systems have been created in a wide assortment of designs, where every one of them has its individual attributes, focal points and drawbacks. Among these designs the mufti-layer feedforward organize which outperforms every one of others [3-7]. It processes a yield design as a reaction to some info design. When prepared, its reaction to a given information will be the equivalent paying little respect to any past system movement. This advised this device would not show any true factors, and along those strains would not have strength issues. Customarily neural machine became utilized to allude as machine or circuit of natural neurons, yet present day use of the time period regularly alludes to ANN. This is scientific version or computational model, a statistic handling worldview for example stimulated by the way natural sensory gadget, for example, cerebrum information framework. ANN is produced from interconnecting counterfeit neurons which might be customized like to replicate the residences of natural neurons. These neurons working as one to take care of explicit problems. ANN is arranged for tackling man-made attention issues without making a version of authentic natural framework. ANN is applied for discourse acknowledgment, picture investigation, flexible manage and so on. These packages are accomplished through a learning technique, which include mastering in herbal framework, which includes the alteration between neurons via synaptic association [8]. Same arise inside the ANN.

IV. PROPOSED TECHNIQUE FOR HVDC TRANSMISSION FRAMEWORK DEPENDENT ON NEURAL SYSTEM

The essential line protection structure for HVDC transmission line uses both the voltage level and its pace of advancement to perceive ground faults on the DC line. Reinforcement line security incorporates DC over-voltage insurance and DC line differential assurance. In any case, the pace of voltage change is low for high impedance issues and multi-stage air conditioning shortcomings may befuddle the voltage level unit. With fast advance of microelectronics innovation, voyaging wave hypothesis-based security has been actualized and received in genuine air conditioning and DC frameworks.

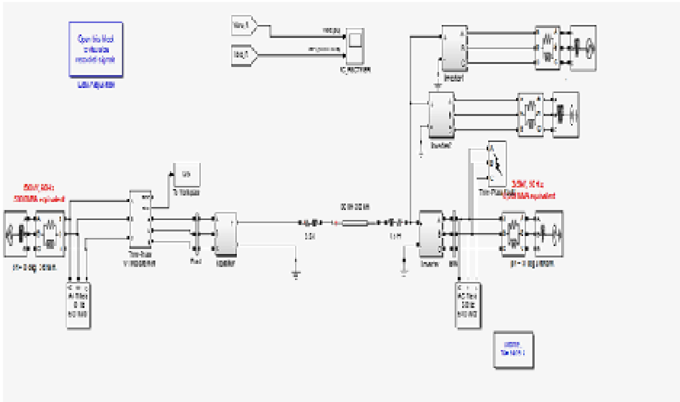

Fig.3. Simulink Block Diagram of HVDC Transmission System

Voyaging wave-based strategies are more beneficial for HVDC line assurance than for air conditioning line insurance [9]. In Air conditioning line, deficiency point can't create transient voyaging wave for flaw beginning edge at zero-intersection while DC line doesn't have this issue. Additionally, the structure of the air conditioner transport has extraordinary impact of the voyaging wave. Reflected going wave must be recognized from refracted wave of the transport. Fig.3. Simulink Block Diagram of HVDC Transmission System. The DC line then again has less complex structure.

V. RESULT AND DISCUSSION

Electric power frameworks endure startling disappointments in transmission lines because of different irregular causes.

These disappointments impede the best possible activity of electrical frameworks. Be that as it may, administration must be desperately re-established as the transmission line in which an issue happened can't be kept uncertainly secluded. Since planning an absolutely dependable framework is beyond the realm of imagination, for both specialized and monetary reasons, building up various new advancements to find blames in transmission lines and cause the system to work effectively has been vital. Along these lines, an expanding number of calculations are being intended to find deficiencies. A portion of the flaws beneath is issue.

A.Fault in Inverter

In HVDC framework, blames on inverter side effectsly affect framework solidness. The different sorts of deficiencies are considered in HVDC framework which causes because of breakdowns of valves and controllers, failure to fire and short out over the inverter station, flashover and three stage impede. The variety of current is appeared in Fig 4. X-hub signifies the example point and Y-hub means current.

Fig.4.Inverter Fault Occur at Phase A

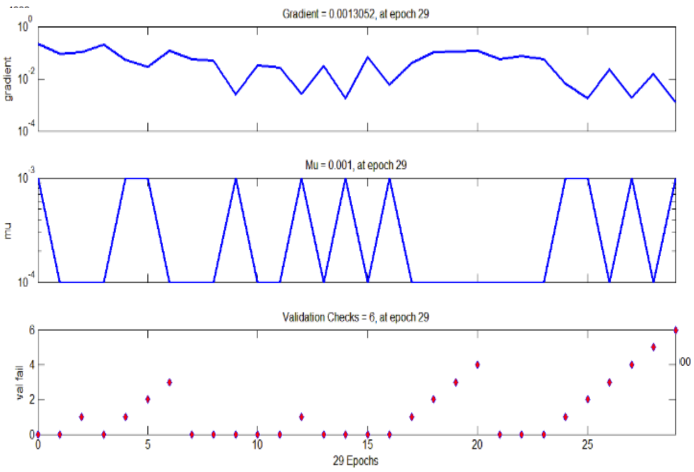

Fig.5.Neural Network Training State

In Fig.5.gradient X-pivot speaks to the quantity of cycle (29 ages), Y-hub speaks to slope. Plots the preparation state from a preparation record angle returned via train. Fig.6. Neural Network Training Performance. Best approval execution is 0.00869 at age at 29 emphasis, Inclination = 0.00131 at age 29.

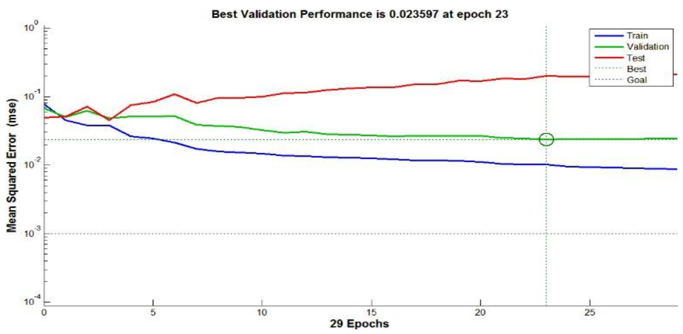

Fig.6.Neural Network Training Performance

By and large, the blunder lessens after more ages of preparing, yet may begin to increment on the approval informational collection as the system begins once again fitting the preparation information. In the default arrangement, the preparation stops after six successive increments in approval blunder, and the best execution is taken from the age with the most minimal approval mistake.

Fig.7.Neural Network Training Error Histogram

Fig.7. demonstrates the blunder histogram of the readied neural framework for the arrangement endorsement and testing steps. This figure exhibits that the data fitting slip-up are scattered with in a reasonably better than average range around 0. Where X-turn address mix-up and Y-center address models.

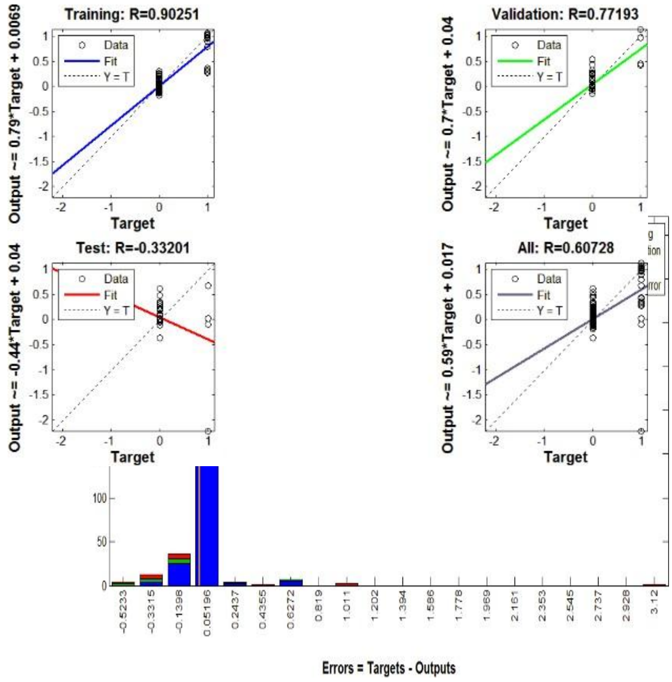

Fig.8.Neural Network Training Regression

The three plots address the planning, endorsement, and testing data. The ran line in each plot addresses the perfect result – yields = targets. The solid line addresses the best fit direct backslide line among yields and targets. The R worth implies that the association between the yields and targets. If R = 0.90, this exhibits there is an exact straight association among yields and targets. If R is close to zero, by then there is no straight association among yields and targets. Fig.8.shows backslide. X-turn addresses target, Y-centre point addresses yield.

B.Fault in Rectifier

The HVDC is a mass power transmission framework the brief span shortcomings may prompt the all out power outage of an area. The transformers utilized in HVDC have various necessities because of superimposed DC voltage and current. converter transformers intended for 12 heartbeat rectifiers have three windings. current reaction is appeared in Fig.9.Rectifier flaw happen at stage A.

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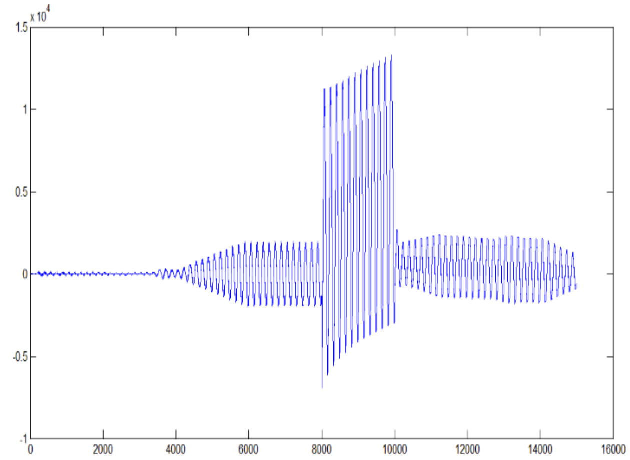

Fig.9. Rectifier fault occur at phase A

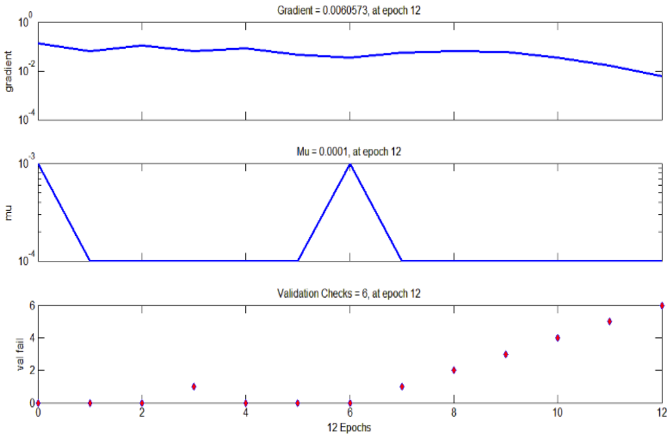

Fig.10. Neural Network Training State

In angle X-hub speaks to the quantity of cycle (12 ages), Y-pivot speaks to slope. Plots the preparation state from a preparation record slope returned via train. Fig.10. neural system preparing.

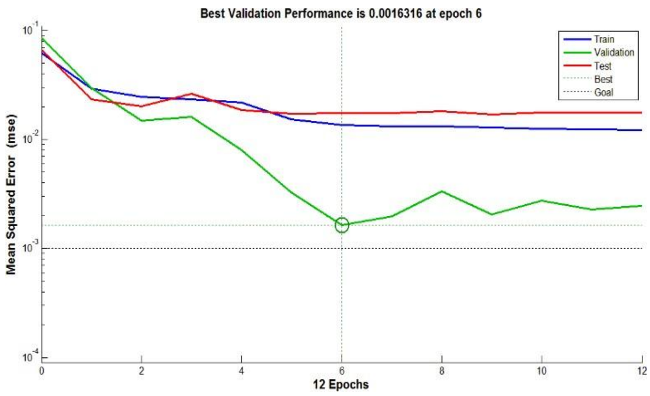

Fig.11.Neural Network Training Performance

Fig.11.Show best execution .X-hub speaks to ages, Y-hub mean square mistake. Best approval execution is 0.0016316 at age at 6.

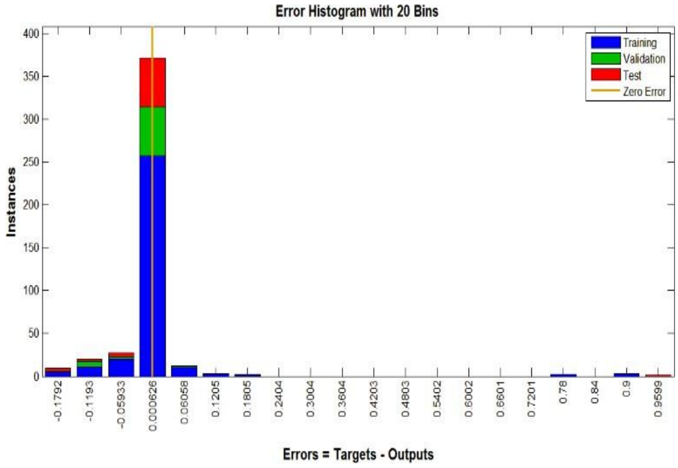

Fig.12.Neural Network Training Error Histogram

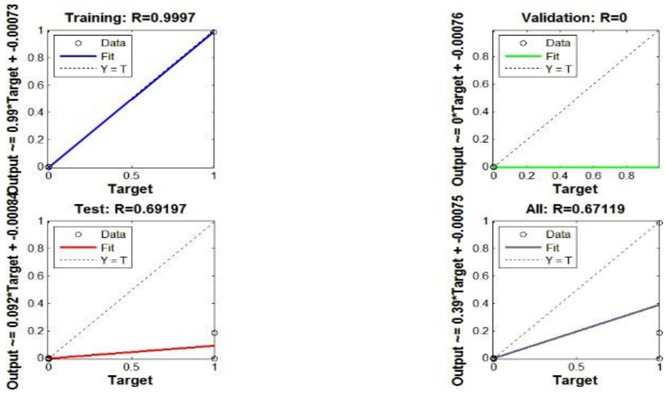

Fig.13.Neural Network Training Regression

The three plots speak to the preparation, approval, and testing information. The ran line in each plot speaks to the ideal outcome – yields = targets. Fig.13.shows relapse. X – pivot speaks to target, Y-hub speaks to yield.

C.Line Fault 100

In HVDC machine, an air conditioner flaw furthermore happens which incorporate even blames and unsymmetrical deficiencies. For example Line to line deficiency, line to ground shortcoming and three area fast circuit flaw. A few deficiencies happens on converters station at rectifier are inverter part of HVDC framework which has excellent impact on gadget balance.

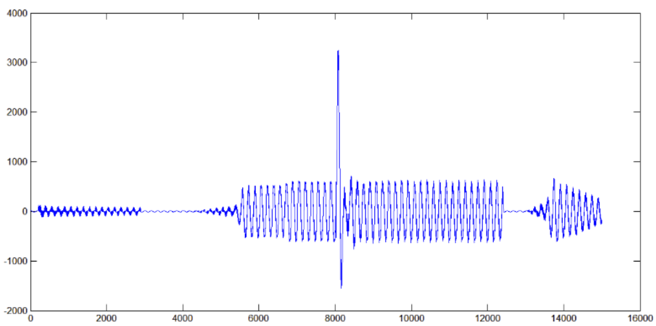

Fig.14.Line fault occur at phase A

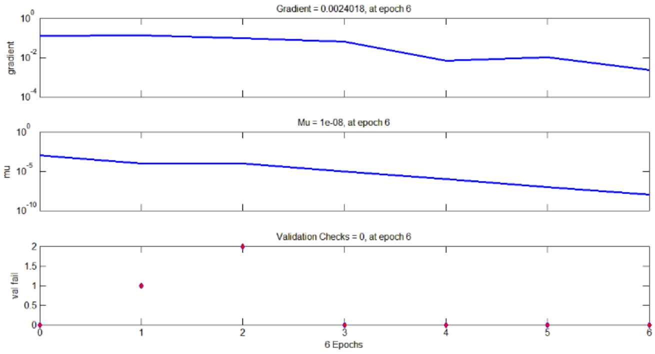

Fig.15.Neural Network Training State

In gradient X-axis represents the wide variety of iteration (0 epochs), Y-axis represents gradient. Plots the education country from a schooling report gradient again by means of train. Fig.15. Neural community education nation.

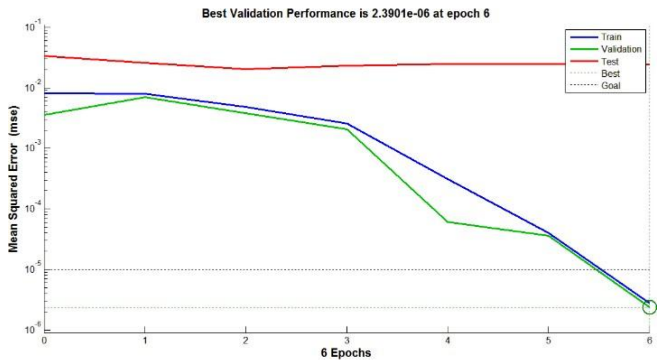

Fig.16.Neural Network Training Performance

Fig.16.indicates exceptional performance-axis represents epochs, Y-axis suggest square blunders. Best validation performance is two.3901e-06 at epoch at 6.

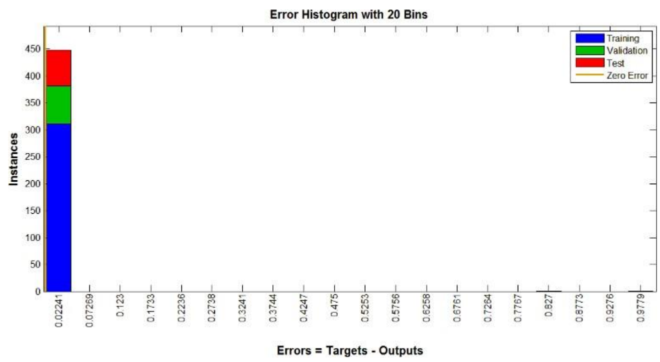

Fig.17.Neural Network Training Error Histogram

Fig17 suggests the error histogram of the educated neural community for the schooling validation and checking out steps. This determine shows that the statistics becoming errors are dispensed with in a reasonably good variety round zero. Where X-axis represent error and Y-axis represent times.

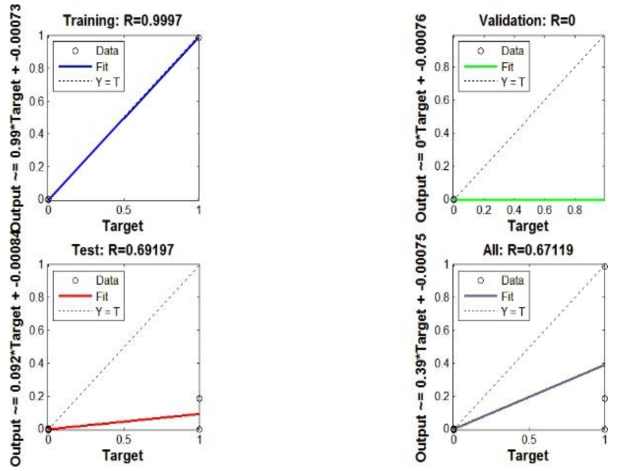

Fig.18.Neural Network Training Regression

The 3 plots constitute the schooling, validation, and trying out statistics. The dashed line in each plot represents the ideal result – outputs = objectives[9]. The strong line represents the quality fit linear regression line among outputs and goals. The R price is an indication of the connection among the outputs and objectives. If R = 1, this indicates that there may be an actual linear courting between outputs and targets. If R is close to 0, then there may be no linear courting among outputs and goals. Fig.18. Indicates regression. X –axis represents goal, Y-axis represents output.

D.Line Fault 200

In HVDC machine, an AC fault moreover takes place which encompass symmetrical faults and unsymmetrical faults. I.E. Line to line fault, line to ground fault and three segment brief circuit fault. Some faults takes region on converters station at rectifier are inverter element of HVDC system which has amazing effect on device stability.

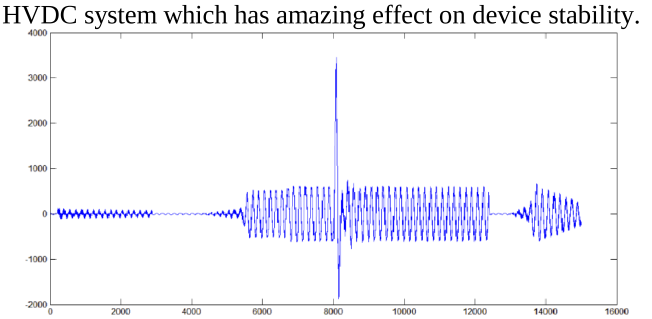

Fig.19.Line Fault Occur at Phase A

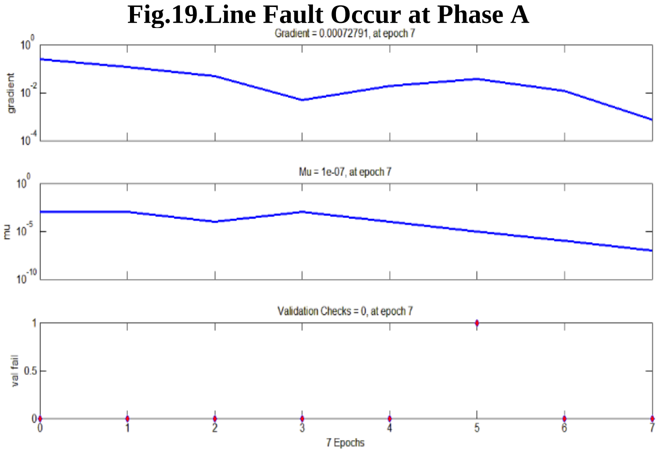

Fig.20.Neural Network Training State

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Fig.20.Neural Network Training State. Gradient=zero.00072791 at epoch 7, Mu=1e-07, validation check=zero at epoch 7.

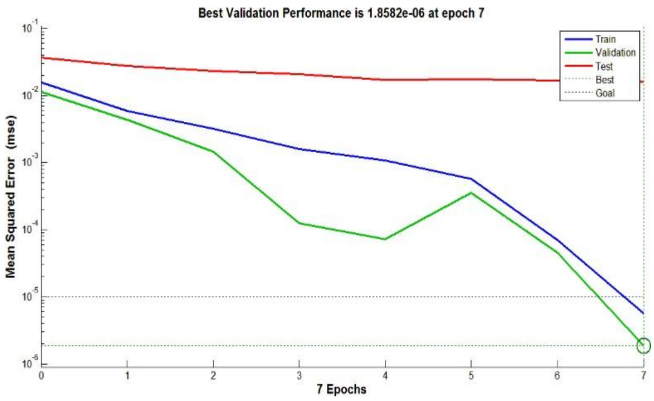

Fig.21. Neural Network Training Performance

Fig.21. Indicates first-class overall performance. X-axis represents epochs, Y-axis imply rectangular blunders. Best validation performance is 1.8582e-06 at epoch at 7.

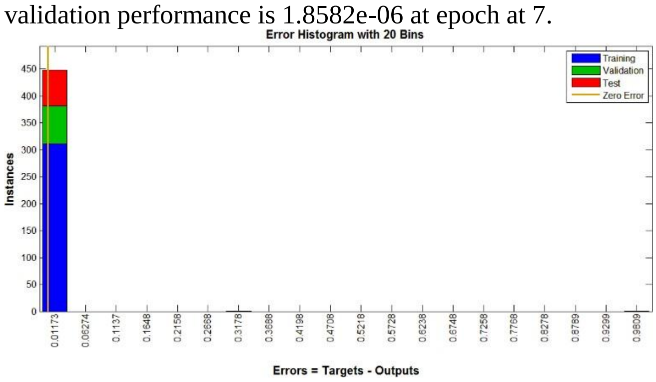

Fig.22.Neural Network Training Error Histogram

Fig.22. suggests the mistake histogram of the educated neural network for the schooling validation and trying out steps. This parent suggests that the information fitting errors are distributed with in a fairly right variety round zero. Where X-axis represent Error Histogram with 20 packing containers and Y-axis represent instances.

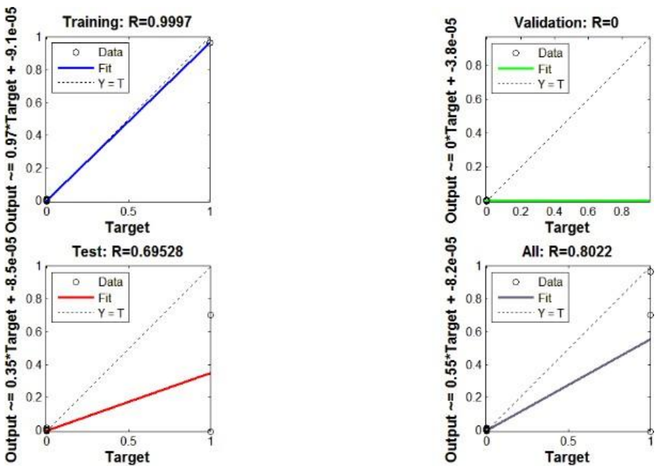

Fig.23. Shows Regression Axis Represents Target, Y-Axis Represents Output.

VI. CONCLUSION

The Fault detection in HVDC system are different compared AC system due to presence of power electronics controllers. In this paper an ANN based production scheme was developed to detect faults on the AC side as well as DC transmission lines with the rapid advancements in microprocessors the travelling wave method in currently used in HVDC protection. The proposed method is simple and cheap for realization on ANN based protection scheme was tested with various testing samples and their performance curves are presented in this report. Hence, the faults are identified using MATLAB and results were extracted.

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AUTHORS PROFILE

C. Poongothai was born on August 17, 1993. She completed her B.E. degree in Electrical and Electronics in 2014.She completed her M.E Power Systems in Annamalai University, India. Currently pursuing Ph.d in Electrical Engineering Annamalai University. Her research interests include power system protection, fault diagnosis and artificial intelligence techniques to power systems.

K.Gayathri was born on April 10,1976.She completed her B.E. degree in Electrical and Electronics in 1999, M.E. degree in Power Systems in 2005 and also awarded her Ph.D in Electrical Engineering in September 2010 at Annamalai University. She is presently working as an Assistant Professor at Annamalai University, India. She has 33 publications to her credit. Her research interests include power system operation and control, power system analysis, fault diagnosis, artificial intelligence techniques, restructuring and restoration to power systems.