International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 05 Issue: 05 | May - 2021 ISSN: 2582-3930

ARTIFICIAL INTELLIGENCE APPLICATION FOR POWER SYSTEM PROTECTION

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Abstract- The application of Artificial Intelligence (AI) methods in power system protection has been addressed in this paper. The present generation of digital protection devices allows the implementation of adaptive strategies for power system protection. AI technique becomes popular for solving different problems in power system like control planning, scheduling, forecast, etc. The application of these technologies has been successful in many areas of power system engineering. This paper originally was studied artificial intelligence in power system on steady and transient, introducing the most suitable method, which can be used as a reference in practical application. All in all artificial intelligence is the ability to use computers to perform some complex problems to solve, such as image recognition, judge the ability to understand the problem.

Keywords**:** Power System, Artificial Intelligence, Technique of AI, Application of AI System in Power System and Transmission Line.

1. INTRODUCTION

In microprocessor technology brings unquestionable improvements of the protection relays criteria signals are estimated in a shorter time; input signals are filtered out more precisely. It is easy to apply sophisticated corrections. The hardware is standardized and may communicate with other protection and control systems. Relays are capable of self-monitoring. AI this, however, did not make a major back through in power system protection as far as security, dependability and speed of operation are considered.

2. WHAT IS A POWER SYSTEM?

An electric power system is a network of electrical components used to supply, transmit and use electric power. Power system engineering is the subdivision of electrical engineering that deals with the generation, transmission, distribution and utilization of electric power and electrical devices connected to such systems as generators, motors and transformers.

3. NECESSITY OF AI IN POWER SYSTEM PROTECTION

For industrial development with power system expansion, stability, strengthening, reliability, technical advancements, selection and dynamic response of the power system are essential. With the growth of the power system, complexity in the networks is increased tremendously. As a consequence of this power system analysis by conventional techniques and conclusions from the acquired data, the process of the information, management of remote devices and utility became more complicated and time-consuming.

As necessity is the mother of invention, AI is developed with the help of sophisticated computer tools and applied to resolve all aforesaid problems for large power systems.

4. ARTIFICIAL INTELLIGENCE

Artificial intelligence (AI) has recently emerged as a science even though it may still be considered in its early stages of development. Depending on the goals

and methods employed in research, its definition varies. It is a wide-ranging branch of computer science with building smart machines capable of performing the task that typically required human intelligence.

The term artificial intelligence(AI) is commonly known to be the intelligence exhibited by machines and software, for example, robots and computer programs. The term is generally used to project developing systems equipped with the intellectual processes features and characteristics of humans, like the ability to think, reason, find the meaning, generalize, distinguish, learn from experience or rectify their mistakes.

Three major families of AI techniques are considered to be applied in modern power system protection.

- Artificial Neural Networks (ANNs)
- Fuzzy Logic Systems (FL)
- Expert System Techniques (XPSs)
- Generic Algorithms (GA)

4.1 Artificial Neural Networks

Artificial Neural Network (ANN) is the piece of computing system designed to simulate the way the human brain analytics and process information. ANN have the self-learning capabilities that enable them to produce better results as more data become available. Processing unit makeup ANN which in turns consist of inputs and outputs. The input is what the ANN learns from to produce the desired outputs.

Artificial Neural Network (ANN) are biologically inspired systems. ANN mathematical models simulate the human biological neural network for processing information where each neuron produces one output as a function of inputs. Each type of neural network is capable of some specific work after being trained and can conclude a function from observations faced in real life such as function approximation, classification, data processing, etc. Its primary advantage is the capability to learn algorithms, and online adaption of dynamics systems, quick parallel computation and intelligent interpolation of data.

They are classified by their architecture, several layers, topology, connectivity pattern, feedforward, backpropagation and radial basis function or recurrent, etc. A neural network consists of some layers of artificial neurons linked by weight connections.

Input Layer:- The input units do not process the data and information but distribute other units.

Hidden Layer:- The hidden units provide the ability to map or classify the nonlinear problems.

Output Layer:- The output units encode possible values to be allocated to the case under consideration.

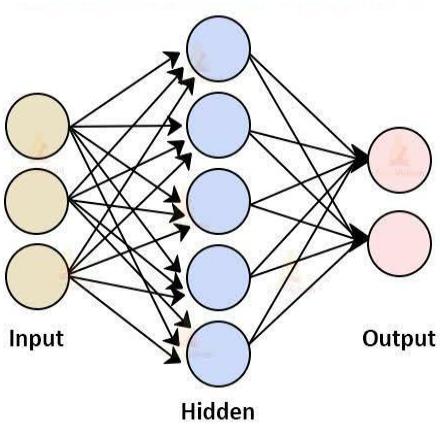

Fig: Architecture of Neural Artificial Intelligence

How ANNs can be used in power system?

An ANNs operate on the biological evaluation of real-world problems, the problems in generation, transmission and distribution of electricity can be fed to the ANNs so that a suitable solution can be obtained. Given the constraints of a practical transmission and distribution system, the exact values of parameters can be determined. For example, the value of inductance, capacitance and resistance in a transmission line can be numerically calculated by ANNs taking in various factors like environmental factors, unbalancing conditions, and other possible problems. Also, the values of resistance, capacitance and inductance of a transmission line can be given as inputs and a combined, normalized value of the parameters can be obtained. In this way, the skin effect and proximity effect can be reduced to a certain extent.

4.2 Fuzzy Logic Systems

Fuzzy systems perform and can make a decision like a human brain, it can be standardised and systematised approximate reasoning. Therefore, with certain or even approximate information and data, it produces accurate solutions. Hence, this technology is used in machines so that they can perform like a human.
Fuzzification provides oversimplification, superior expressive power, and an improved capability to model a complex problem at a low cost. It allows a particular level of uncertainly it minimizes problem complexity and available specific information.

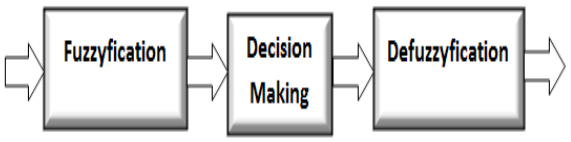

Fig: Simplified block diagram of the fuzzy logic system

How Fuzzy Logic can be used in power system?
Fuzzy logic can be used for designing the physical components of power systems. They can be used in anything from small circuits to large mainframes. They can be used to increase the efficiency of the components used in power systems. As most of the data used in power system analysis are approximate values and assumptions, fuzzy logic can be of great use to derive a stable, exact and ambiguity-free output.

4.3 Expert Systems

Expert System is also called knowledge-based systems or rule-based systems. It is a computer program that incorporates knowledge derived from experts in a specific subject to provide problem analysis to users. This knowledge is generally stored in one of the many forms, like rules, decision trees, models, and frames. It uses this knowledge and interface mechanism to solve problems that cannot be or difficult to be solved by human skill and intellect. The common form of an expert system is a computer program containing the rules for analysis and recommendations for users.

Expert Systems are computer programs, it is based on the process of writing codes which is simpler than actually calculating and estimating the value of parameters. Therefore, any modifications even after design can be easily done. These systems are incapable of accepting new problems or situations other than programmed.

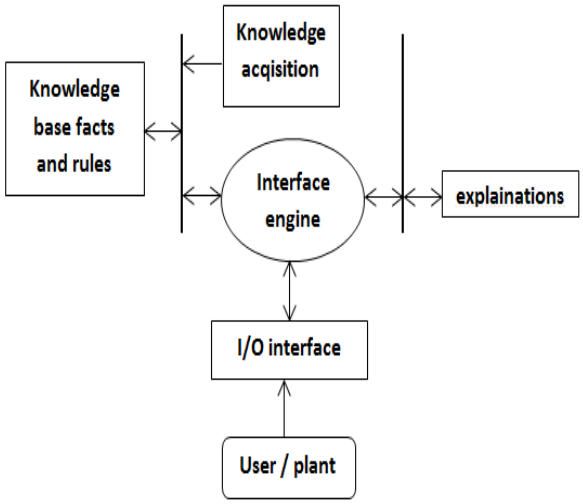

Fig: Structure of an Expert System

How Expert System can be used in power system?
Since expert systems are computer programs, the process of writing codes for these programs is simpler than actually calculating and estimating the value of parameters used in generation, transmission and distribution. Any modifications even after design can be easily done because they are computer programs. Virtually, estimation of these values can be done and further research for increasing the efficiency of the process
can be also performed.

4.4 Generic Algorithms

The Genetic algorithm gives a global technique based on biological metaphors. It is an optimization technique based on the study of "Natural selection and natural Genetics." Several methods for increasing the efficiency and analysis of power system to increase power output can be proposed, but out of these methods, Genetic Algorithms withstands all selected constraints. In computing terms, a genetic algorithm implements the model of

computation by having arrays of bits or characters (binary string) to represent the chromosomes. Each string represents a potential solution. The genetic algorithm then manipulates the most promising chromosomes searching for improved solutions.
It is the best method for solving complex and nonlinear problems. it is used for the planning of power generation, transmission and distribution. It adjusts the parameters of excitation to solve the voltage control problem and reactive power compensation.

How Generic Algorithms can be used in power system?
As genetic algorithms are based on the principle of survival of the fittest, several methods for increasing the efficiency of power system processes and increasing power output can be proposed. Out of these methods, using genetic algorithms, the best method which withstands all constraints can be selected as it is the best method among the proposed methods (survival of fittest).

5. CURRENT APPLICATION OF AI SYSTEMS IN POWER SYSTEM PROTECTION

1) The current approach of AI in power system applications are: Planning for Generation expansion, power system reliability, transmission expansion, and reactive power.
2) Operation of power systems like unit commitment, hydro-thermal coordination, economic dispatch, congestion management, maintenance scheduling, state estimation, load and power low.
3) Control of power system like voltage control, stability control, power flow control, load frequency control.
4) Control of power plans like fuel cell power plant control, thermal power plant control.
5) Automation of power system like restoration, management, fault diagnosis, network security.
6) Electricity markets like strategies for bidding, analysis of electricity markets.
7) Retail, Shopping and Fashion. Security and Surveillance. Sports Analytics and Activities. Manufacturing and Production.

6. APPLICATION OF AI IN TRANSMISSION LINE

1) If any occurs in the transmission line, the fault detector detects the fault and feeds it to the fuzzy system. Only three line currents are sufficient to implement this technique and the angular difference between fault and pre-fault current phasors are used as inputs to the fuzzy system. Fuzzy systems can be generally used for diagnosis.
2) Artificial Neural Networks and Expert Systems can be used to improve the performance of the line. The environmental sensors sense the environmental and atmospheric conditions and give them as input to the expert systems. The expert systems are computer programs that provide the value of line parameters to be deployed as the output.
3) The ANNs are trained to change the values of line parameters over the given ranges based on environmental conditions. Training algorithm has to be given to ANN. After training is over, the neural network is tested and the performance of an updated trained neural network is evaluated. If performance is not up to the desired level, some variations can be done like varying the number of hidden layers, varying the number of neurons in each layer.
4) The processing speed is directly proportional to the number of neurons. These networks take different neurons for different layers and different activation functions between input and hidden layer and output layer to obtain the desired output. In this way, the performance of the transmission line can be improved.

7. FUTURE SCOPE OF AI

In the future, the scale of the power system will continue to expand, its complexity is also constantly improved and will bring some more difficult factors to deal with, in which some artificial intelligence currently has its different advantages and disadvantages and limitations, lacking a

power system applied to the effective hybrid intelligent, namely seek a more suitable method for artificial intelligence processing problems in power system that combines the advantages of artificial intelligence. Believe in the future, with the deepening of research, artificial intelligence will become more and more mature, and easier to operate, to better solve the problems in power systems. In a short, the integration of a variety with artificial intelligence is a major trend in future development.

8. CONCLUSION

This paper introduces the application of artificial intelligence in the power system in recent years, including artificial neural network, expert system, fuzzy theory and so on. These applications can greatly improve the efficiency of the power system, reduce the input of human and material resources, and play an important role in power system security.

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