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Neural Networks

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ABSTRACT

Artificial neural networks have emerged from the studies of how brain performs. The human brain consists of many millions of individual processing elements, called neurons that are highly interconnected. Information from the outputs of the neurons, in the form of electric pulses is received by the cells at connections called synapses. The synapses connect to the cell inputs, or dendrites and the single output the neuron appears at the axon. An electric pulse is sent down the axon when the total input stimuli for all of the dendrites exceed a certain threshold. Artificial neural networks are made up of simplified individual models of the biological neuron that are connected together to form a network. Information is stored in the network in the form of weights or different connections strengths associated with synapses in the artificial neuron models.

Keywords: Human Brain, Neural Networks, ANN

I. INTRODUCTION

The importance of electricity in our day to day life has reached such a stage that it is very important to protect the power system equipments from damage and to ensure maximum continuity of supply. But there are power system blackouts by which the continuous power supply is being interrupted. What is more important in the case of a blackout is the rapidity with which the service is restored. Now- a -days power system blackouts are rare. But whenever they occur, the effect on commerce, industry and everyday life of general population can be quite severe. In order to reduce the social and economic cost of power system blackouts, many of the electric utility companies have pre-established guidelines and operating procedures to restore the power system. They contain sequential restoration steps that an operator should follow in order to restore the power system. They are based on certain assumptions whichmay not be present in the actual case. This reduces the success rates of these procedures.

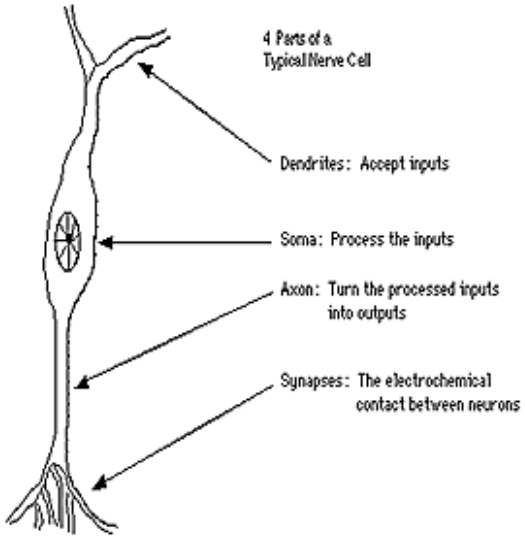
II. WHAT ARE ANNs?

Artificial Neural Network (ANN) is a system loosely modeled on human brain. It tries to obtain a performance similar to that of human's performance while solving problems. As a computational system it is made up of a large number of simple and highly interconnected processing elements which process information by its dynamic state response to external inputs. Computational elements in ANN are non-linear and so the results come out through non-linearity can be more accurate than other methods. These non-linear computational elements will be working in unison to solve specific problems. ANN is configured for specific applications such as data classification or pattern recognition through a learning process. Learning involves adjustment of synaptic connections that exist between neurons. ANN can be simulated within specialized hardware or sophisticated software. ANNs are implemented as software packages in computer or being used to incorporate Artificial Intelligence in control systems.

III. BIOLOGICAL NEURON

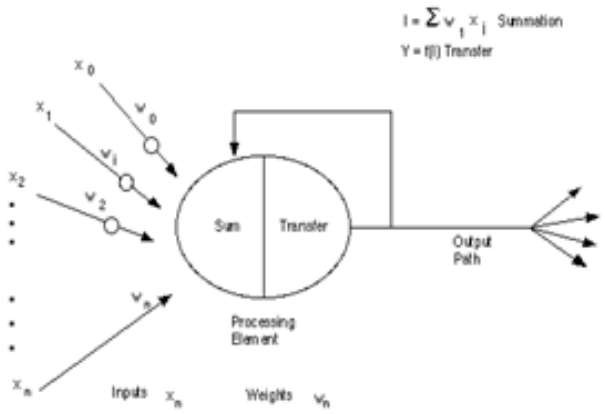
The most basic element of the human brain is a specific type of cell, which provides us with the abilities to remember, think, and apply previous experiences to our every action. These cells are known as neurons, each of these neurons can connect with up to 200000 other neurons. The power of brain comes from the numbers of these basic components and the multiple connections between them.

All natural neurons have four basic components, which are dendrites, soma, axon and synapses. Basically, a biological neuron receives inputs from other sources, combines them in some way, performs a generally non-linear operation on the result, and then output the final result. The figure below shows a simplified biological neuron and the relationship of its four components.



IV. ARTIFICIAL NEURON

The basic unit of neural networks, the artificial neurons, simulates the four basic functions of natural neurons. Artificial neurons are much simpler than the biological neurons. The figure below shows the basic structure of an artificial neuron.



Note that various inputs to the network are represented by the mathematical symbol, x(n). Each of these inputs are multiplied by a connection weight, these weights are represented by w(n). In the simplest case, these products are simply summed, fed through a transfer function to generate a result, and then output. Even though all artificial neural networks are constructed from this basic building blocks the fundamentals may vary in these building blocks and there are differences.

V. NEURAL NETWORKS

Artificial neural networks emerged from the studies of how brain performs. The human brain consists of many million of individual processing elements called neurons that are highly interconnected.

ANNs are made up of simplified individual models of the biological neurons that are connected together to form a network. Information is stored in the network in the form of weights or different connection strengths associated with the synapses in the artificial neuron models.

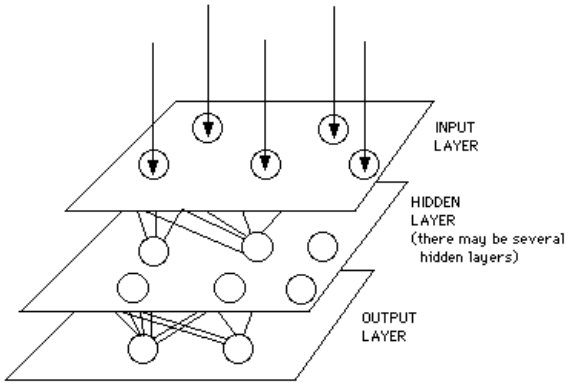
Many different types of neural networks are available and multilayered neural network are the most popular which are extremely successful in pattern reorganization problems. An artificial neuron is shown in the figure. Each neuron input is weighted by Changing the weights of an element will alter the behavior of the whole network. The output y is obtained summing the weighted inputs and passing the result through a non-linear activation function.

VI. PROCEDURE FOR ANN SYSTEM DESIGN

In realistic application the design of ANNs is complex, usually an iterative and interactive task. The developer must go through a period of trial and error in the design decisions before coming up with a satisfactory design. The design issues in neural network are complex and are the major concerns of system developers.

Designing of a neural network consists of:

- Arranging neurons in various layers.
- Deciding the type of connection among neurons of different layers, as well as among the neurons within a layer.
- Deciding the way neurons receive input and produces output.
- Determining the strength of connection that exists within the network by allowing the neurons learn the appropriate values of connection weights by using a training data set.



As the figure above shows, the neurons are grouped into layers. The input layer consists of neurons that receive input from external environment. The output layer consists of neurons that communicate the output of the system to the user or external environment. There are usually a number of hidden layers between these two layers. The figure above shows a simple structure with only one hidden layer.

When the input layer receives the input, its neurons produces output, which become input to the other layers of the system. The process continues until certain condition is satisfied or until the output layer is invoked and fire their output to the external environment.

VII. LEARNING TECHNIQUES

Learning rules are algorithm for slowly alerting the connections weighs to achieve a desirable goal such a minimization of an error function. The generalized step for any neural network leaning algorithm is follows are the commonly used learning algorithm for neural networks.

- Multi-Layer Neural Net (MLNN)
- Error Back Propagation (EBB)
- Radial Basis Functions (RBF
- Reinforcement Learning
- Temporal Deference Learning
- Adaptive Resonance Theory (ART)
- Genetic Algorithm

Selection of a particular learning algorithm depends on the network and network topology. As MLNN with EBP is most extensively used and widely accepted network for process application, namely for identification and control of the process.

VIII. FEATURES OF ANNs

ANNS have several attractive features:
Their ability to represent non-linear relations makes them well suited for non-linear modeling in control systems.

- Adaptation and learning in uncertain system through off line and on line weight adaptation.
- Parallel processing architecture allows fast processing for large-scale dynamic system.
- Neural network can handle large number of inputs and can have many outputs.
- ANNs can store knowledge in a distributed fashion and consequently have a high fault tolerance.

An ANN can been seen as a union of simple processing units, based on neurons that are linked to

each other through connections similar to synapses. These connections contain the "knowledge" of the network and the pattern of connectivity express the objects represented in the network. The knowledge of the network is acquired through a learning process where the connections between processing elements is varied through weight changes.

Learning rules are algorithms for slowly alerting the connection weights to achieve a desired goal such as minimization of an error function. Learning algorithms used to train ANNs can be supervised or unsupervised. In supervised learning algorithms, input/output pairs are furnished and the connection weights are adjusted with respect to the error between the desired and obtained output. In unsupervised learning algorithms, the ANN will map an input set in a state space by automatically changing its weight connections. Supervised learning algorithms arecommonly used in engineering processes because they can guarantee the output.

In this power system restoration scheme, a multilayered perceptron(MLP) was used and trained with a supervised learning algorithm called back-propagation. A MLP consists of several layers of processing units that compute a nonlinear function of the internal product of the weighted input patterns. These types of network can deal with nonlinear relations between the variables; however, the existence of more than one layer makes the weight adjustment process for problem solution difficult.

IX. ANN BASED CONTROL CONFIGURATION

- Direct Inverse Control
- Direct Adaptive Control
- Indirect Adaptive Control
- Internal Model Control
- Model Reference Adaptive Control

X. ADAPTIVE CONTROL

The neural network approximates a wide variety of nonlinear control laws by adjusting the weights in training to achieve the desired approximate accuracy. One possible MRAC structure based on neural network is shown:

- In this configuration, control systems attempted to make the plant output YP (t) to follow the reference model output asymptotically. The error signal
- Used to train the neural network controller is the difference between the model and the plant outputs, principally; this network works like the direct adaptive neural control system.

XI. CONCLUSION

PSR has become a field of growing interest. Several techniques based on artificial intelligence have been proposed to improve power system restoration. These techniques propose the use of the computer as an operator aid instead of the use of predefined operating procedures for restoration. The stressful condition following a blackout and the pressure for achieving a restoration plan in minimum time can lead to misjudgment by system operator. This paper proposes the use of ANN for service restoration plan, since it has generalization capability and high processing speed. The large number of possible faulty conditions and the need to provide a restoration plan in minimum time are arguments in favor of this technique.

XII. REFERENCES

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