

A Review on the Application of Artificial Neural Networks on Communication Systems

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Abstract

This paper presents a review on the applications of Artificial Neural networks. Artificial neural networks nowadays playing an important role in providing solutions to many complex computational problems. These networks provide many applications in the areas like Electrical engineering, Electronics engineering, Telecommunications, Computer science engineering etc.

Keywords: Artificial Intelligence (AI), Artificial Neural Network.

INTRODUCTION

Many researchers nowadays prefer to adopt a particular term called Artificial Intelligence. The term intelligence can be clearly defined as the ability or capacity to understand a particular task. Hence AI can be defined as the Science and engineering of making Intelligent machines which are used to perform some computational tasks. It analyses the working of a Human brain in solving a particular task. An AI system must be able to do three things i.e., storing the knowledge, apply the knowledge to solve the problems and acquiring some knowledge from the experience. An AI system has three components mainly i.e., Representation, Reasoning and Logic. The Artificial neural networks are said to be one of the methods of AI and highly useful in performing many computational tasks. The rest of the paper is organised as follows. In the coming sections, this paper presents the concepts of artificial neural networks, applications in communications.

Artificial Neural Networks

The definition of an Artificial Neural Network is as follows. It can be defined as “An Information processing algorithm which is highly and massively inspired by the way of human biological nervous systems such as Brain”.

ANNs are one of the methods of AI that always tries to imitate the working of a human brain. It is a massively parallel distributed processor that has a natural tendency for storing some particular knowledge and making it available for doing certain tasks. The main goal or aim of ANNs is too imitating the human capability to adapt to changing environments and the current environment. The ANNs consists of nodes in large number which can be termed as the processing units analogous to neurons in the brain. In this, each node is has a node function associated with it. ANNs can be defined as the Information processing systems in which the elements called Neurons are used to process the information. The signals will be transmitted with the help of connection links which possess some weights. The output can be obtained by sending the net input into an activation function block.

The ANNs resembles the human brain in two aspects i.e. a learning mechanism is used in order to acquire the knowledge and for the storing of knowledge, Synaptic weights are used. An Artificial neuron is characterised by its Architecture, Training or Learning and Activation Function.

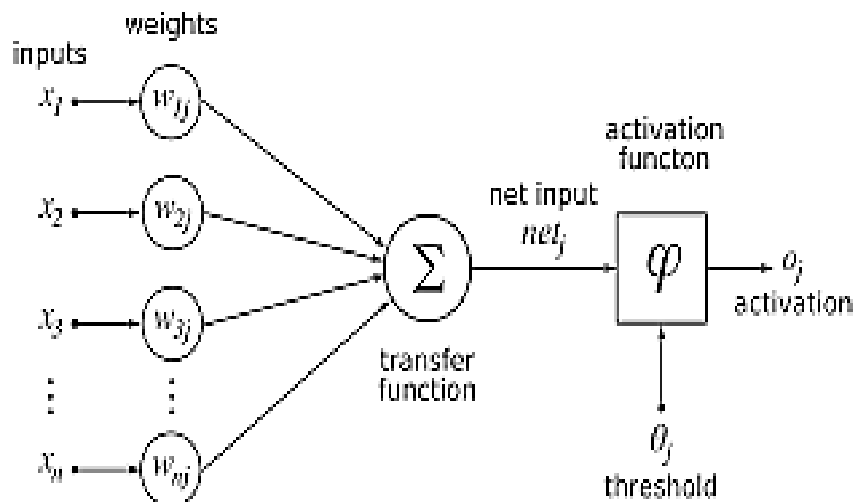


Fig: 1. Artificial Neural Network

The above figure shows a simple artificial neural network in which x_1, x_2, x_3, \dots represents the input nodes and w_{1j}, w_{2j}, \dots are the weights and the net input will be obtained from the Transfer function block and then it will be sent to the activation function to get the output. The artificial neural networks possess some of the characteristics like Parallel, Non-linearity, Input-output Mapping, Learning, Fault tolerant, Adaptability and Response. The neural networks will be more accurate by learning the network with more number of inputs.

Applications of ANNs in Communications

The researchers nowadays prefer to computational intelligence to analyse the techniques of ANNs. The ANNs are applicable in the areas of Network design, Management, routing and control techniques, Equalisers, ATM network control, Fault management and Network monitoring.

Design of RF and Wireless Circuits using ANNs

The design of an RF network section in a wireless communication system was somewhat difficult and hence the simulation too due to the large number of non-linear elements, complexity of the

network. We cannot obtain any meaningful results for some specifications like BER that must be included in the design process.[1]

The complexity of the portion of RF network section in a wireless system continues to increase in order to support multiple standard, multiple frequency bands, need for larger BW and stringent channel specifications. This problem of time consuming can extensively overcome with the help of a modelling tool called ANN tool. By using this tool, it achieves accuracy of a full wave EM simulator but with little compromise of efficiency. In this approach, knowledge-based neural networks are trained initially by using the results of a full-wave solver and hence are used to extract the S-parameters of the circuit in an efficient manner.

Natural Landmark Recognition using ANNs

For achieving this task, two types of neural networks will be trained and tested on a real robot. The two types of neural networks are Multi-layer perceptron (MLP) and learning vector quantisation (LVQ)[1]. This application is suited for autonomous vacuuming robots in completely unknown indoor environments, using an approach or a topological world

model and region-filling algorithm. The Artificial neural networks can easily recognize the natural landmarks selected.

ATM calls admission control by ANNs

The ANNs are used in call admission control of an ATM. There are good algorithms existing on these application Researchers have been developed an algorithm called Call admission control (CAC) algorithm with the help of Neural networks.[3] This algorithm is used to calculate the bandwidth which is required for heterogeneous multimedia traffic with multiple QOS requirements. Here the required bandwidth can be calculated by the ANN. A large set of learning data which represents the various traffic patterns with different QOS requirements were used here in order to ensure that the ANN can produce accurate results. The results have proven that the ANN approach is highly effective in achieving more accurate results compare to other traditional networks.

Location Predictor in cellular networks using ANNs

The major issue basically comes into the picture in cellular network is The Mobility Management. Mobility management seals with managing of the limited frequency BW and the roaming of mobile stations. It has two parts mainly in which first called Hand-off deals with the frequency channel allocation and second called Location management which deals with tracking an active mobility station within the cellular network. The location management will burden the network with many messages of paging and location update to make the network know the location of the mobile station at any time. Hence in order to improve the Location management, ANNs are extensively used to perform the Location prediction. This will help in reducing the total cost of the location management using the prediction and here a back propagation multilayer artificial

neural network was used to learn the movement of the subscriber and then to train the network to predict the new location of the subscriber.

Fault Detection using ANNs

The ANNs are used in detecting the fault in real vibrational data. A neural network can be used as a monitoring device in which it can be used to detect major changes in the operation of the system.[3] The process of fault detection by using the neural networks can be done as follows. The neural network will be learned or trained on a well- behaving system and then it will be operated with no training or learning in parallel to the actual system. Hence by doing this process, the neural net output will be compared to that of the actual system and detects the faults if occurs.

CONCLUSIONS

This paper presented a review on different applications of Artificial Neural networks in the area of communications. The artificial neural networks nowadays considered to be very powerful and playing a vital role in performing many complex computational tasks. This paper was just restricted to present few applications of ANNs in the area of communications and the ANNs can be massively used in every areas of engineering as it these networks provide a basic methodology in solving a particular task.

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