Efficient Load Scheduling Method For Power Management

Vijo M Joy, S Krishnakumar

Abstract: An efficient load scheduling method to meet varying power supply needs is presented in this paper. At peak load times, the power generation system fails due to its instability. Traditionally we use load shedding process. In load shedding process disconnect the unnecessary and extra loads. The proposed method overcomes this problem by scheduling the load based on the requirement. Artificial neural networks are used for this optimal load scheduling process. For generate economic scheduling artificial neural network has been used because generation of power from each source is economically different. In this the total load required is the inputs of this network and the power generation from each source and power losses at the time of transmission are the output of the neural network. Training and programming of the artificial neural networks are done using MATLAB.

Index Terms: Load scheduling, power management, artificial neural networks.

1 Introduction

Now a day, there is an increase in the demand for power. The unit commitment and online dispatch are the economically scheduling problems [1]. In unit commitment scheduling at minimum cost over a required period of time fixed amount of power will supply through the network. Online dispatching means distribute the power parallel with the system. To meet the required power we must consider all the available power sources. So the optimum scheduling [2] of different power plants is important because, the hydro power sources are insufficient to meet the required power demand and thermal sources are very expensive. When consider the solar energy, it is easily available but the amount of power generated from it is insufficient to meet the load demand. When consider all these aspects, we must require an optimum load scheduling method for energy saving and more over to meet the demand. Among these power stations the thermal power is very expensive. Therefore in optimum scheduling [3] we give low priority to the thermal energy. When hydro power is sufficiently available, maximum power is generated from the hydropower station and remaining power from other sources [4]. The most important concept in the power system operation is the frequency and voltage stability. The instability of such parameters makes serious threats to the system security. The faults such as short circuit, load growth and generation shortage may disturb the voltage and frequency. Such instability leads to total blackout of the system [1, 5]. Most of the study in this area is mainly focusing to forecast the power based on cost and time. Instability of the power generation is one of the major drawbacks of this method. The proposed method overcomes this drawback by scheduling the load based on the requirement. In this method, scheduling [3, 6] provides at the consumer area instead of power plants. i.e., optimal scheduling [7] of power depends on the load. The total load of the system is the sum of the maximum load required by the entire regions and loss.

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There is no need to make any change in the output generated by the power plants. If any region requires additional power to meet the load requirement, system checks the regions with their maximum load. This comparison helps us to find the minimum load required units and schedule this load to the required region. The system never interrupts the power source [8]. Artificial Neural Network (ANN) can be defined as a class of mathematical algorithm designed to solve a specific problem. ANN is a simple and fast growing technology used in wide range of application including pattern classification, pattern recognition, optimization products and automatic circuits. ANN commonly applied to get an optimal solution in various scheduling application [7]. In our proposed work ANN is trained with different load demand. Once it has been trained it acquires the ability to give load scheduling pattern for any value for load demand. In ANN the maximum load to each region and the additional load required to any region are the inputs and power generated and power losses are the outputs. Back propagation Neural (BPN) Network algorithm is proposed for the scheduling [6]. R. Hooshmand, et.al [1] explained the optimal algorithm for load shedding. The method provides a fast algorithm for load shedding. In load shedding process separate the least possible loads from network and it reduce the manual effort [1]. Later Mohammad Mohatram,et.al introduced a method for economically scheduling different thermal power plants. ANN based Hydrothermal Scheduling was proposed by M . Suman ,et.al. In this scheduling the total load is shared to hydro and thermal power stations according to the cost of generation [6]. Main aim of the proposed work is to reduce the power generation cost and make the availability of power on demand without any distortion. The proposed neural network will consists of three input neurons, four middle layer neurons and one output neurons. The inputs for the neural networks are the power demand for each region, additional power required to each region due to additional load and power loss. The output is total power required for entire section [8].

2 Load Scheduling Optimization

Load scheduling is the process of sharing the availability of total load and losses in power generators. If we schedule the total load in uniform manner then it is known as uniform scheduling. If we consider the parameters such as load requirement, availability of power, power losses and cost then it is known as optimal scheduling. Here we propose an optimal load scheduling algorithm for our power system [4]. Different power generating plants are connected to a common grid

which is used to deliver power to the load centers. Power generation cost is not same for all the plants. That is we require an optimal scheduling of this plants based on the cost and amount of energy to meet the required load. The total load generated from the plants is the sum of the load demand by the networks and the losses during the time of transmission. Most of the systems have a non linear cost function [6]. Total electric power generation = load demand + losses. The rate of change of transmission losses is based on the length of the transmission line. When the distance between generating station and load increases the amount of power loss is also increases and it nearly 10-15% of the total power [6]. The electrical energy demand in any country depends on the number of parameters such as temperature, time, load, population, etc. To train a network using this number of parameters would be difficult. So we select an optimum number of mutually independent inputs [8].

3 PROPOSED MODEL

The main objective of this model is to schedule or forecast the electric energy on demand in future year with minimum input data. It is due to the simplicity of model implementation, ANNs find wide acceptance in many areas for modeling the complex real world problems. ANN behaves like a human brain and massively parallel – distributed information processing system with highly flexible configuration. Also they possess excellent non- linear capturing ability [3]. Usually, ANNs are multi-layer feed forward network consisting of an input layer, an output layer and hidden layers. Each layer has a set of neurons and is designed to perform a particular task [2]. The generated input target data is split into two. First one is training data, which uses to train the network and the next is testing data uses to test how well the network is generated. Sometimes the networks have the poor performance because the non-uniform distribution of training data [3-6]. At the time of network training, the influence of small data or less weighted data are suppressed by the higher value input variable. When the neuron reaches the peak value or it becomes in saturation, then the change in input value produces a very small change or no change in the output value [5]. The learning capability of the network is depends on the hidden layer. To select the number of neurons in hidden layer is a challenge while design a network. So we perform trial and error method for the selection of hidden layer. If the number of hidden neurons will increase then the design complexity also increases.

Wij - represents the weight connecting from the j th node to the i th node.
Vij - Weight Correction Term.

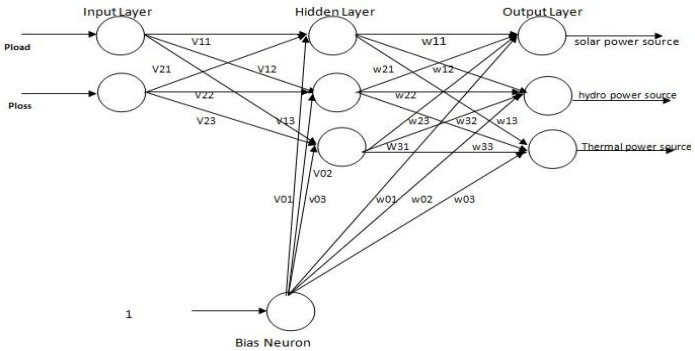

Fig 1. *BPN network proposed method at source end.*

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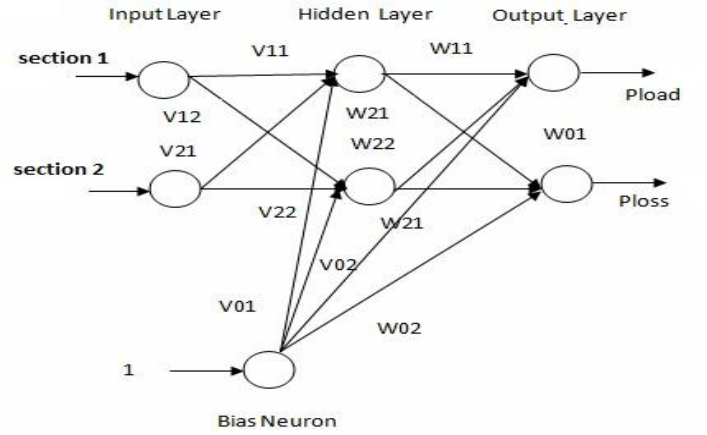

Fig 2. *BPN network proposed method at user end*

Fig 1 shows the scheduling of power source based on cost and availability. In this total power required is the sum of power demands by load and power loss during the transmission time. Fig 2 shows the scheduling of load to the different sections based on the demand and priority.

4 BPN NETWORK.

For training multilayer artificial neural network back propagation algorithm is used. This is a systematic method for training artificial neurons. It provides efficient method for changing the weights of neurons with different activated functional units to learn a training set of input and output. The network is trained using supervised learning method. The aim of this network is to train the network to achieve a balance between the ability to respond correctly to the input pattern that are used for training and the ability to provide good response to the input. During training all the weights are adjusted to minimize the error [9].

4.1 Back propagation algorithm.

1. Start
2. Read all the input values, target values, learning rate coefficient. input node, output nodes, total number of input layers , maximum value of input, maximum value of target and constant,
3. Each hidden unit receives the input signal and transmits the signal to all units in the layers.
4. Each hidden unit adds all weighted input signals.
5. Process output of hidden layer through a non- linear function to produce output of hidden layers.
6. Each unit update with its bias and weights.
7. Calculate the final output.
8. Test stopping condition.

5 RESULT AND DISCUSSION

Scheduling using different power stations like hydro, thermal and solar is shown in the Fig 3 and Fig 4 below. In this table load demand and losses are the inputs. By using BPN network algorithm we schedule the power sources based on cost and availability. From the table we conclude that the execution time is varying when the number of power sources changes. In

this, scheduling is based on the cost of generation. In this solar power station is very cheap. If we consider the storage facility its cost increases. Here we applied different load demand and losses as input. By using the proposed algorithm perform the scheduling of power generators based on the availability and cost. If we reduce the number of power generators then the execution time decreases.

6 CONCLUSION

The objective of this work is to carry out development for ANN based method to schedule the electric energy economically and on demand. In our power system the instability leads to major problems. Large variation of load leads to system black out. Freeze the generated voltage and frequency and vary the load on demand. A trained ANN can be applied to find out the scheduling based on cost and on demand. This algorithm also reduces the processing time.

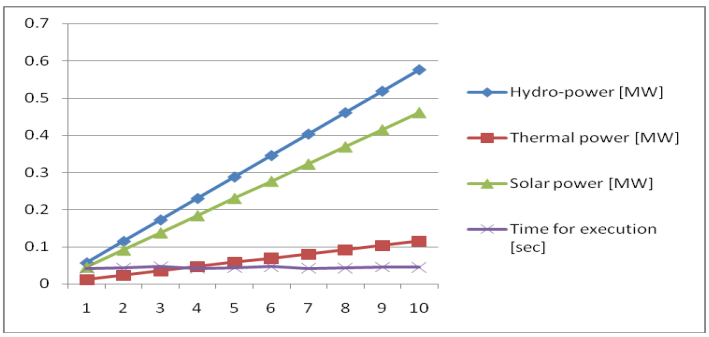

Fig . 3. *Graphical representation of power distribution - Day time*

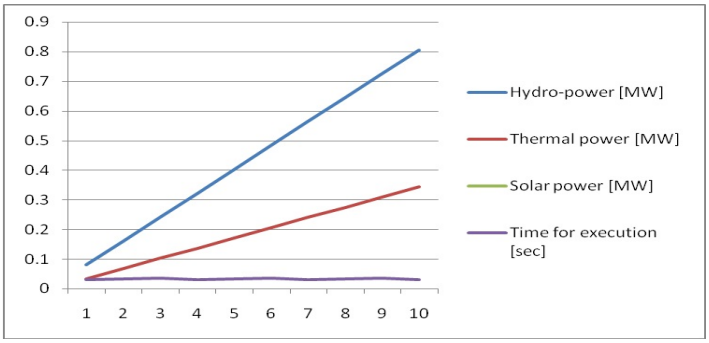

Fig.4*. Graphical representation of power distribution- Night time*

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