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LoadFrequency Control of Power System

SadeqAminifar, MohammadaminDaneshvar, GhaderYosefi

Department of Electrical and Electronic Engineering, Mahabad Branch, Islamic Azad University,Mahabad, Iran

ABSTRACT

This paper present power system load frequency control by adaptive neuron fuzzy controller. An Adaptive Neuron-Fuzzy Controller for load control of generator with a five layer neural network is used to adjust input and output parameters of membership function in a fuzzy logic controller. In this paper, the least square estimation method is applied for the tuning of linear output membership function parameters and the error back propagation method is used to tune the nonlinear input membership function parameters.

Keywords: Generator, Hybrid Learning,Adaptive Neuron Fuzzy Controller

INTRODUCTION

The power system load frequency control (LFC) problems are caused by small load perturbations which continuously disturb the normal operation of power system [1]. Also, the LFC problem is very important in interconnected power system because the load perturbation in any areas disturb the frequency of others [2]. Many researches have been done in the past about load-frequency control in interconnected power system. In the literature, some control strategies have been suggested based on conventional and fuzzy, neural network controllers [3].

In this paper, we uses Takagi-Sugeno Type Adaptive Neuron Fuzzy Network with hybrid learning algorithm for identification of generator then trained Adaptive Neuron – Fuzzy Network is used to Adaptive Neuron- Fuzzy controller for load frequency control of generator[4 and 5].

Also, in this paper to achieve the sensitivity of power systems model modified adaptive neuron fuzzy method used for identification the power system [6 and 7].

Dynamic model of the generator

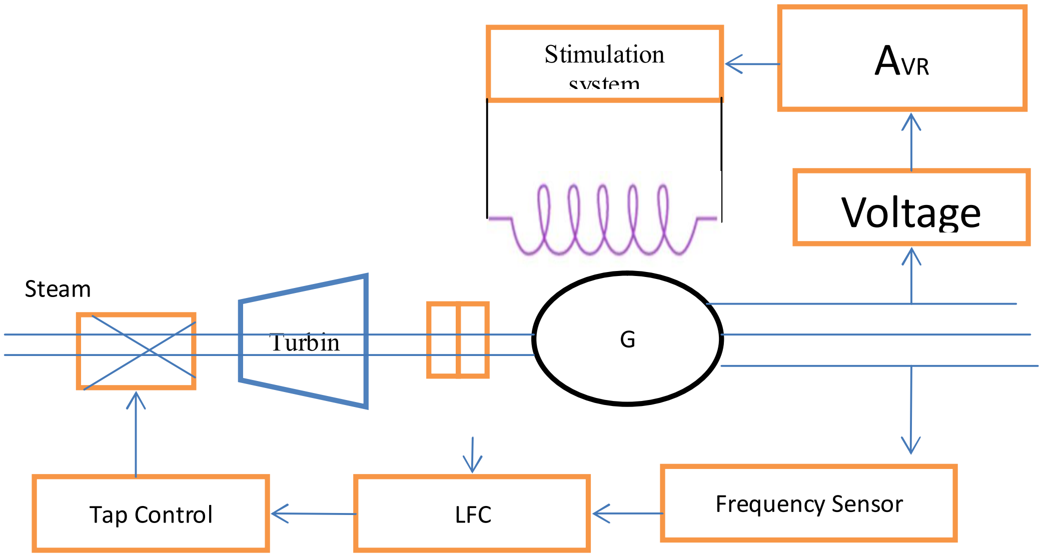

Fig 1synchronic Generator with LFC and AVR

Corresponding author: SadeqAminifar,Department of Electrical and Electronics Engineering, Mahabad Branch,Islamic Azad University,Mahabad, Iran

The dynamical analysis of the generator investigates a relation between the frequency applied by the actuators and the load, current and frequency of the generator with respect to the time. Generator has complex non-linear dynamics that might make accurate and robust control difficult. Therefore, they are good examples to test performance of the controllers.

The generator shown in Fig. 1 was selected as an example problem. The dynamic equations of the generator are usually represented by the coupled non-linear differential equations.

Adaptive Fuzzy Neuron Controller

Since ANFIS design starts with a pre-structured system, DOF for learning is limited, i.e., the MF of input & output variables contain more information that NN has to drive from sampled data sets. Knowledge regarding the systems under design can be used right from the start. Part of the system can be excluded from the training [9]. The structure of the network is composed of a set of units (and connections) arranged into five connected network layers, as shown in the figure 2.

Layer 1: This layer consists of input variables (membership 5 functions), viz., input 1 & input 2. Here, triangular or bell shaped MF can be used.

Layer 2: This layer (membership layer) checks the weights of each MFs. It receives the input values x from the 1st layer and act as MFs to represent the fuzzy sets of the respective input variables. Further, it computes the membership values which specify the degree to x belongs to the fuzzy set, which acts as the inputs to the next layer.

Layer 3: This layer is called as the rule layer. Each node (each neuron) in this layer performs the pre-condition matching of the fuzzy rules, i.e., they compute the activation level of each rule, the number of layers being equal to the number of fuzzy rules. Each node of these layers calculates the weights which are normalized.

Layer 4: This layer is called as the defuzzification layer & provides the output values
y resulting from the inference of rules.

Layer 5: This layer is called as the output layer which sums up all the inputs coming from the layer 4 and transforms the fuzzy classification results into a crisp.

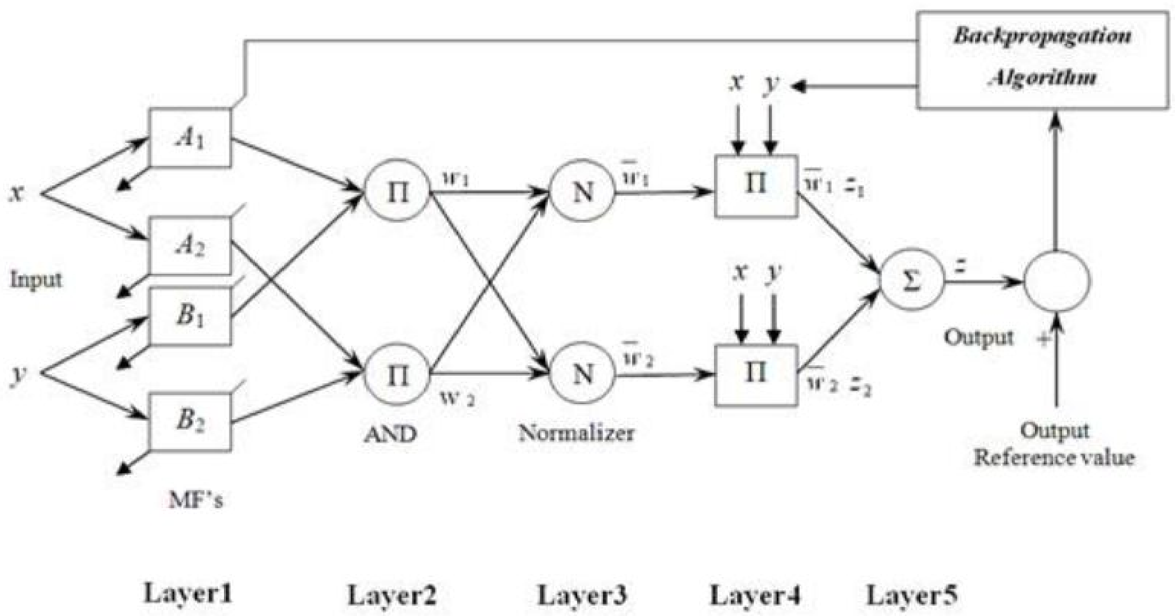

Fig.2structure of T-S Fuzzy Neural Network

RESULTS

The block diagram of generator and Adaptive Neuron- fuzzy controller is shown in Fig 3. In this block, two trained fuzzy neural networks are used that one of themis utilized for control of load and another is utilized for control frequency.

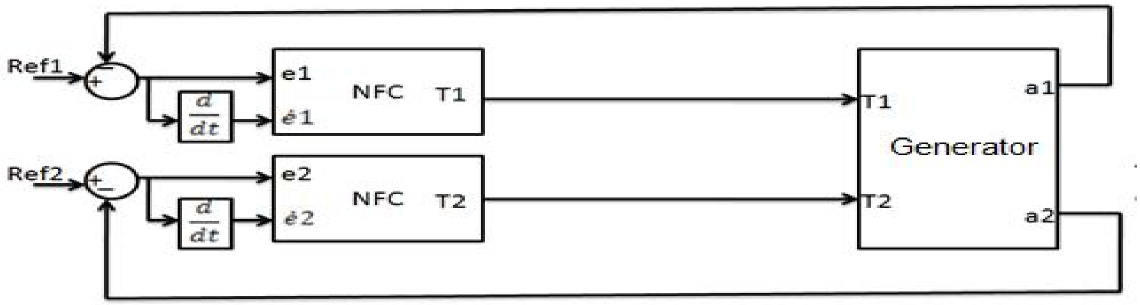

Fig 3.Simulink model of the Adaptive Neuron-fuzzy controller and generator

Two Adaptive Neuron - Fuzzy controllers are effective to controldesiredload and frequency which are designed for generator.These controllers have five membership functions andtrapezoidal type membership functions are used in theirfuzzificationprocess.The rule bases of controllers are made of 25rules and these rules are determined by fuzzy neuralnetwork (FNN).

The desired load and the actual loadof bus 1 and 2 are shown in Figs. 5.

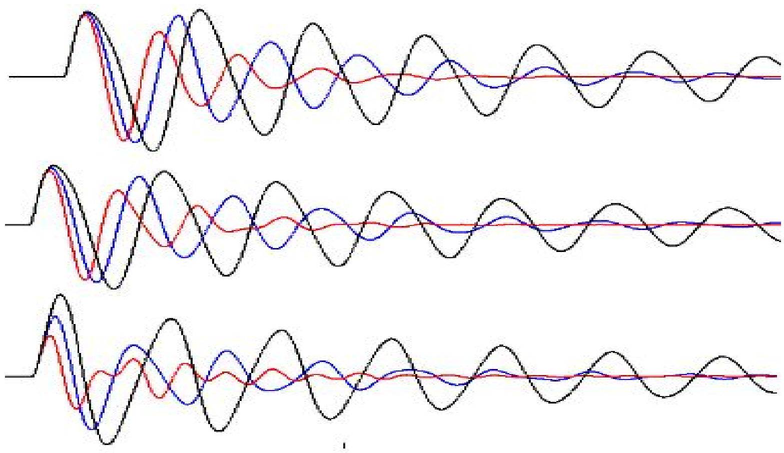

Fig. 4.The existence loads in three buses

The desired frequency and the actualload of the Adaptive Neuron-fuzzyand PID controllerforgeneratorare given in Figs4.

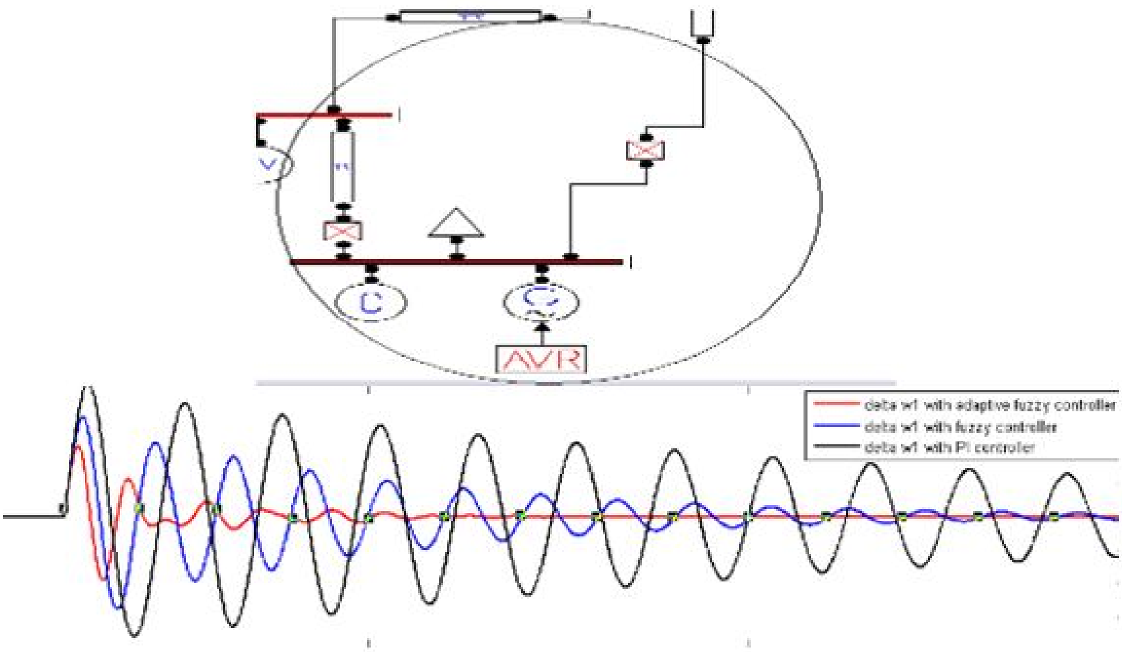

Fig. 5 the speed of generator 1 and 2

Conclusions

The whole structure of power systems have nonlinear dynamic and their operation points may change, therefore the adaptive controllers which don't require exact model of system should be used. For these reasons in this paper we used Adaptive Neuron fuzzy controller for LFC. The whole structure of power systems have nonlinear dynamic and their operation points may change, therefore the adaptive controllers which don't require exact model of system should be used. For these reasons in this paper we used Adaptive Neuron fuzzy controller for LFC. Adaptive Neuron– Fuzzy controller has provided best results for control of power system frequency as compared to the conventional control strategies.Adaptive Neuron– Fuzzy controller has provided best results for control of power system frequency as compared to the conventional control strategies.

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