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IMPROVED AUTOMATIC GENERATION CONTROL OF INTERCONNECTED POWER SYSTEM USING NATURE INSPIRED ALGORITHM

P.S. Pavan Kumar*1, I.K. Reddy*2

*1,2Department Of Electrical And Power Engineering, VIT, Bhimavaram. India.

ABSTRACT

In power systems, automatic generation control is essential to meet the consumer's load demand without affecting the quality of the power with frequency and voltage variations. In this paper we applies some of the nature inspired optimization algorithms such as differential evolution algorithm and artificial neural networks to improve the automatic generation control of interconnected power systems by using PID controllers. We compares the algorithms for feedback and feed forward networks of two area interconnected thermal power systems and reduces the minimum change in frequency.

Keywords: Load Frequency Control, Automatic Generation Control, Differential Evolution, Artificial Neural Network,

I. INTRODUCTION

The main goal of power system is to meet the load demand satisfying the relevant system constraints. The Electrical energy needs to be generated, transmitted and distributed to the consumers. With increasing power demand, power systems are operated as large interconnected system forming the largest complex system consists of generation, transmission and distribution systems. The most significant objective of the power system components is to secure the stable state operation and reliability and quality of power supply. It is known as an Automatic Generation Control (AGC) or load frequency control (LFC).

The major objectives of Automatic Generation Control, in the interconnected power system are to maintain the frequency of each control area and keep the tie-line power flows within the some specified tolerance limits by adjusting the real power outputs of the Automatic Generation Control generators so as to contain the changeable load demands. Any sudden small load perturbation in any of the interconnected areas causes the deviation of the area frequencies and also of the tie line powers.

II. DESCRIPTION OF POWER SYSTEM MODEL

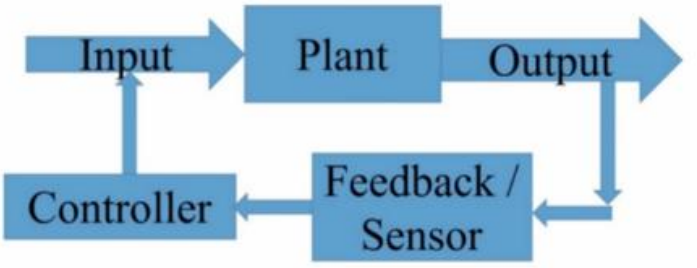

Fig1. Single area feedback system

Two areas are interconnected with a tie line and are controlled by PID controllers in Two area power system model.

III. NATURE INSPIRED ALGORITHMS

These are a type of meta heuristic algorithms which includes randomness of variables. These algorithms are designed based on the nature things such as colony optimization, African bees, strawberry plants etc.

The Nature Inspired Algorithms used in this report are: Differential Evolution (DE), Artificial Neural Network (ANN) and Particle Swarm Optimisation (PSO).

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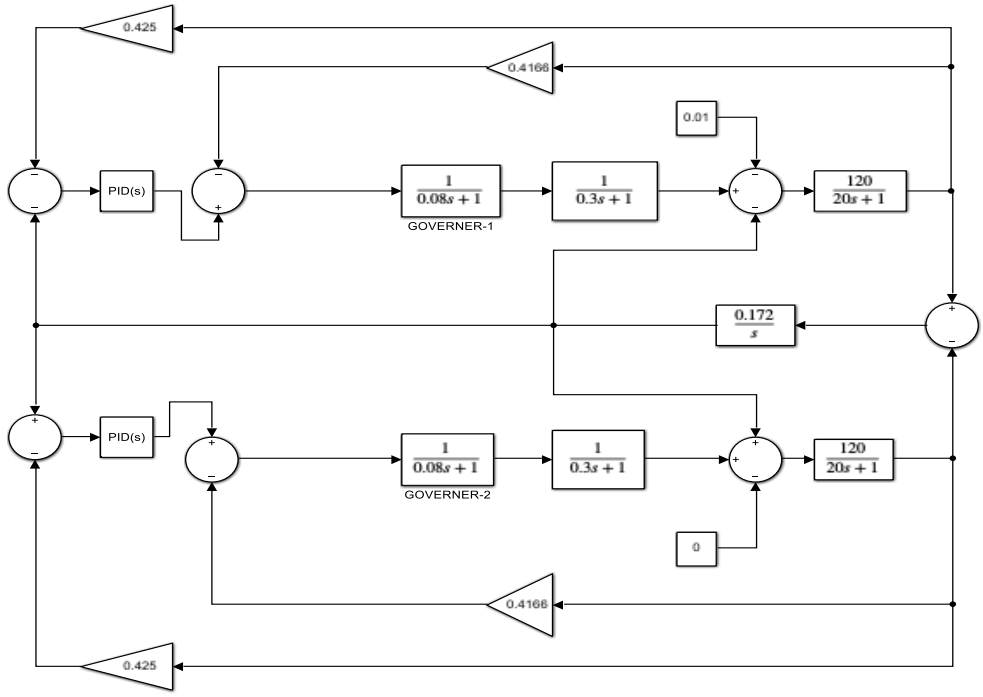

Fig 2. Two area interconnected power system

3.1 Differential Evolution

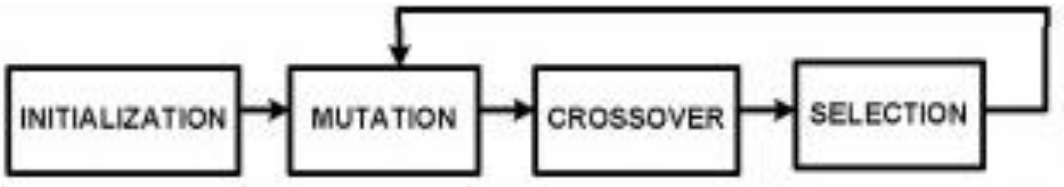

Fig 3. Block diagram of DE algorithm

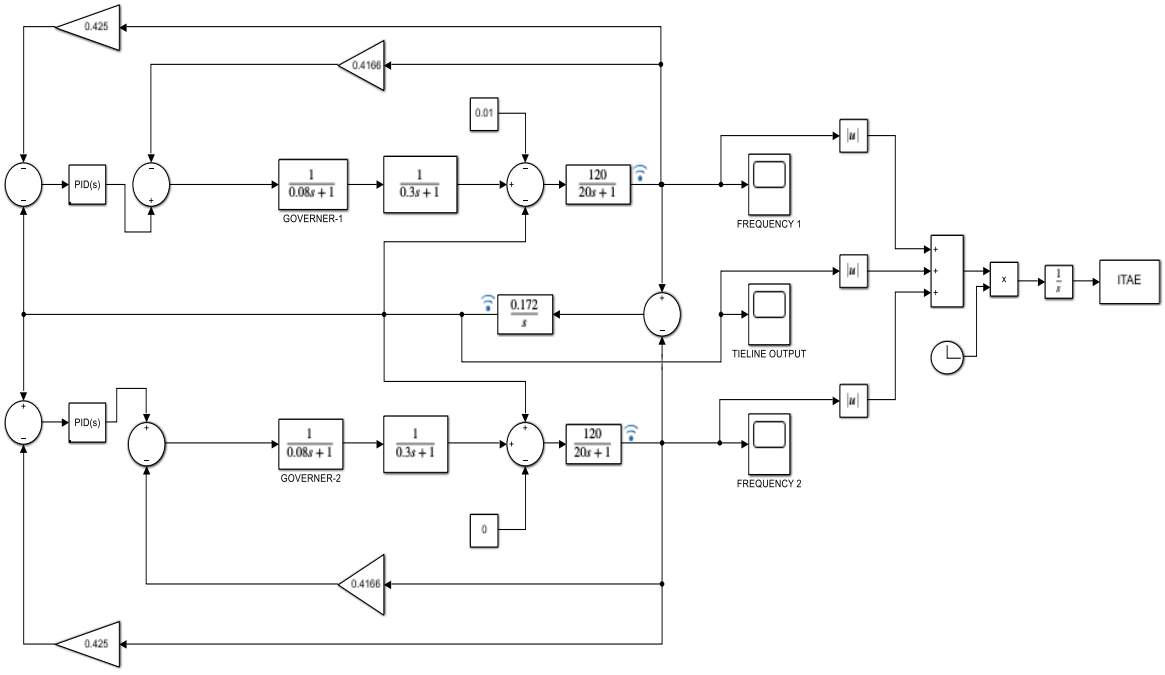

Fig 4. Simulated model for 1% step change in load disturbance of area

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- Differential algorithm is a population based optimization algorithm
- Advantages of DE are: simplicity, efficiency, and real coding, easy use, local searching property and speediness.
- DE works with two populations; old generation and new generation.
- The optimization process is conducted by means of three main operations: mutation, crossover and selection.

3.2 Artificial Neural Network

Artifical Neural Network can quickly adapt to changing operating points and calculates optimal control commands. It can perform effectively even with nonlinearities. The system parameters are not required during starting. It can function even if system inputs are temporarily lost or errors are introduced. If telemetry failure occurs, ANN controller continues to function without needing any decision support software.

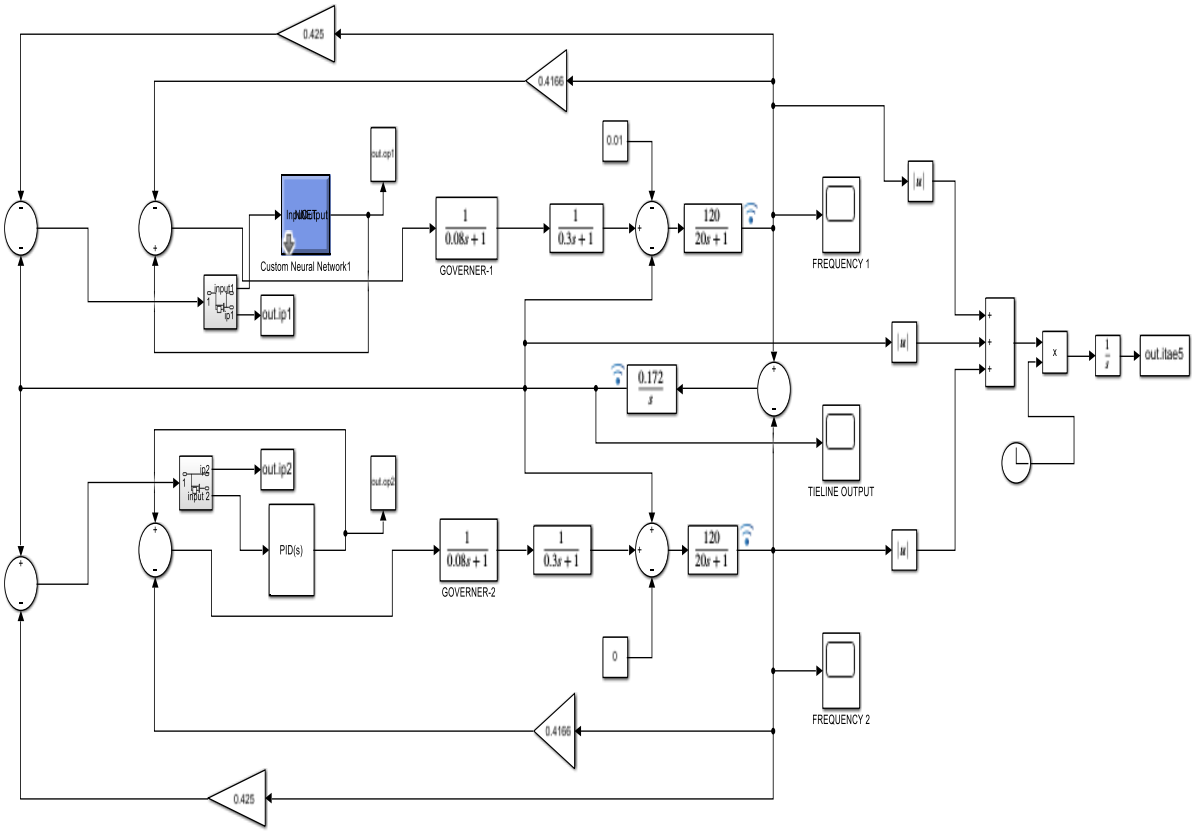

Fig 5. Simulated model for 1% step change in load disturbance of area-1

- Initialize the inputs and outputs.
- Initialize the network weights and bases using functions like logsig, transig, purelin, trainlm etc.
- after that the results are shown at each iteration with training of error, max number of training epoch are initialized.
- Then start training the system and generate trained simulation system after successful training for completion of process

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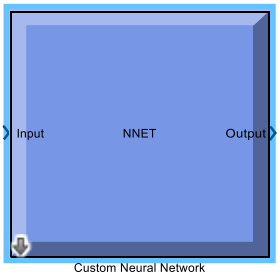

Fig 6. ANN controller

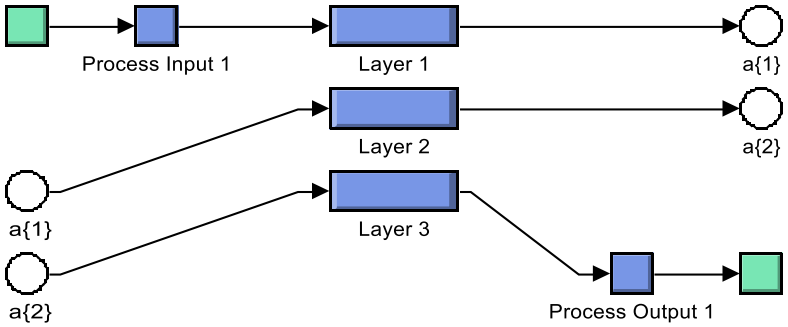

Fig 7. ANN trained neural network

IV. COMPARISION OF OUTPUT RESULTS OF CHANGE IN FREQUENCY

4.1 DE algorithm

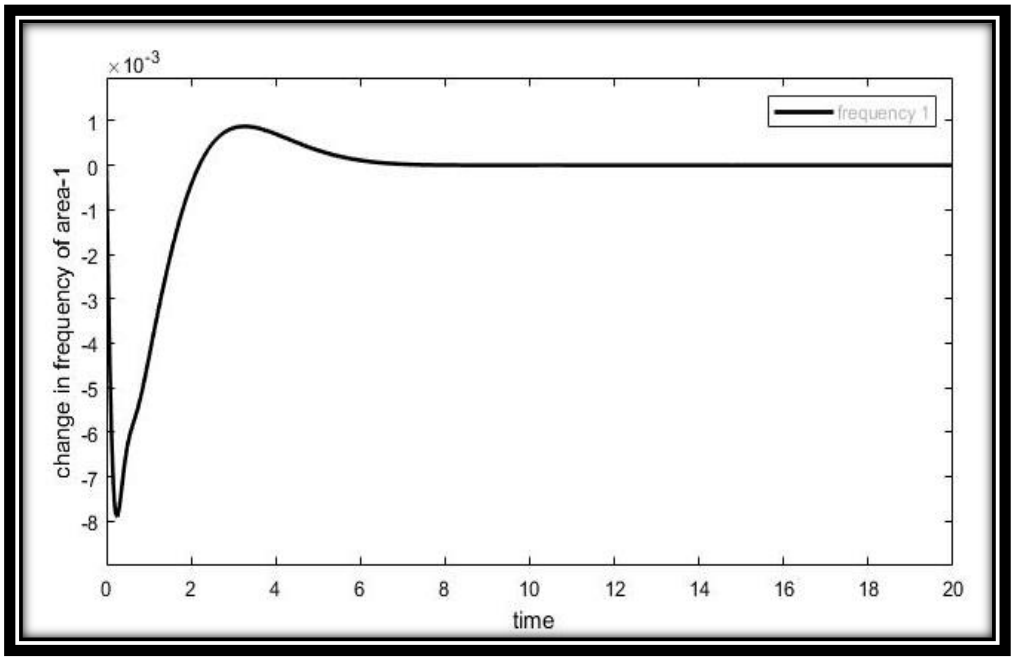

Fig 8. Change in frequency of area-1

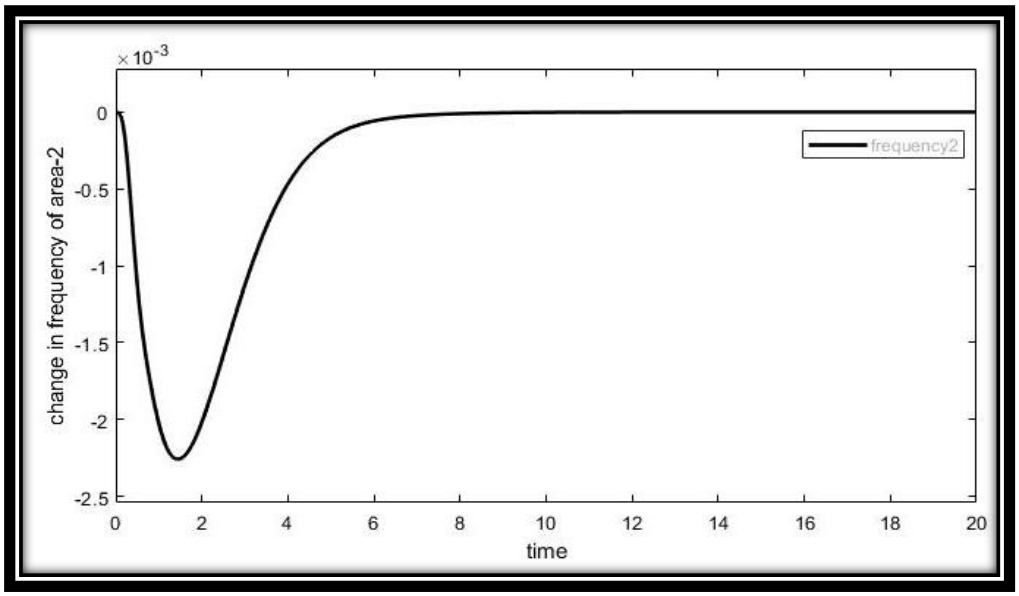

Fig 9. Change in frequency of area-2

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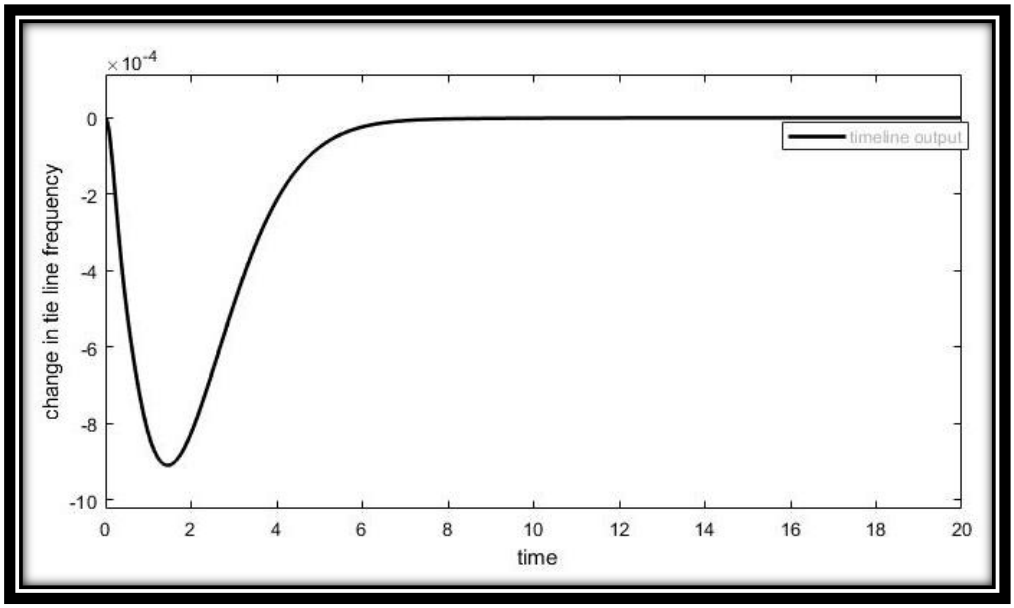

Fig 10. Change in frequency of tie-line

4.2 ANN algorithm

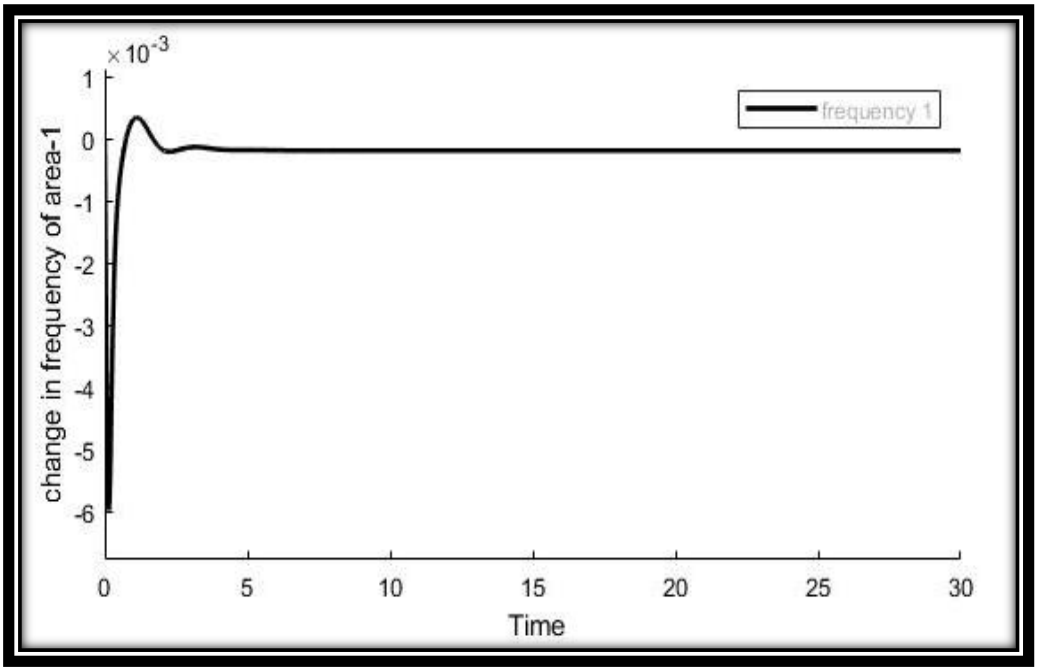

Fig 11. Change in frequency of area-1

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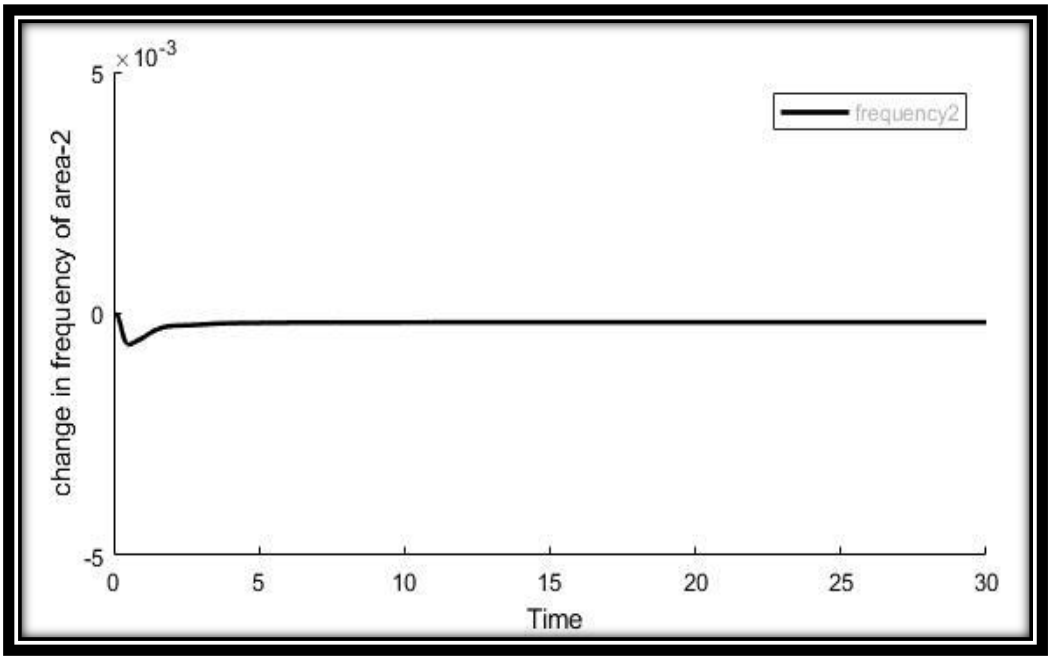

Fig 12. Change in frequency of area-2

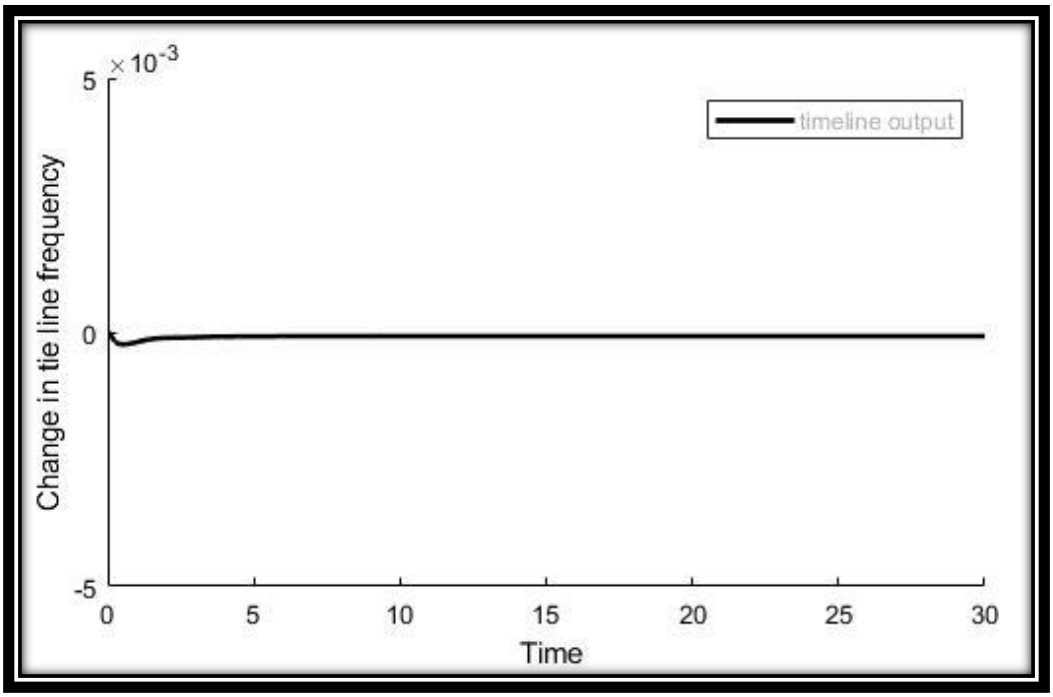

Fig 13. Change in frequency of tie-line

The characteristics two area interconnected power system using same PID same controller of gains: kp=1.5042, ki=1.9628, kd=1.0915, are achieved for fmin=0.02817.

The same PID controllers of gains: kp=1.4, ki=1.6, kd=1.4 are used for both areas initially and after simulation the ANN controller is trained for area-1 for 1% step change in load disturbance of area-1 and the ANN controller is designed for obtained trained neural network.

V. CONCLUSION

By comparing both DE and ANN algorithms on two area interconnected power systems the Artifical Neural Networks (ANN) gives better optimisation results and with little amount of error compared to DE based feedback system.

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