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Simulation of Automatic Load Frequency Control of Power System Area With/Without Conventional Control

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ABSTRACT

The need for satisfactory operation of power stations running in parallel and the relation between system frequency and the speed of the motors has led to the requirement of close regulation of power system frequency. Power systems are frequently subjected to varying load demands. The perturbation in generated power must match the load perturbations if exact nominal state is to be maintained, such mismatches have to be corrected via supplementary control. In this paper work, a detailed investigation on simulation of load frequency control problem for single and double area power system has been carried out by considering PI control in both cases.

Keywords—Area control error, Conventional PI controller, two area power system, Automatic load frequency control.

I. INTRODUCTION

The continuous growth in size and complexity of electric power systems along with increase in power demands has motivated the power control engineers to put their best efforts in the area of Power System Control. Automatic generation control (AGC) of interconnected power systems is defined as the regulation of power output of generators within a prescribed area, in response to change in system frequency, tie line loading, or the relation of these to each other, so as to maintain scheduled system frequency and/or established interchange with other areas within predetermined limits.

The main purpose of operating the load frequency control is to keep uniform the frequency changes during the load changes. The main requirement of AGC is to ensure that:

1) Frequency of various bus voltages and currents are maintained at near specified nominal values.
2) Tie line power flows among the interconnected areas are maintained at specified levels.
3) Total power requirement on the system as a whole is shared by individual generators economically in optimum fashion.

Controller must be sensitive against changes in frequency and load. To analyze the control system mathematical model must be established. There are two models which are widely used,

1. Model of Transfer function
2. State variable approach.

The most applied controller is Conventional Proportional Integral (PI). It is easier but usually gives large settling time. In this paper, LFC with and without PI controller is proposed in both single and double area of power system.

II. SINGLE AREA POWER SYSTEM

The models of speed governor, turbine and generator-load are combined to represent complete block diagram of a single area power system for Load Frequency Control and is represented in fig 1

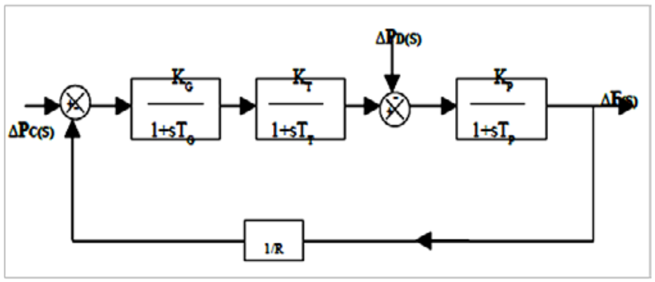

Fig:1 Block Diagram of a single area Power System for load frequency control

From the block diagram in fig 1, the change in ΔF (change in frequency) is due to

1) Change in speed changer setting (ΔPc) and

2) Load Demand (ΔPd)

III. DOUBLE AREA POWER SYSTEM

All power systems today are tied together with neighboring areas and the problem of load-frequency control becomes a joint undertaking. By considering a practical system with a number of generator stations and loads, it is possible to divide an extended power system into sub areas in which the generators are tightly coupled together so as to form a coherent group. Such a coherent area is called a control area in which the frequency is assumed to be the same throughout in static as well as dynamic conditions.

The objective of load frequency control of interconnected power systems is twofold: minimizing the transient error deviations in both frequency and tie line power and ensuring zero steady state errors of these two quantities. A two area power system consists of two single area systems, connected through a power line called tie-line, is shown in the Fig. 2

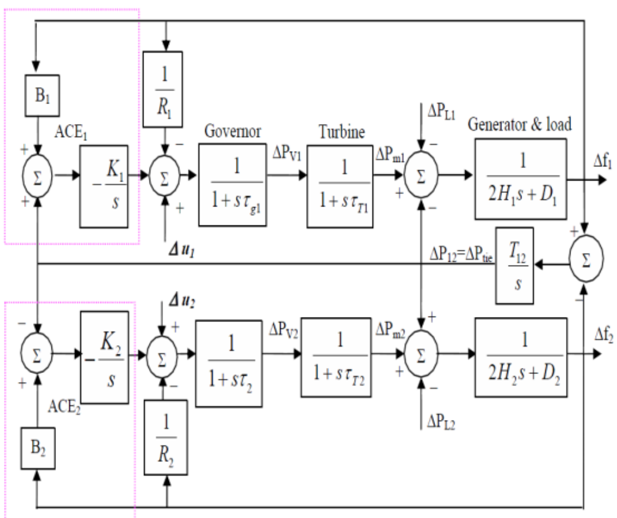

Fig:2 Block Diagram of a double area Power System for load frequency control

Each area feeds its user pool, and the tie line allows electric power to flow between the areas. Information about the local area is found in the tie line power fluctuations. Therefore, the tie-line power is sensed, and the resulting tie-line power is fed back into both areas. It is conveniently assumed that each control area can be represented by and equivalent turbine, generator and governor system.

IV. CONVENTIONAL INTEGRAL CONTROL

The integral control composed of a frequency sensor and an integrator. The frequency sensor measures the frequency error Δf and this error signal is fed into the integrator The input to the integrator is called the Area Control Error (ACE). The ACE is the change in area frequency, which when used in an integral-control loop, forces the s steady-state frequency error to zero.

The integrator produces a real-power command signal ΔPc and is given by

$$\Delta Pc = -Ki \int \Delta f dt$$

$$= -Ki \int (ACE)\, dt$$

Where ΔPc = input of speed –changer and

Ki = integral gain constant.

V. SIMULATION AND RESULTS

The following simulations were performed in order to investigate the performance of the load frequency control using with and without conventional proportional integral (PI) controller.

(1) Simulation of single area LFC without control

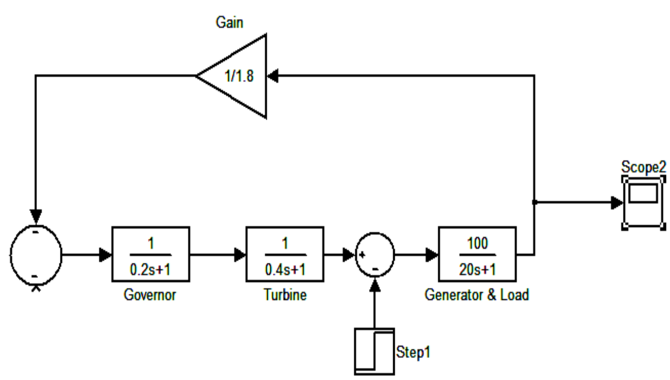

Fig 3 Simulation of Single area LFC without PI control

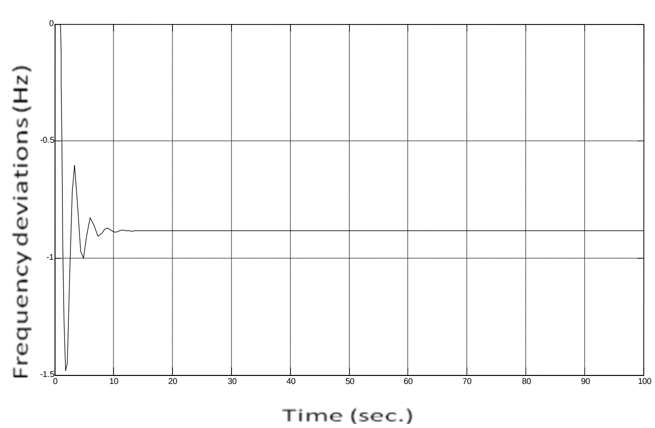

Fig 4 Result of Single area LFC without PI control

(2) Simulation of Single area LFC with PI control

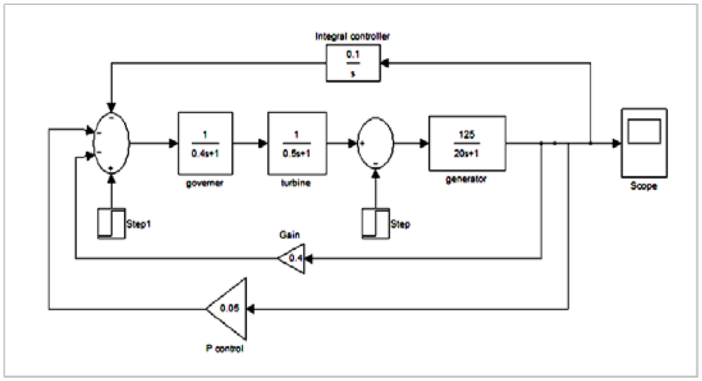

Fig 5 Simulation of Single area LFC with PI control

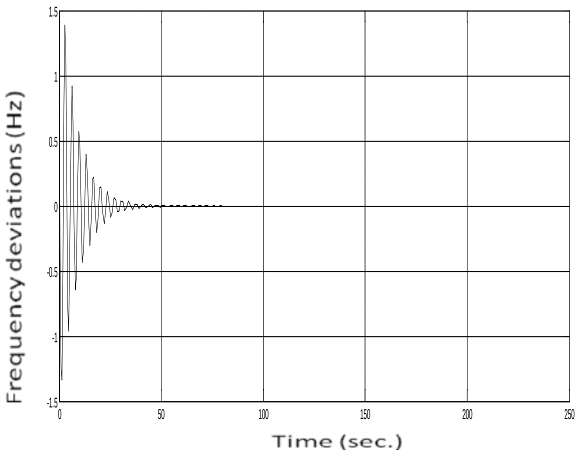

Fig 6 Result of Single area LFC with PI control

(3) Simulation of double area LFC with PI control

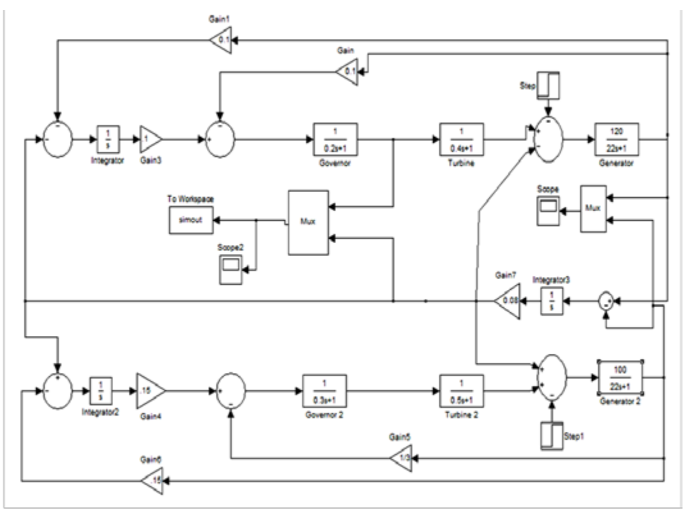

Fig 7 Simulation of double area interconnected power system

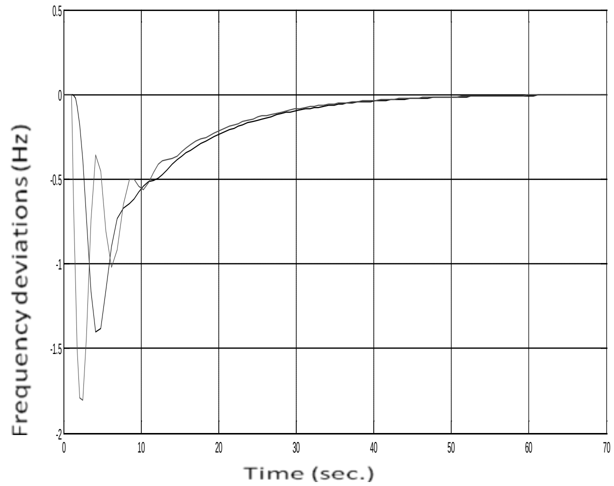

Fig 8 Result of double area interconnected power system (change in frequency)

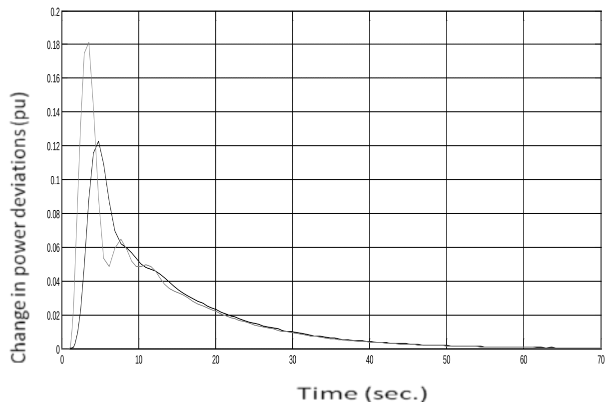

Fig 9 Result of Tie-line interconnected power system (change in power)

V. CONCLUSION

In this paper approach the conventional proportional integral has been investigated for single and double area LFC using MATLAB. As compared without control, the conventional PI control has been improved the frequency deviations and steady state errors (ACE).

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