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Automatic Generation Control of Two Area Power System

Dr. V. A. Kulakarni¹, Siddhant Mohod², Nikhil Gaurkar³, Khimit Jangale⁴,
Nikhil Ghanbahadur⁵

Department of Electrical Engineering, Government College of Engineering, Aurangabad,
Maharashtra, India ¹²³⁴⁵

ABSTRACT: In an electric power system, Automatic Generation Control (AGC) is a system for adjusting the power output of multiple generators at different power plants, in response to changes in the load. Since a power grid requires that generation and load closely balance moment by moment, frequent adjustments to the output of generators are necessary. The performance of the AGC system with optimized gain, in interconnected power system is investigated in this paper. A two area interconnected power system is considered and based on it a comprehensive mathematical model is developed.

The simulation results show that the system stabilizes very quickly following a sudden load changes which in turn increases the capability of the whole system.

KEYWORDS: Automatic Generation Control, Load Frequency Control, Optimal Control System.

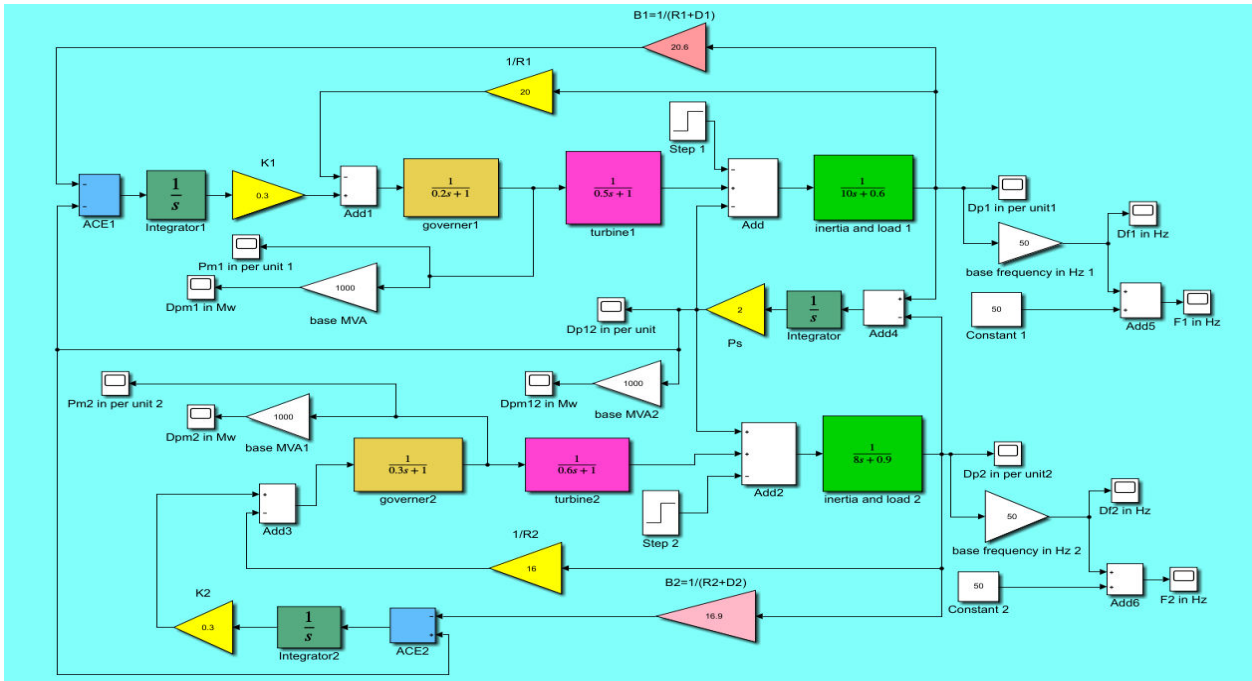
I. INTRODUCTION

Automatic generation control is very important issue in power system operation and control to ensure the supply of sufficient and reliable electric power with good quality. Owing to the continuous growth of electrical power system in size and complexity with increasing interconnections, the problem of power and frequency oscillations due to unpredictable load changes, has become increasingly serious. This problem can be conquered by adopting automatic generation control (AGC). The main goal of the AGC is to maintain the system frequency which has zero steady state error at scheduled value by keeping the balance between generation and load demand plus losses. Many investigations in the area of AGC of interconnected power systems have been reported over past decades with simplified approach. A sudden change in load demand, the area frequencies and tie-line power undergo fluctuations, which persists for a very long time. These fluctuations are poorly damped and usually lie in the frequency range of 0.2 to 1 Hz.

The instantaneous mismatch between generation and consumption of real power due to oscillations can be reduced by optimized gain, and this in turn results in significant improvement in the transients of frequency and tie-line power deviations against small load disturbances. The optimal value of the integral control gain and frequency bias parameter is chosen on the basis of performance index.

II. SYSTEM MODEL WITH AGC

The block diagram of a two area interconnected power system is shown in Fig. 1.



The constant frequency is required to adjust the speed of the turbine by changing the governor characteristic as and when required. If a change in load is taken care by two generating stations running at parallel then the complexity of the system increases. There are many possibilities of sharing the load by two machines, In this paper we have used tie line bias control method.

For a two area system, during normal operation the real power transferred over the tie line is given by –

$$P_{12} = (|E_1||E_2|\sin\delta_{12}) / X_{12}$$

Where, $X_{12} = X_1 + X_{tie} + X_2$ and $\delta_{12} = \delta_1 - \delta_2$

For a small deviation in the tie-line flow

$$\Delta P_{12} = (dP_{12}/d\delta_{12})|_{\delta_{12}} \Delta \delta_{12}$$

$$= P_s \Delta \delta_{12}$$

The tie-line power deviation then takes on the form,

$$\Delta P_{12} = P_s (\Delta \delta_1 - \Delta \delta_2)$$

For increase of 187.5 MW of load in area 1.

The speed regulation of Area 1 and 2 is given by $\frac{1}{R_1} = 20$ and $\frac{1}{R_2} = 16$.



The inertia and load for area 1 and 2 is given by $\frac{1}{2H_1s+D_1} = \frac{1}{10s+0.6}$ and $\frac{1}{2H_2s+D_2} = \frac{1}{8s+0.9}$.

The per unit steady state frequency deviation is $\Delta w = \frac{-\Delta P_{L1}}{[(D_1 + \frac{1}{R_1}) + (D_2 + \frac{1}{R_2})]} = \frac{-0.1875}{[(20 + 0.6) + (16 + 0.9)]} = -0.005$ pu.

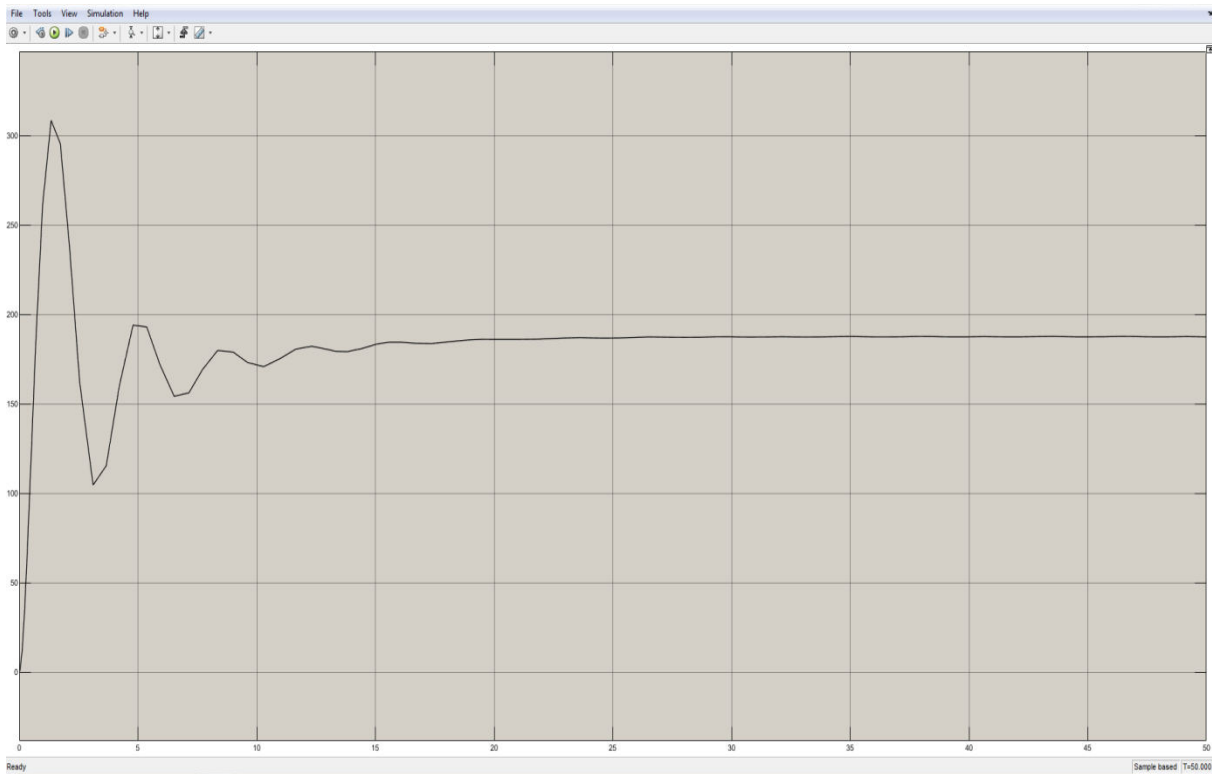
The steady state frequency deviation in Hz is $\Delta f = \Delta f_{P.U.} * f_{Base} = (-0.005)(50) = -0.25$ Hz

The steady state frequency in Hertz is given by $f_{Actual} = f_{Original} + \Delta f_{Actual} = 49.75$ Hz.

The tie line power flow is $\Delta P_{12} = \Delta w * (D_2 + \frac{1}{R_2}) = 0.0845$

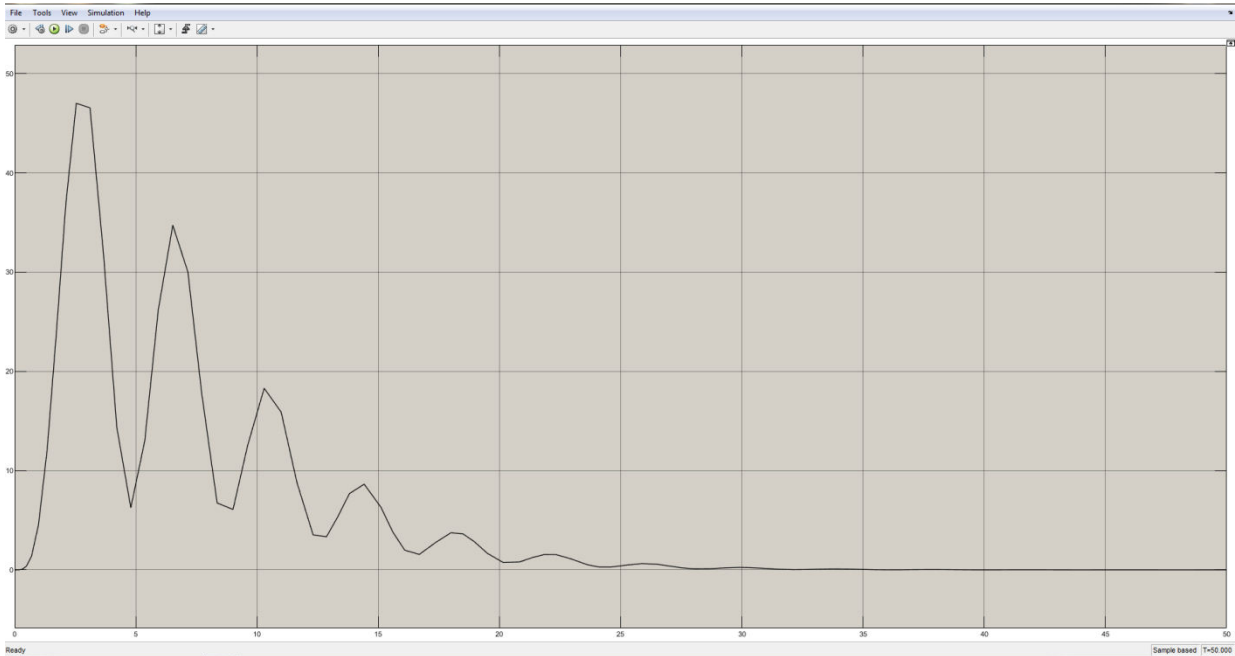
III. RESULTS AFTER ADDITION OF CONTROL LOOP –

- 1) change in mechanical power in area 1 in MW- 187.5 MW

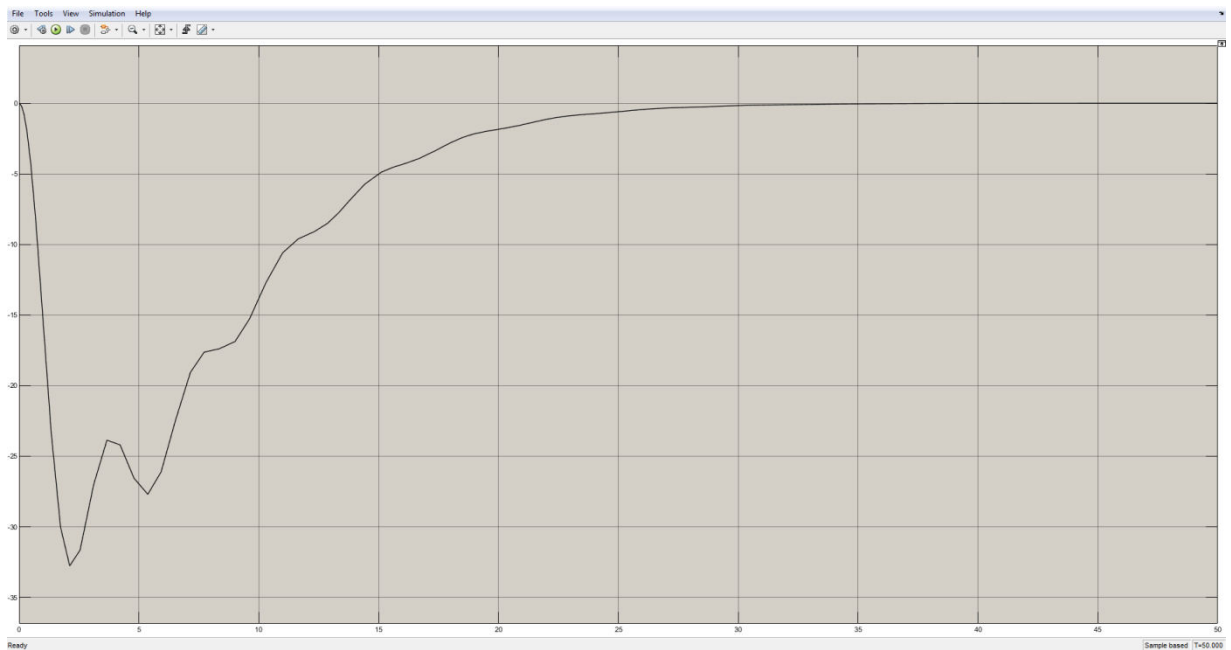




2) change in mechanical power in area 2 in MW – 0MW

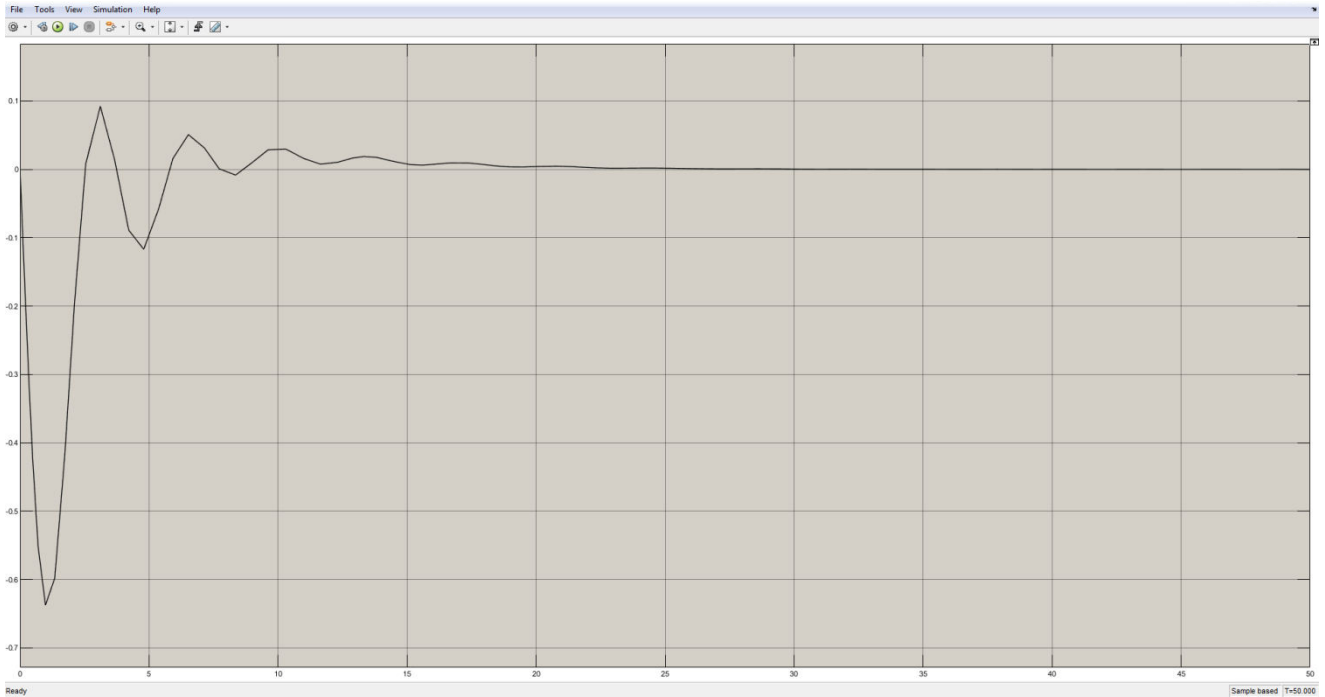


3) change in tie line power in MW – 0MW

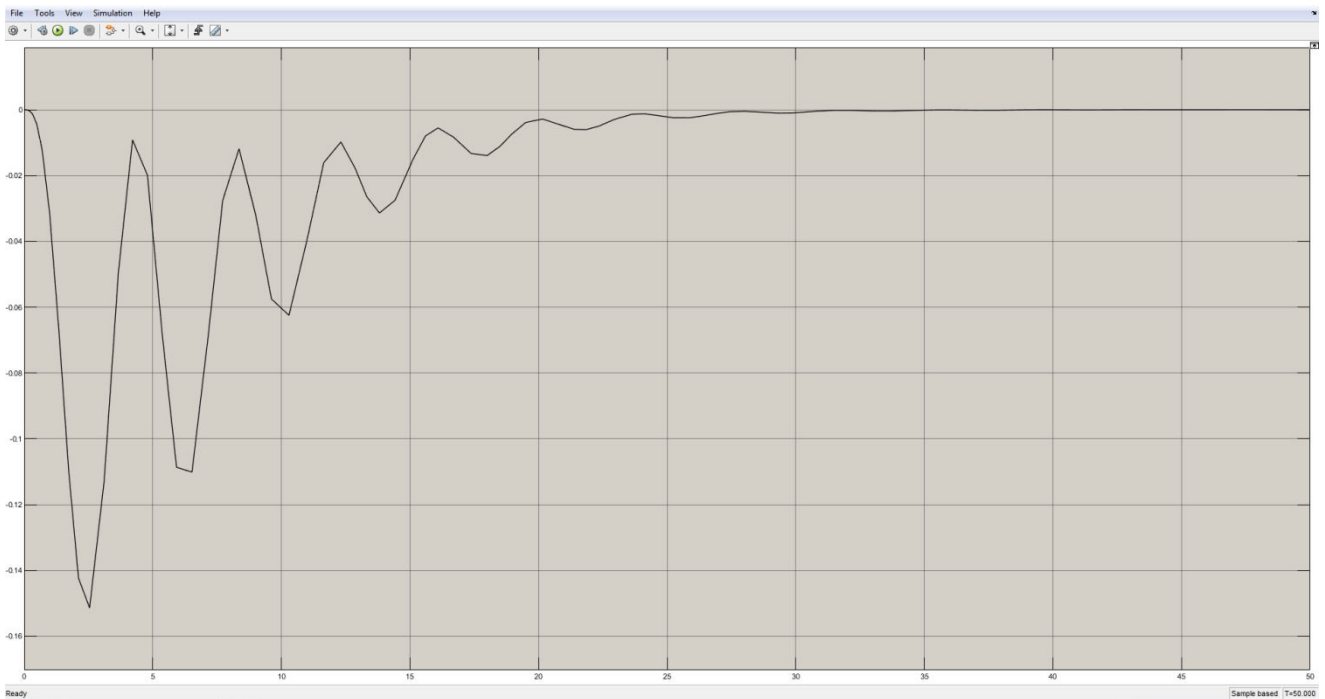




4) frequency deviation in area 1 in Hz – 0Hz



5) frequency deviation in area 2 in Hz – 0Hz





IV. CONCLUSION

In this study a comprehensive mathematical model for AGC of two-area interconnected system is presented. The area frequency and tie-line power oscillation due to small load change are found to persist for a long time for considering non linearity, they are kept as smaller as plausible by optimizing the gain parameters. On the basis of performance index, the optimization of the gain parameters is done. All the tables and simulation results are obtained under the MATLAB environment.

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