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Design of Power System Stabilizer (PSS) to Enhance Power System Stability in Power System

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***Abstract*—The Power system is a Dynamic and highly integrated system and it is being continuously subjected to disturbances. The disturbances may be having frequency range of 0.2 to 3.0 Hz. These low frequency oscillations cause a loss of synchronism and eventual breakdown of the entire system. The used of PSS has become very common in operation of large electric power system. Power system stabilizer are used to generate supplementary control signal for the excitation system in order to damp the low frequency oscillation. The traditional solution of this problem is application of conventional Power system stabilizer. The CPSS which use Dynamic compensator where gain setting design for the specific operating conditions is giving poor performance under different loading condition. Therefor it is very difficult to design a stabilizer that could present good performance in all operating points of electric power system**

Keywords—SMIB; Power system stabilizer

I. INTRODUCTION

Power system is dynamic system and modern power system are highly integrated, large scale interconnections that operate in an uncertain environment where loads, generator output and key operating parameters changes continuously so that Voltage control is difficult task . Keeping voltage within certain limits help to reduce energy losses and improves voltage regulations in the power system.[3]. An important application area for the synchronous machine is used almost exclusively in power system as a source of electrical energy. The synchronous machine is main frame work of power system just like heart in human body So that their protection and maintenance is too important to keep the power system in healthy condition. Occurrence of short circuit and open circuit faults makes fluctuation on the voltages and electrical power and rotor suddenly accelerated. Stability of synchronous generators is influenced by a number of factors such as the setting of generators AVR. In power system generators are placed with high gain, fast acting automatic voltage regulator to provide large scale stability by holding the generator in synchronism with the power system in faulty conditions. AVR can decrease the damping torque of generators, leading to a system oscillatory type instability. Sufficient controllers and dampers are required to compensate speed and jerk of rotor.[1][4].

The interconnected power system has different types of oscillations. There are mainly two different types of system oscillations. One type is that the units at a generating station swinging with respect to the rest of the power system is called as local plant mode oscillation. The disturbance of local mode have frequency range from 0.6 to 2.0 Hz. The second type of oscillations is associated with the swinging of many machines in one part of the system against machine present in other parts. These oscillation is called as inter-area mode oscillations. The disturbance of inter-area mode have frequency range from 0.1 to 0.8 Hz.[5] Several techniques are used for increasing the damping in a power system are as HVDC, static voltage condenser (SVC), and power system stabilizer (PSS). The use of power system stabilizer is better as compare to other techniques in power system. recently most of the generators in the power system are equipped with power system stabilizers for enhancing low frequency oscillations in power system. The aim of PSS is to provide damping to generator rotor oscillations by controlling its excitation using auxiliary stabilizing signal.[2][3]

II. BLOCK DIAGRAM OF SMIB

The union of a governor and turbine are used to drive the synchronous machine as shown in below diagram. AVR and PSS are used in feed back as shown in diagram.PSS is generator control device which is used to enhance the damping of rotor oscillation. Single machine infinite bus block diagram is shown in fig.[6]

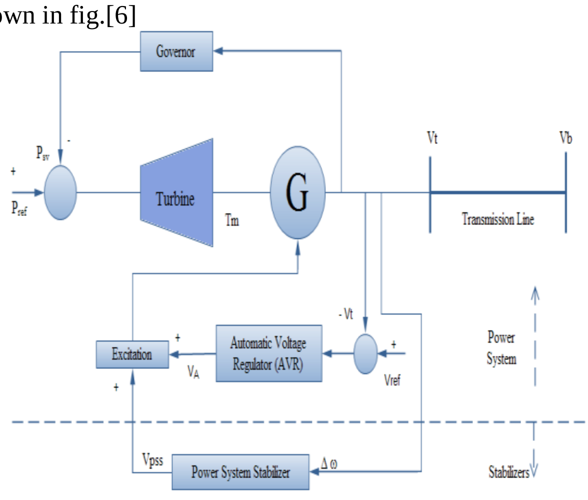

Fig 1. Block Diagram of SMIB

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III. SYNCHRONOUS MACHINE EQUATION FOR SYSTEM SIMULATION

The machine equations for system simulation is given below

$$\frac{d\delta}{dt} = \omega_b(s_m - s_{mo}) \quad (1)$$

$$\frac{ds_m}{dt} = \frac{1}{2H}\left[-D(s_m - s_{mo}) + T_m - T_e\right] \quad (2)$$

$$\frac{dE'_q}{dt} = \frac{1}{T'_{do}}\left[-E'_q + (X_d - X'_d)i_d + E_{fd}\right] \quad (3)$$

$$\frac{dE'_d}{dt} = \frac{1}{T'_{do}}\left[-E'_d - (X_q - X'_q)i_q\right] \quad (4)$$

$$T_e = -E'_d i_d + E'_q i_q + (X'_d - X'_q)i_d i_q \quad (5)$$

IV. POWER SYSTEM STABILIZER

The basic function of the components of power system stabilizer is to extend stability limits by modulating generator excitation and provide damping to the oscillation of synchronous machine rotors relative to one another. PSS consists the different block which is shown in fig.

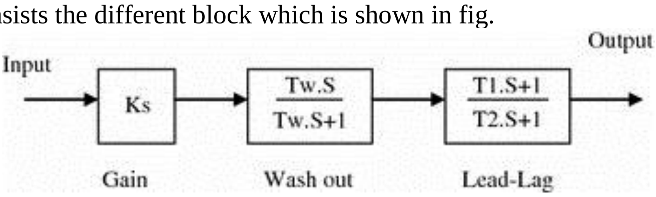

Fig 2. Structure of PSS

V. SIMULATION AND RESULTS

A. *Simulation of SMIB without PSS*

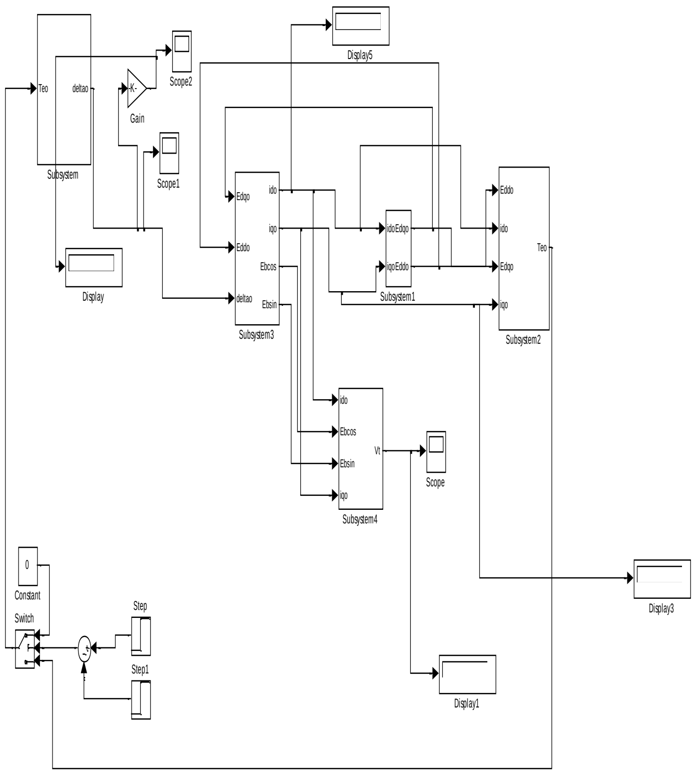

Fig 3. Simulink model of SMIB without PSS

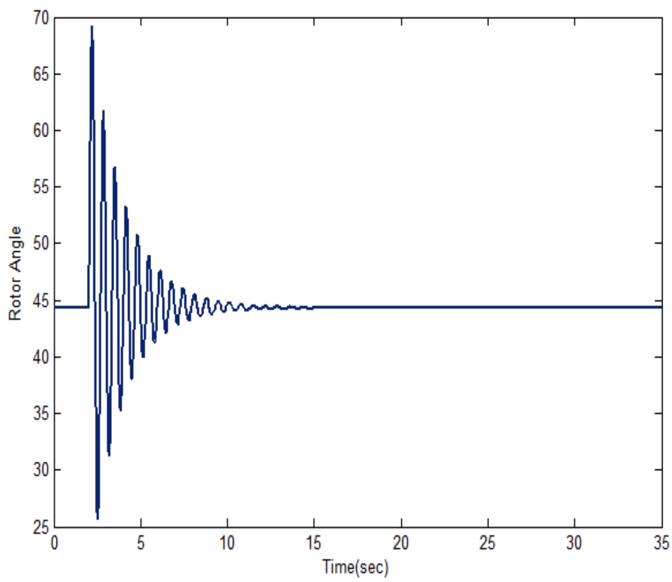

Fig 4. system response without PSS

B. Simulation model of SMIB with PSS

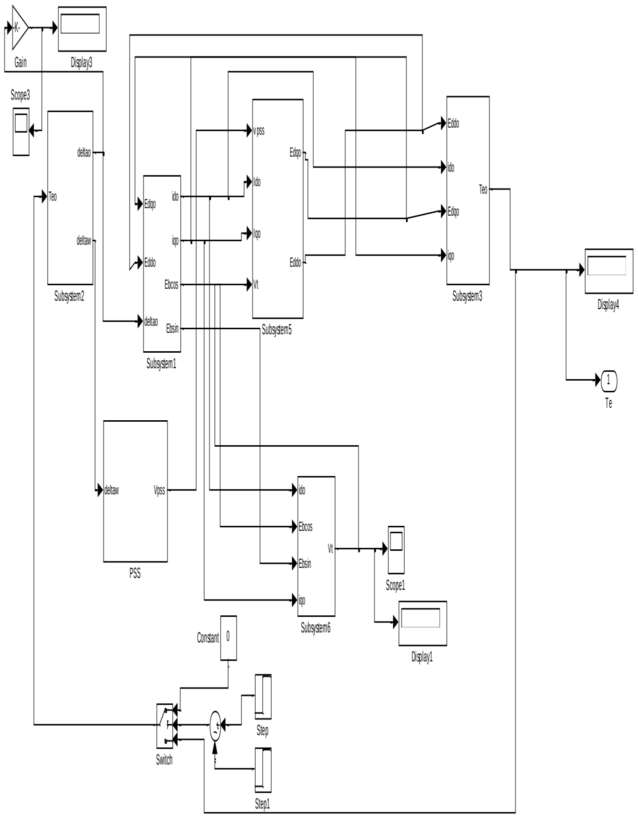

Fig -5: Simulink model of SMIB with PSS

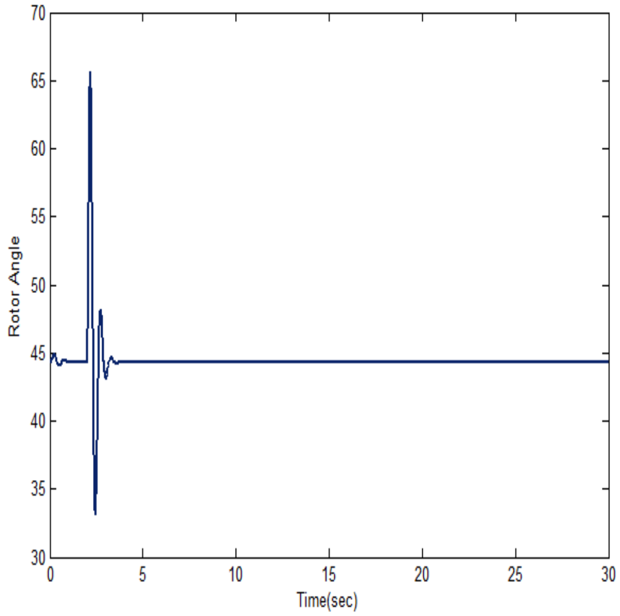

Fig 6. system response with PSS

CONCLUSIONS

Power System Stabilizer is a equipment that produce a damping torque Proportional to the speed variation of the synchronous generator. PSS improve small signal stability of power system which is mainly affected by AVR. Power systems could loose synchronism and experience system separation if the low-frequency oscillations are not damped efficiently. A CPSS can provide damping for a limited range Around its tuning point. To enhance the performance of PSS artificial Intelligent techniques introduce. Which may give better results for PSS.

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APPEDIX

For SMIB

The generator data:X_d=1.93, X_q=1.77, X'_d=0.23, X'_q=0.50, T'_{do}=5.2 sec, T'_{qo}=0.81 sec, H=3.74

The transmission line data:R_a=0, X_e=0.192

Operating data:E_b=1.0, P_t=0.9, Q_t=0.6, V_t=1.098

AVR data:K_A=200, T_A=0.05

PSS data:K_s=6, T_w=10sec, T_1=0.1sec, T_2=0.0472

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