International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2015): 78.96 | Impact Factor (2015): 6.391

Dynamic Stability Improvement of Mulitimachine Power System with PSS

Dr. Ami T. Patel[1], Pratik B. Patel[2], Pal N. Naik[3]

[1]Assistant Professor,Department of Elect. Engg., GEC, Bharuch

[2]Assistant Professor,Department of Elect. Engg., GEC, Bharuch

[3]M.E 2ndYear Elect. Department, MGITER, Navsari

Abstract: *As Power systems become more interconnected, analysis of dynamic performance of such systems become very important. Due to its increasing complexity, the stabilization of system is recent interest of area. Power system mostly subjected to low frequency oscillations due to disturbances. The stability analysis of synchronous generator under small disturbances is examined for multi machine system. The multi-machine system is predominant in inter area mode oscillations. These disturbances occur due to large reactive power, weak ties or large AVR gain with low time constant. The main function of AVR is to maintain constant terminal voltage of Generator and hence improving transient stability. However, it produces negative damping to the system which leads to electromechanical oscillations. To overcome the effect of negative damping, a supplementary control loop is provided by Power system stabilizers. The PSS can increase the damping of the system and transmission capability. Conventional Power system stabilizers (CPSS) is widely used for enhancing system stability, but CPSS design can't guarantee its performances under heavy loading conditions.*

Keywords: stability analysis, automatic voltage regulator (AVR), power system stabilizer (PSS), conventional power stabilizers (CPSS), Mathematical model of synchronous generator.

1. Introduction

Power system is a dynamic system. Nowadays, the electric power systems are not operated as isolated system, but as interconnected systems which having thousands of electrical elements and be spread over wide areas. Synchronous Generator is widely used in a power system as a source of electrical energy. The power systems are frequently exposed to different instabilities such as low frequency oscillations and disturbances that occur due to minor variation in load and generation which results in change in Generator rotor angle.

Excitation control is very useful for maintaining stability of power system. Excitation systems constitute the fast acting AVR. Automatic voltage Regulator (AVR) is needed to regulate the terminal voltage of Generator whenever any drop in terminal voltage due to sudden change in loading or at any fault occurrence. However, it produces a negative damping at higher values of system reactance high generator output. Thus, it is very important to increase the damping torque in order to reduce the rotor angle oscillations.

The Power system stabilizer (PSS) is added to damp the Generator rotor oscillations by controlling its excitation by providing supplementary signal in the excitation system to damp out low frequency Oscillations. To provide damping, the stabilizer must provide component of electrical torque in phase with rotor speed deviation. The use of PSS has become very common in operation of large power system. The Conventional Power system stabilizer (CPSS), which uses lead lag compensation, where gain settings designed for specific operating condition is giving poor performance under different synchronous generator loading condition.

2. Power System Stability

Steady-state stability analysis is the study of power system and its generators in strictly steady state conditions and trying to answer the question of what is the maximum possible generator load that can be transmitted without loss of synchronism of any one generator. The maximum power is called the steady-state stability limit.

Transient stability is the ability of the power system to maintain synchronism when subjected to a sudden and large disturbance within a small time such as a fault on transmission facilities, loss of generation or loss of a large load.

Dynamic stability is a concept used in the study of transient conditions in power systems. Any electrical disturbances in a power system will cause electromechanical transient processes. Besides the electrical transient phenomena produced, the power balance of the generating units is always disturbed and thereby mechanical oscillations of machine rotors follow the disturbance .A system is said to be dynamically stable if the oscillations do not acquire more than certain amplitude and die out quickly.

The multi-machine system is predominant in inter area mode oscillations. These disturbances occur due to large reactive power, weak ties or large AVR gain with low time constant. The main function of AVR is to maintain constant terminal voltage of Generator and hence improving transient stability. However, it produces negative damping to the system which leads to electromechanical oscillations.

3. Conventional Power System Stabilizer (CPSS)

The basic function of a PSS is to add damping to the generator rotor oscillations by controlling its excitation using auxiliary stabilizing signal. To provide damping, the stabilizer must produce a component of electrical torquein phase with the rotor speed deviation. The CPSS design consists Of Stabilizer gain, signal Washout and phase compensation.

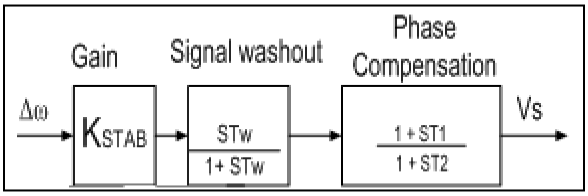

Figure 1: The basic block diagram of CPSS

The **phase compensation block** provides the appropriate phase lead characteristics to compensate for the phase lag between exciter input and generator electrical torque.

The **signal washout block** serves as high pass filter, with time constant Tw high enough to allow signals associated with oscillations in ωr to pass unchanged, which removes D.C. signals. Without it, steady changes in speed would modify the terminal voltage. It allows PSS to respond only to changes in speed.

The **stabilizer gain** KSTAB determines the amount of damping introduced by PSS. Ideally, the gain should be set at a value corresponding to maximum damping.

4. Power System Stabilizer(PSS)

The Power system stabilizer (PSS) is added to damp the Generator rotor oscillations by controlling its excitation by providing supplementary signal in the excitation system to damp out low frequency Oscillations. To provide damping, the stabilizer must provide component of electrical torque in phase with rotor speed deviation. The use of PSS has become very common in operation of large power system. The Conventional Power system stabilizer (CPSS), which uses lead lag compensation, where gain settings designed for specific operating condition is giving poor performance under different synchronous generator loading condition. consider a two area four machine system.

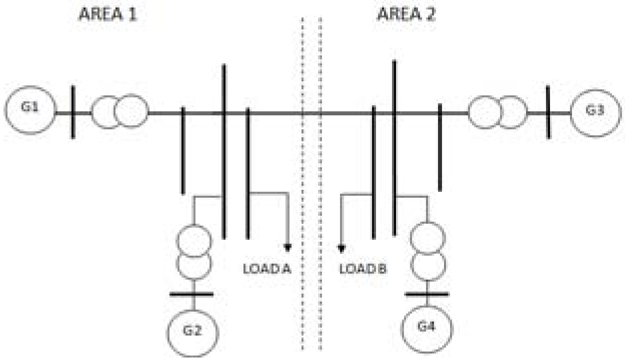

Figure 2: One line diagram of two area four machine system

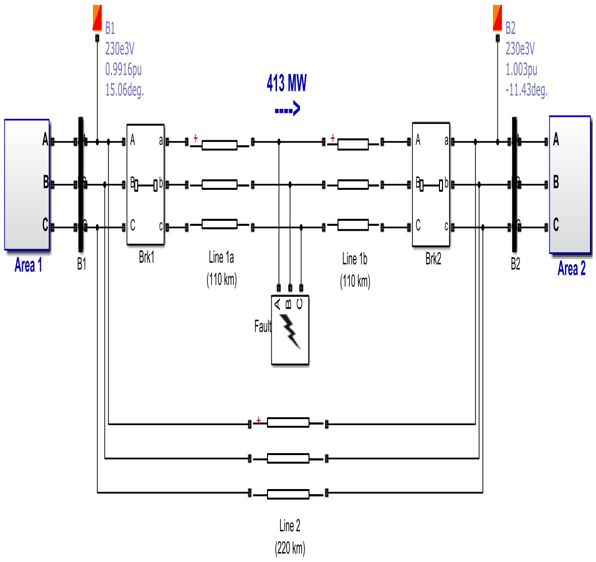

Figure 3: System diagram of two area four machine system

Both the areas are identical but load in area 2 is more. So power is transferred from area 1 to area 2.The ever increasing demand for the electrical energy necessitates the interconnections of various power networks which are geographically dispersed. This is also necessary in order to ensure stable, reliable and economical operation of the power system. But continuous changes in load demand with generation adjustments leads to oscillations of rotors in generator.

5. Mathematical Model of Synchronous Generator

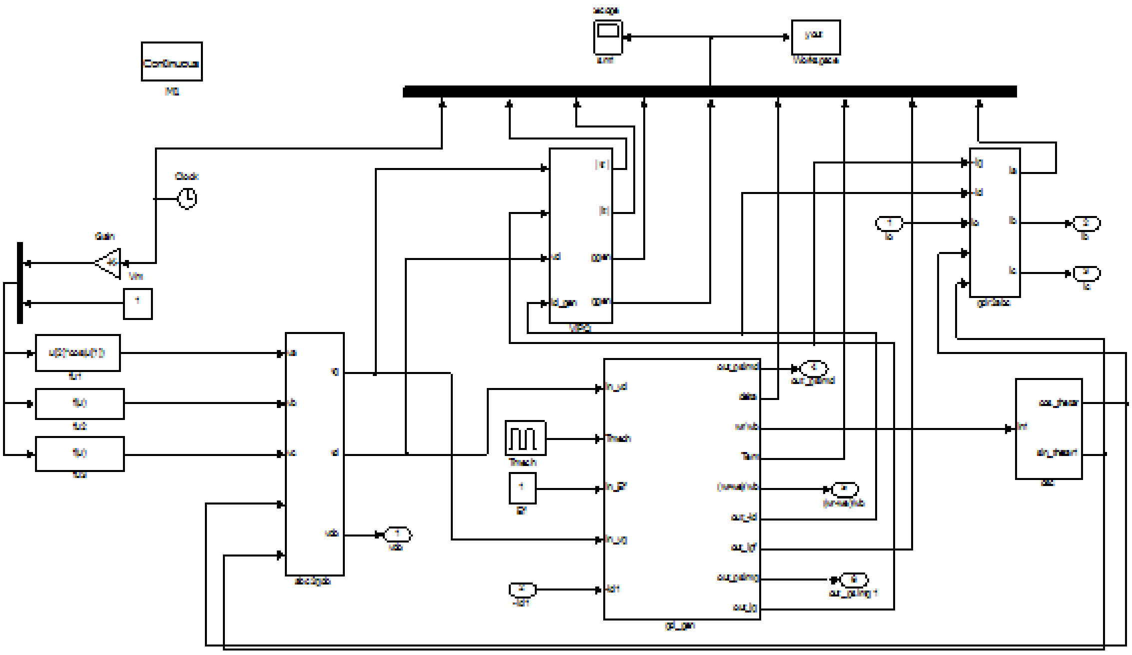

Figure 4: Mathematical model of synchronous generator

6. Inside block

6.1 Qd_gen block:

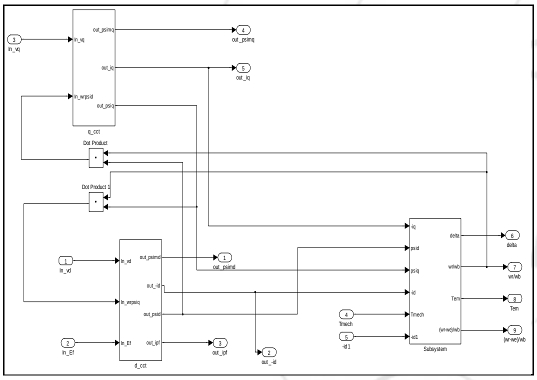

Figure 5: Inside Qd_gen block

6.2 OSC block:

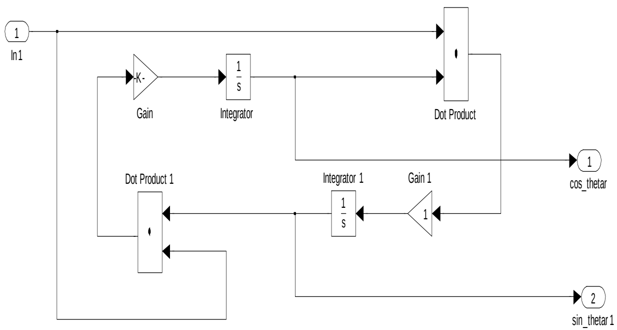

Figure 6: Inside OSC block

7. Result and Discussion

7.1 Real power comparisons between with and without PSS

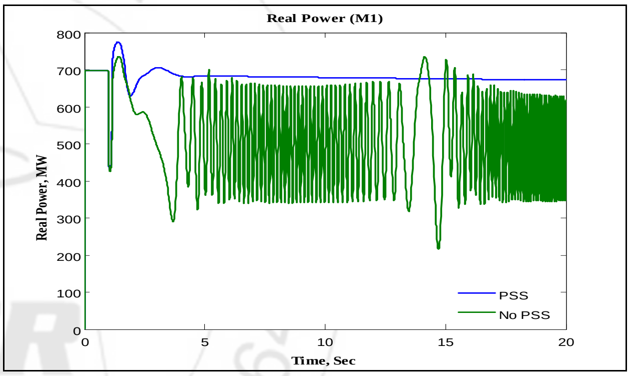

Figure 7: Real power Comparisons in M1

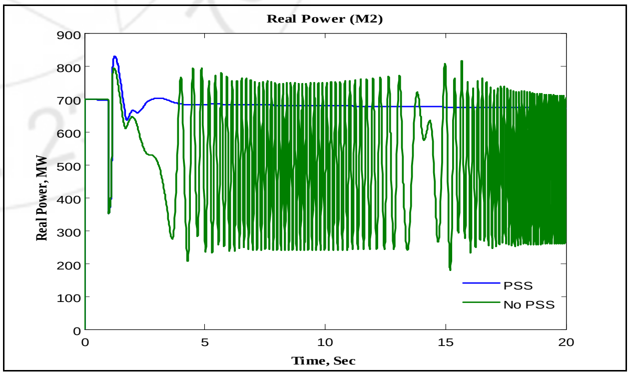

Figure 8: Real power Comparisons in M2

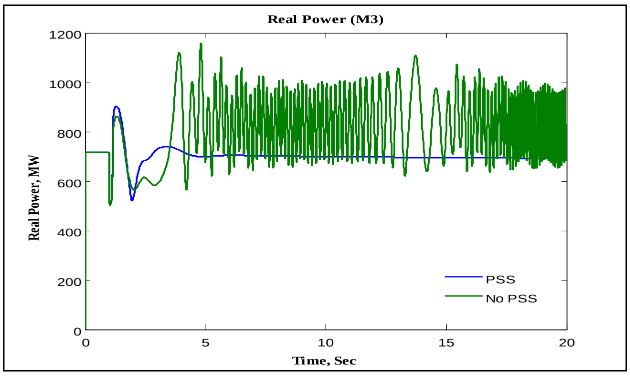

Figure 9: Real power Comparisons in M3

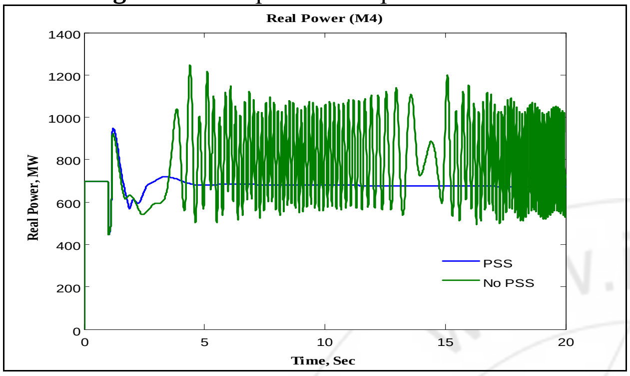

Figure 10: Real power Comparisons in M4

8. Conclusion

After reviewing the outcomes from literature are, analysis of different system like single machine and multi-machine. Different types of Power system stabilizer like CPSS and MPSS. Power system stability like transient stability and steady state stability. To develop a mathematical model of the three phase synchronous generator. To develop test set up for multi area system. To develop a mathematical model of the machine with CPSS. Set up check without PSS in four generators. Set up check with PSS in four generators. Check the parameter like active power, reactive power, rotor angle and speed

References

[1] G N Pillai, Pramod Agarwal Bhavin J Shah, "Power Oscillation Damping in Multi-Machine Power System Using PSSs Considering Various Load Models," in Nirma university conference, Ahemdabad, 2013, pp. 1-6.

[2] Rasool Kazemzadeh, Mohammad Reza Azizian Javad Morsali, "Coordinated Design of MPSS and TCSC-based Damping Controller Using PSO to Enhance Multimachine Power System Stability," , 2013, pp. 978-983.

[3] Anandita Chowdhury Hitesh R. Jariwala, "Design of PID-PSS and SVC in a Multi-machine System for Damping of Power System Oscillations Using Genetic Algorithm," , 2012, pp. 978-983.

[4] Lee, Life Fellow Linjun Shi, "Robust ESS-Based Stabilizer Design for Damping Inter-Area Oscillations in Multimachine Power Systems," pp. 1-11, 2015.

[5] Rajendraprasad Narne2, P.C.Panda sunil kumar sunkara1, "Co-ordinated Tuning of PSS with TCSC Damping Controller through Advanced Adaptive PSO for a Multi-machine Power System," , 2013, pp. 1097-1102.

[6] A. Salem Nia A. Beik Khormizi, "Damping of Power System oscillations inMulti-machine Power Systems Using Coordinate Design of PSS and TCSC," , 2011, pp. 978-982.

[7] M.E-D. Mandor and E.Salim Ali Z.S.EL-Razaz, "DAMPING CONTROLLER DESIGN FOR POWER SYSTEMS USING LMI AND GA TECHNIQUES," , 2011, pp. 500-506.

[8] G. Shahgholian Ghfarokhi- M. Arezoomand-H. Mahmoodian, "Analysis and Simulation of the Single-Machine Infinite-Bus with Power System Stabilizer and Parameters Variation EffectsParameters Variation Effects," , 2007, pp. 167-171.

[9] [9,12] Ancy Sara Vargheses Haseena K A, "Comparative Analysis of Stability Enhancement in SMIB Using Robust PSS with Different Controllers," , 2013, pp. 346-351.

[10] Richard C. Schaefer Michael J. Basler, "Understanding Power-System Stability," , 2008, pp. 463-474.

[11] Rudiger Kutzner and Lutz Hofmann Rodrigo Trentini, "Power grid modeling based on the Electromechanical Energy Approach aiming power systems stability studies," in 24th Mediterranean Conference on Control and Automation (MED), Greece, 2016, pp. 943-948.

[13] Teng Wang Delin Wang Ningning Ma and You Yuan, "Study on Electromechanical Dynamic of Power Systems Based on Trajectory Eigenvalue Sensitivity," , China, 2015, pp. 1446-1451.

[14] R.Behera. M.Pradhan and B.P.panigrahi, "Damping Control of a multi-area System using Fuzzy Logic based Robust Co-ordinate Automatic Voltage Regulator (AVR) & Power System Stabilizer (PSS)," , 2011, pp. 50-62.

[15] P.Pavan kumar, Aeidapu Mahesh and Ankit Shrivastava Dr. Jagdish kumar1, "Power System Stabilizer Based On Artificial Neural Network," , 2011, pp. 978-983.

[16] Nasar.A and Preethy K J.Abdul Jaleel, "Performance Evaluation ofGA and RL based PSS of a Multi-Machine System," in Power and Computing Technologies, 2013, pp. 461-466.

[17] M A Hannan, Hussain Shareef and Azah Mohamed Naz Niamul Islam, "Power System Stabilizer Design Using BAT Optimization Algorithm in Multimachine Power System," in Research and Development, Malaysia, 2013, pp. 540-544.

[18] Soumya Pradhan and Soumya Pradhan Niranjan Nayak, "Optimal Design of Power System stabilizer in a Multimachine System Using Evolutionary Computing,A Comparative Study," , Bhubaneswar, 2015, pp. 978-984.

[19] Faiza Dib and Ismail Boumhidi, "Optimal H∞ Control without Reaching Phase with the Differential Evolution PID Based on PSS for Multi-machine Power System," , 2015, pp. 978-981.

[20] Mohammad S. Naderi b, A. Jalili G and B. Khamenehpour G 0. AbediniaG, "Optimal Tuning of Multi-Machine Power System Stabilizer Parameters Using Genetic-Algorithm," in Power System Technology, 2010, pp. 978-982.

[21] Vivek Prakash, B. P. (2015). A Comparative Study of Different Power System Stabilizers for Dynamic Stability Analysis., (pp. 781-785).