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Simulation and Performance Analysis Two Area Four Machine System Power Stabilization Using PID-PSS

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Abstract— **Power systems are steadily growing with ever larger capacity with their demand. Formerly all separated systems are interconnected to each other parts. Modern power systems are evolved into systems of very wide size. With day by day growing generation capacity, different areas on a power system are added with even large inertia. As a consequence in large interconnected power systems, low frequency oscillations have an increasing importance. Low frequency oscillations include local area modes and inter-area modes. Inter-area modes of oscillations may be caused by the either high gain exciters or heavy power transfer across weak tie line. The occurrence of the inter-area oscillations depends on various reasons such as weak ties between interconnected areas, voltage level, transmitted power and load. At time, the oscillations may continue to grow causing the instability of the power system. lots of power system stabilizers have been developed by the researchers in the past few years, but the area is still open for the efficient power stabilizer development which can efficiently able to handle the power oscillations without increasing the system controller system complexity. This proposed work presents simulation and performance analysis of two area four machine system transmission lines power stabilization capability using conventional PID Power System Stabilizer (PID-PSS). The implementation of this work is with the Simulink of MATLAB 2012(b).**

Keywords: **PID Controller, Power System Stabilizer (PSS), Multi area machine system, Power oscillation Damping.**

I. INTRODUCTION

The power systems are complex for non-linear operating systems, that which are often subjected to low frequency oscillations. The application of power system stabilizers for improving dynamic stability of power systems and damping out the low frequency oscillations due to disturbances has received much attention recently. Power system is a highly nonlinear system and it is difficult to obtain exact mathematical model of the system. In recent years, adaptive self-tuning, variable structure, artificial neural network based PSS, fuzzy logic based PSS, have been proposed to provide optimum damping to the system oscillations under wide variations in operating conditions and system parameters. Low frequency oscillation problems are very difficult to solve because power systems are very large and complex and geographically distributed system. Therefore, that are necessary to utilize most efficient optimization methods to take full advantages in simplifying the problem and its implementation [1-5].

From this perspective, many successful and powerful optimization methods and algorithms have been employed in formulating and solving this problem. These days swarm intelligence has become more and more attractive for the researchers, who work in the relevant research field area. It will be classified as one of the branches in evolutionary computing. Here the Swarm intelligence would be defined as the measure introducing the collective behavior of social insect colonies or other animal societies to design algorithms or distributed problem-solving devices. Generally, the algorithms in swarm intelligence are applied to solve optimization problems. Many swarm intelligence algorithms for solving problems of optimization have proposed such as the Cat Swarm Optimization, the Parallel Cat Swarm Optimization, the Artificial Bee Colony, the Particle Swarm Optimization, the Fast Particle Swarm Optimization, and the Ant Colony Optimization. Moreover, several applications of optimization algorithms based on computational intelligence or swarm intelligence one after another [6-9].

Karaboga proposed the Artificial Bee Colony (ABC) algorithm based on a particular intelligent behavior of the honeybee swarms. The accuracy and efficiency of the ABC are compared with the Differential Evolution, the PSO and the Evolutionary Algorithm for numeric problems with multi-dimensions. By observing the operation and the structure for the ABC algorithm process, we notice that the operation of the process, e.g. the artificial bee, only move straight to one of the nectar sources which are discovered

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by the employed. Nevertheless, all this characteristic may narrow down the zones of which the bees can explore and may become a drawback of the ABC.

This work deals with the simulation and performance analysis of two area four machine system transmission lines power stabilization capability using conventional PID-PSS. The basic aim of this work is to analyze the power stabilization capability of PID-PSS along with the associated problems during power stabilization of two area four machine transmission line systems.

II. Four Machine Two Area System

The test system present in MATLAB 2012(b) consists of two fully symmetrical areas linked together by two tie 230 KV lines of 220 Km length as shown in given MATLAB simulation model. It was specifically designed to study low frequency electromechanical oscillations in large interconnected given power systems. All Despite its minor size, it mimeses very closely the behavior of typical system in all actual operation. That each area are equipped with two identical round rotor generators rated 20000/900 MVA. Given synchronous machines have identical parameters except for the inertias which are H = 6.5s in area 1 and H is = 6.175s in area 2. Thermal plants having identical speed regulators are further assumed at all locations, in addition to fast static exciter with a 200 gain. The load is represented as constant impedance and spilt between the areas [1, 11, and 12].

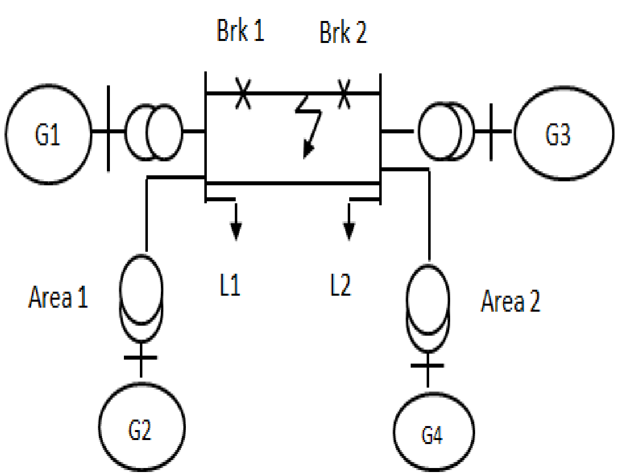

Fig. 1.Two Area Four-Machine power system for Stability Analysis

Now the actual simulation model implemented for analysis of the PID-PSS for power stability is shown in fig. 2. Fig.3. Shows the internal structure of area-1 of the implemented power study testing system and fig. 4. depicts the internal configuration of Turbine and regular consisting the conventional PID-PSS.

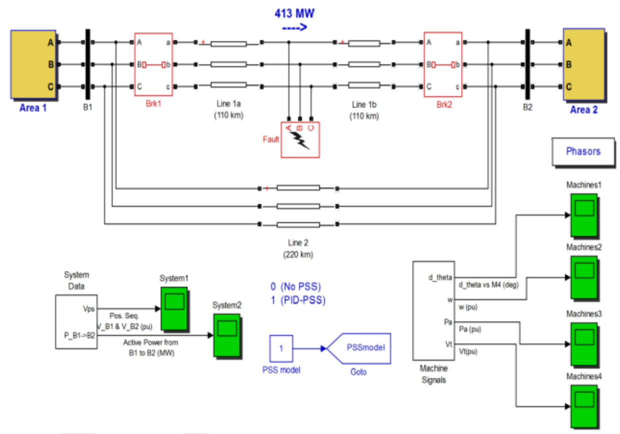

Fig. 2.Actual simulation model implemented with PID-PSS for power stability Analysis.

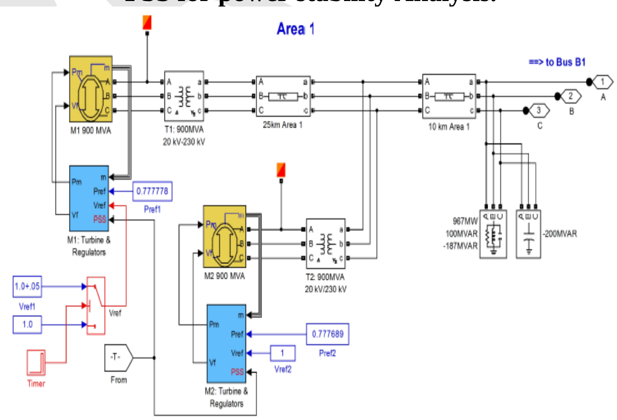

Fig.3.Internal configuration of area 1(subsystem)

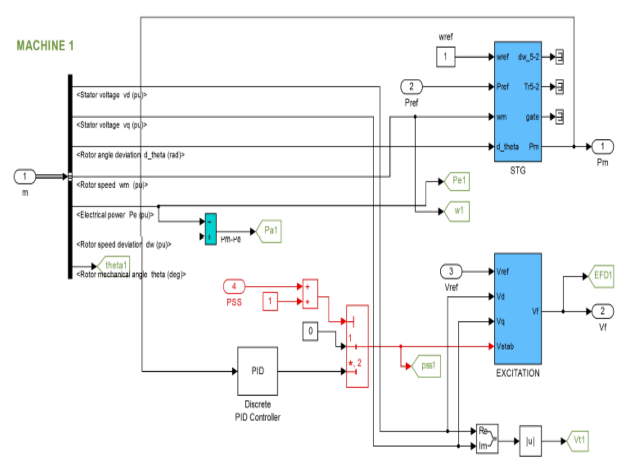

Fig.4.Internal configuration of Turbine and regulator With PID-PSS (subsystem)

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III. Simulation Results

The performance of the PID-PSS was evaluated by applying a large disturbance caused by three-phase fault applied at the middle of one tie line at 0.2 sec. and cleared after 0.133 sec by opening the breakers, with one tie-line the system can reach a stable operating point in steady state. The Parameters of PID controllers of PID-PSS test generators are given in Table 1. Each generator parameters are based on data in Table 2.

Table 1: Parameter of PID controller

Parameter	Kp	KI	Kd
G1	30	10	0.001
G2	10.50	0.67	0.45
G3	10.50	0.67	0.45
G4	10.50	0.67	0.45

Table 2: Parameters of the generator

Parameter	Generator
Xd	1.8
Xd'	0.3
Xd''	0.25
Xq	1.7
Xq'	0.55
Xq''	0.25
Xt	0.2
Tdo	8
Tdo'	0.03
Tq	0.4
Tq'	0.05

To investigate the developed PID-PSS with two-area four-machine test system performance the three phases to ground fault was considered in the simulation study. A 3 phase fault of 0.4sec duration is simulated at line 1. Figure (4), Shows the response of system under without PSS.

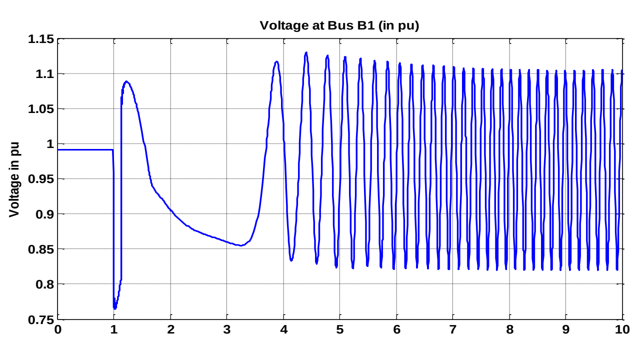

Fig.5 Voltage at Bus_1 without PSS.

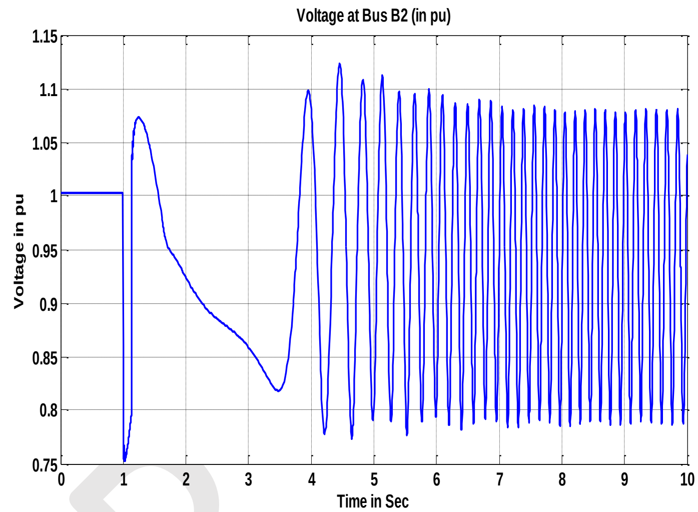

Fig.5 Voltage at Bus_2 without PSS

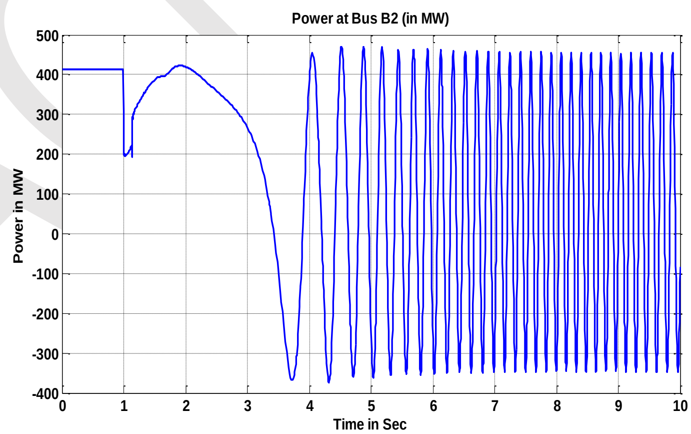

Fig.6 Power at Bus_2 without PSS.

IV. Conclusions

This paper presents a complete performance analysis of two area four machine transmission lines power oscillation damping with PID-PSS and without any PSS. After the simulation of the testing system without PSS, it is found that the power transfer between sending and receiving end highly suffers from large oscillation. In addition to this the most important part with this simulation is that the system without PSS is not able to damp the power oscillation even after 10 sec of simulation. On the other side with the PID-PSS the same system response is quite good and acceptable, but the response is still suffering from oscillations and needs further improvement to efficiently damp the oscillations.

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REFERENCES

[1] Junbo Zhang; Chung, C.Y.; Shuqing Zhang; Yingduo Han, "Practical Wide Area Damping Controller Design Based on Ambient Signal Analysis," Power Systems, IEEE Transactions on , vol.28, no.2, pp.1687,1696, May 2013.

[2] Hussein, T.; Shamekh, A., "Direct Adaptive Fuzzy Power System Stabilizer for a Multi-machine System," Computer Modeling and Simulation (UKSim), 2013 UKSim 15th International Conference on , vol., no., pp.33,38, 10-12 April 2013.

[3] Qudaih, Y.S.; Mitani, Yasunori; Mohamed, T.H., "Wide-Area Power System Oscillation Damping Using Robust Control Technique," Power and Energy Engineering Conference (APPEEC), 2012 Asia-Pacific , vol., no., pp.1,4, 27-29 March 2012.

[4] Babaei, E.; Golestaneh, F.; Shafiei, M.; Galvani, S., "Design an optimized power system stabilizer using NSGA-II based on fuzzy logic principle," Electrical and Computer Engineering (CCECE), 2011 24th Canadian Conference on , vol., no., pp.000683,000686, 8-11 May 2011.

[5] Alsafih, H. A.; Dunn, R. W., "Performance of Wide-Area based Fuzzy Logic Power System Stabilizer," Universities' Power Engineering Conference (UPEC), Proceedings of 2011 46th International, vol., no., pp.1,6, 5-8 Sept. 2011.

[6] Daryabeigi, E.; Moazzami, M.; Khodabakhshian, A.; Mazidi, M.H., "A new power system stabilizer design by using Smart Bacteria Foraging Algorithm," Electrical and Computer Engineering (CCECE), 2011 24th Canadian Conference on , vol., no., pp.000713,000716, 8-11 May 2011.

[7] Babaei, E.; Galvani, S.; AhmadiJirdehi, M., "Design of robust power system stabilizer based on PSO," Industrial Electronics & Applications, 2009. ISIEA 2009. IEEE Symposium on, vol.1, no., pp.325, 330, 4-6 Oct. 2009.

[8] Hadidi, R.; Jeyasurya, B., "Reinforcement learning approach for controlling power system stabilizers," Electrical and Computer Engineering, Canadian Journal of , vol.34, no.3, pp.99,103, Summer 2009.

[9] Huaren Wu; Qi Wang; Xiaohui Li, "PMU-Based Wide Area Damping Control of Power Systems," Power System Technology and IEEE Power India Conference, 2008. POWERCON 2008. Joint International Conference on, vol., no., pp.1, 4, 12-15 Oct. 2008.

[10] Athanasius, G.X.; Pota, H.R.; Subramanyam, P.V.B.; Ugrinovskii, V., "Robust power system stabilizer design using minimax control approach: Validation using Real-time Digital Simulation," Decision and Control, 2007 46th IEEE Conference on, vol., no., pp.2427, 2432, 12-14 Dec. 2007.

[11] Hunjan, M.; Venayagamoorthy, G.K., "Adaptive Power System Stabilizers Using Artificial Immune System," Artificial Life, 2007. ALIFE '07. IEEE Symposium on , vol., no., pp.440,447, 1-5 April 2007.