Investigating the Effect of Power System Stabilizer (PSS) by Using of Particle Swarm Optimization Algorithm (PSO) in Power Systems

MohammadReza Afsharnia, Department of Electrical Engineering, Masjedsolyman Dam and Power, Masjedsolyman, Iran and Farideh Khodabakhshi, Department of Electrical Engineering, Shushtar Branch, Applied Science University, Azin, Iran

***Abstract*— In this paper, we tried to highlight the effect of a power system stabilizer by mentioning a sample and it to be determined the importance of the equipment in the power system that way by modeling and simulating with software MATLAB, was investigated stabilizer effect of the power system on a synchronous machine for complete repelling and dropping of fluctuation and then Particle Swarm Optimization algorithm (PSO) was used to optimize the values of PSS. By using the PSS this fluctuation reduced dramatically, in the final using optimal PSS values we will get a better response.**

***Index Terms*— Power system stabilizer (PSS), particle swarm optimization (PSO), Power System.**

I. Introduction

ONE of the indicators of safe operation in the power system the dynamic stability of the power system against disturbances such as short-circuit, off and switch transmission lines, load variation and production is, which is the ability and capability to return the power system to steady state and maintain synchronization against such disturbances. Since disturbance in an electrical grid is unavoidable, so the improvement of dynamic stability in different directions is of particular importance, which include reducing the number of unwanted outputs, rise of equipment life span, optimal utilization of available capacities in power plants, improve the quality of electricity. Due to the fundamental changes in the network topology and so the deviation of the model parameters of some components of the power plant, such as generator and turbine, relative to the installation time, it is clear that the controller settings of these units are out of optimum mode. This matter has also been a local influence on the stability of the power plant. And more generally, can affect the overall network stability Additionally, these controllers may not be optimized at the installation time and commissioning of the power plant. Also, in many PSS power plants, this controller is out of range due to inappropriate settings. One of the most important tools required to carry out these activities is to have a precise dynamic model of the network, in particular the components of the energy generation units, including generator, excitation system, PSS, governor and turbine. Currently, for the modeling of Iran's network, considering the lack of precise models, examples of standards, articles, or producer companies are used, that they may differ from the existing reality. This can lead to unusual conservatism in the studies and exploitation of the power system and or it can cause unwanted problems

Therefore, it is important do identification tests to determine the exact model of the components of the power plants and to have a consistent and regular program periodically for these experiments. In this paper, a method is based on simulating by Particle Swarm Optimization algorithm (PSO) which is discussed for tuning in the power stabilizer system (PSS).

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Submission date: 01 December 2017, Publication date: 31 January 2018.
Corresponding Author: (e-mail: Farideh Khodabakhshi@gmail.com).

II. Review of the Classical Method and Optimization Algorithms

A power system is made up of generators, loads, transformers transmission lines also disruption in the power system is due to electromechanical fluctuations and consequently, the system variables will also fluctuate. These changes may include system voltage, frequency, load angle of generators, or other system parameters. The stability of these parameters is very important for the stability of the power system. Designed controllers using the classical method, despite having the right simplicity for the system's specific operating conditions, that in it, the network, does not work with unpredictable situations, is suggested. So when the system's work point changes, it is not possible to dump the fluctuations perfectly and properly and it's even possible to make unstable the system is intended also. This matter is because parameters settings of controller that is suitable for system operating conditions in the intended work point, for other locations is not satisfactory. Although there are adaptive control methods that solve this problem, but these methods are very complex, moreover it costs a lot of money. So requirements to design a simple controller that is able to provide a stable system against disturbances in a wide range of performance conditions looks very significant and important. One of the method described here is that the parameter setting method is not very important. That's because precision in design means precision in parameter settings. In practice, each of the parameters of simplicity, speed and proper settings, at least a few points of the of system operating conditions are required. Which in this case affects the impact of classical methods. Optimization methods that based on random Review algorithms. It is suitable for solving complex problems that are very difficult or even impossible to solve using common mathematical methods such as gradients. Sustainability of the power system is one of these issues as solving various equations of the power system in order to identify sustainability of the complexity problem. The operation of such methods in solving complex problems has already been considered by many researchers. For example, the use of Genetic algorithms has been used to coordinate and tune control parameters. There are some factors and requirements for the system's steady state which makes the intended system more stable. In some cases, is possible these factors may be in error which minimizes this error by optimizing algorithms the more can help to sustainability power system.

A. Specifications and hypothetical data for convergence operations in the PSO algorithm

pop=10;
iteration=10;
maxval=[25 0.1 0.1 4 7];
minval=[15 0.01 0.01 2 4.01];
w=0.7;X=zeros(5,pop);
A=rand(1,pop);

III. Simulate Power Systems Using MATLAB and SIMULINK and Use of the PSO Algorithm

If the diagram block of the PSS used in this study is shown in figure 1. The washout signal is a high pass filter that prevents changes at constant speed. Time constant for low frequency fluctuation usually is selected in the range $1 \leq T_w \leq 10$. Lower time constant reduces the component of the synchronous torque in the desired frequency region.

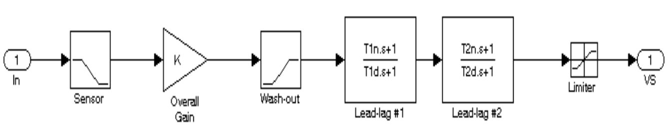

Fig. 1. PSS diagram block.

A. Power system simulation by using an indirect method

In this section, it is assumed that the model of the power system under study is defined and the simulation of this model is considered. To illustrate the subject, an example is expressed according to the previously mentioned content. The simulated circuit is simulated in the Simulink environment in the form of figure (2).

In this level, we want to consider the stabilizer effect of the power system on a synchronous machine for complete repelling and dropping off fluctuation and then we can get better and more complete results using the PSO optimization algorithm. In the first step, we assume that there is not stability in the system. The results of the simulation are shown in figure (3-4).

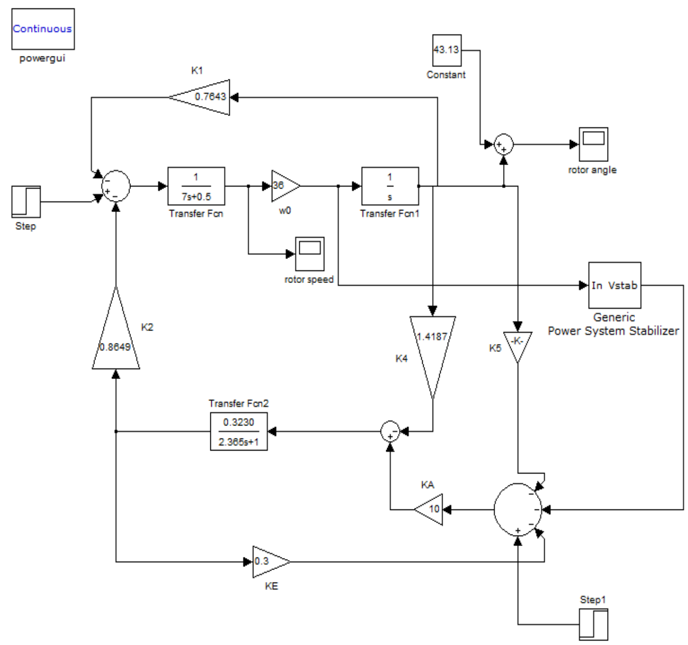

Fig. 2. Simulation of linear model of synchronous machine with excitation system effect and the AVR and PSS stimulation control system in the Simulink environment.

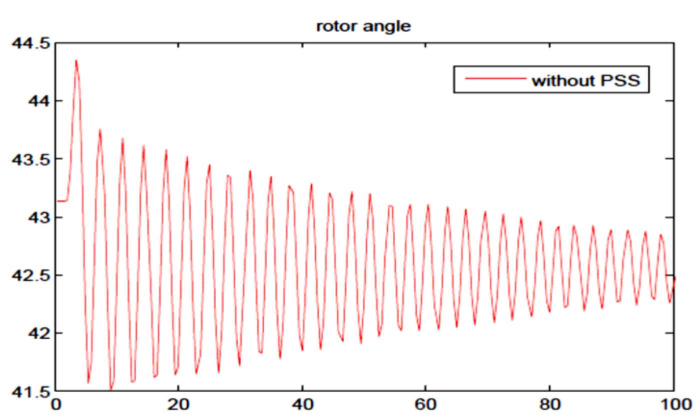

Fig. 3. Wave form of Rotor angle without PSS.

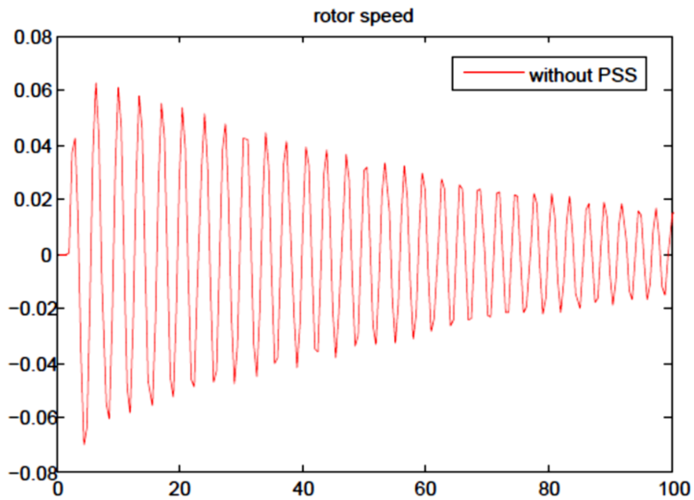

Fig. 4. Wave form of Rotor speed deviation without PSS.

In the second step, we introduce the stabilizer into the simulation circuit. There is a stable model for using of stabilizer in the MATLAB library which we use from that to study. This stabilizer is available at the Matalb Library on the following path.

Simulink Library Browser:\Sim Power Systems:\Machines:\Generic Power System Stabilizer.

That in it, the system parameters are considered are shown in table (1).

After performing the simulation operations, the results are shown in figures (5-6).

At this section with consideration previous simulation part and with using of the PSO algorithm, we will optimize the values in the PSS. Which according to the explanations given in previous sections, this algorithm chooses the most optimal values for PSS components. This block of diagrams is considered the same as the previous, with the difference that in this section, using the PSO algorithm, we try to select the most optimal values for the PSO. The PSS optimal information is updated and used in simulation values updated in table (2) are shown.

TABLE I
PSS PARAMETERS IN THE CLASSIC METHOD

K	10
t_{1n}	7
t_{1d}	10
t_{2n}	8
t_{2d}	10

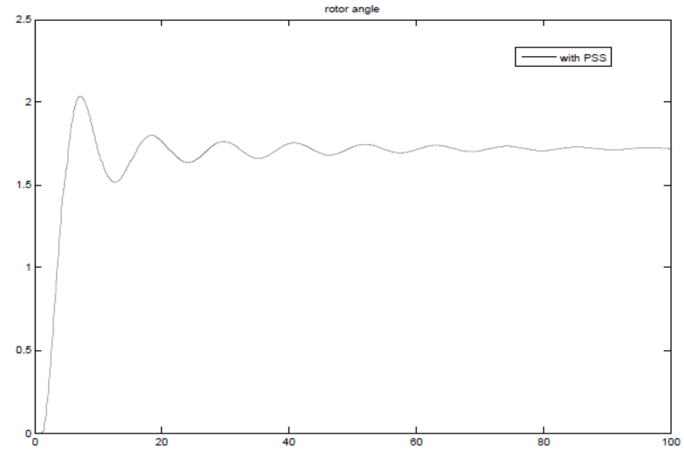

Fig. 5. Wave form of Rotor angle with PSS.

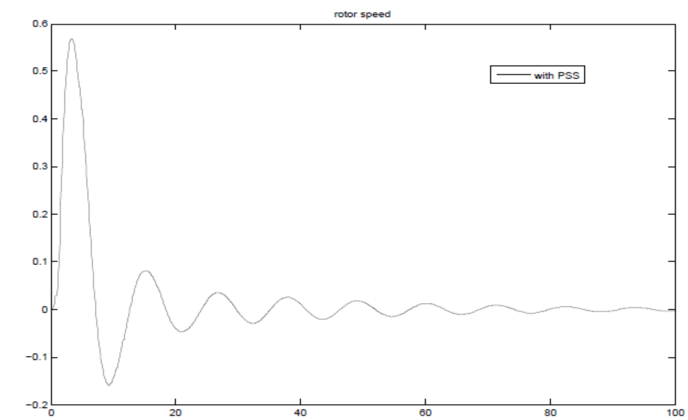

Fig. 6. Wave form of Rotor speed deviation with PSS.

TABLE II
OPTIMIZED PSS VALUES BY THE PSO ALGORITHM

K	7.638
t_{1n}	0.0331
t_{1d}	0.1
t_{2n}	2
t_{2d}	130.4219

The simulation results are shown in figures (7-8).

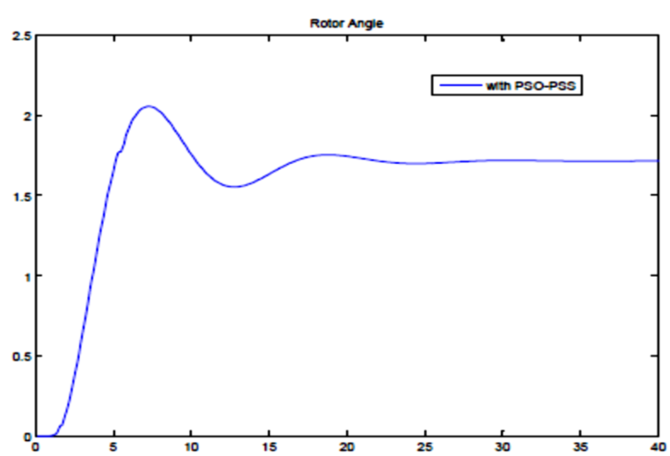

Fig. 7. Wave form of Rotor angle with PSS and Optimization by PSO Algorithm.

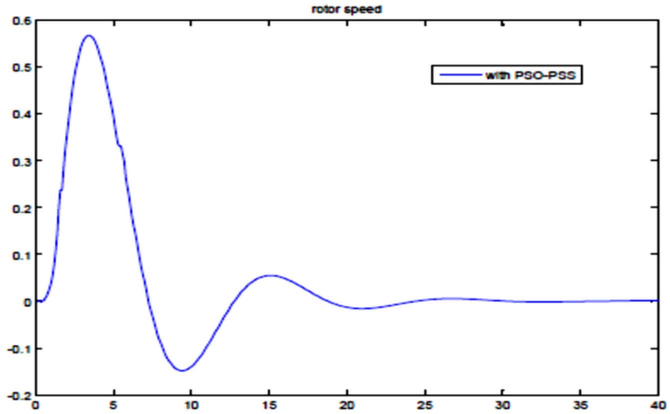

Fig. 8. waveform of Rotor speed deviation using PSS and optimization by PSO algorithm.

IV. CONCLUSION

In this paper we tried by mentioning an example, be investigated the effect of power system stabilizer and be determined he importance of the equipment in the power system. We got these results by modeling and simulation by Matlab software, that before using the stabilizer. The system has a lot of fluctuation and amplitude by using the PSS. this fluctuation will decrease dramatically and the use of PSS improves performance and causes early damping of the power system, in the final step using optimal PSS values we will get a better response.

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