Modeling Comparison on Control System of Synchronous Generator between DIgSILENT Power Factory and PSASP

Dawei Zhao, Lingzhi Zhu, Dajun Jiang, Minhui Qian, Liang Zhao, and Lei Zhang

***Abstract*—PSASP is a widely used power system analysis program in China, and it provides various measured models and corresponding parameters of synchronous generator's control system. DIGSILENT Power Factory is a popular power system analysis software package around the world. In this paper, some commonly used models in PSASP are established in DIGSILENT Power Factory. The contrast effect is implemented by conducting small perturbation and large disturbance in a two-area four-machine system at last.**

***Index Terms*—DIgSILENT power factory, PSASP, automatic voltage regulator (AVR), power system stabilizer (PSS), speed governor (GOV)**

I. Introduction

The reliability of power system simulation depends heavily on the accuracy of the generators and their control system's model structures [1]-[4]. In recent ten years, various measured models and corresponding parameters of synchronous generator's control system (such as automatic voltage regulator (AVR) , power system stabilizer (PSS), and speed governor (GOV)) are got by doing field tests which conducted by China EPRI [5]-[6]. These models and parameters are always integrated into PSASP (Power System Analysis Software Package, developed by China EPRI), which is a widely used power system analysis program in China [7]-[9]. DIgSILENT PowerFactory is a popular power system analysis software package around the world [10]-[13]. Comparison of different power system simulation software for studies on related problems is of importance to know the software's modeling capabilities and limitations [14], and can be used to validate models. In this paper, some commonly used models (type12 AVR, type4 PSS and type1 GOV) in PSASP are established in DIgSILENT PowerFactory, and comparison of the two software is presented by conducting small perturbation and large disturbance in a two-area four-machine power system.

The rest of the paper is organized as follows. Section II describes some commonly used models (type12 AVR, type4 PSS and type1 GOV) of synchronous generator in PSASP and their realization in DIgSILENT Power Factory. Section III presents the research system and comparison results. Section IV concludes the paper.

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II. Commonly Used Models in PSASP and Their Realization in DIgSILENT POWERFACTORY

A. Control Frame

Based on control structure of synchronous generator's control system in PSASP [8], the control frame realized in DIgSILENT PowerFactory is as shown in Fig.1. It contains four parts, i.e., the generator part (GEN), turbine and its governor part (GOV), excitation sysem part (AVR) and the power system stabilizer part (PSS). In this figure, V_S is the output of PSS, E_{fd} is excitation voltage, P_m is the mechanical power, P_e is the active power, w is rotor speed, V_t is the terminal voltage, Q is the reactive power, I_{fd} is excitation current, I_t is the terminal current, $\cos\varphi$ is power factor and S_N is the total nominal apparent power.

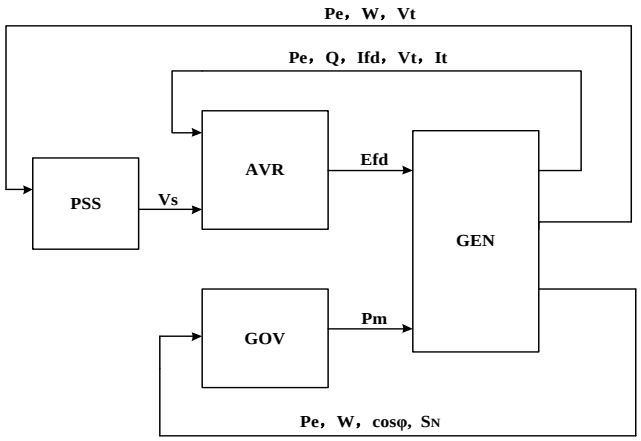

Fig. 1. Control frame realized in DIgSILENT PowerFactory

B. Some Models Realized in DIgSILENT Power Factory

Owing to space limitation, model of type12 AVR in PSASP [8] is not listed here. As a representative, type4 PSS and type1 GOV models and their realization in DIgSILENT PowerFactory are shown in Fig. 2 and Fig. 3 in detail. Please refer to [8] and [1] for meanings of parameters showed in the models. Before modeling them in DIgSILENT PowerFactory, user defined (UD) models are established in PSASP and are compared with original ones in order to make sure each component of the model is clear. Also, it is worth noting that the power's per-unit value is based on the system capacity in PSASP, while in DIgSILENT PowerFactory it is based on generator's rated active power.

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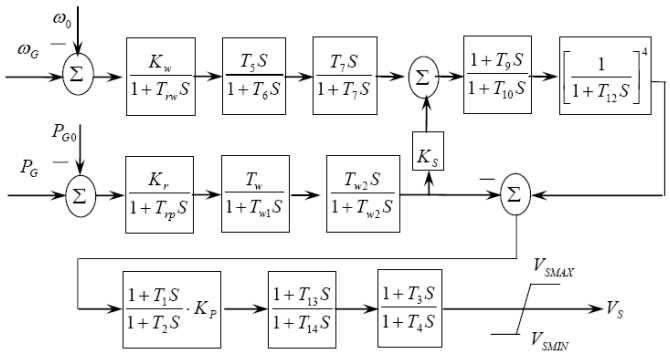
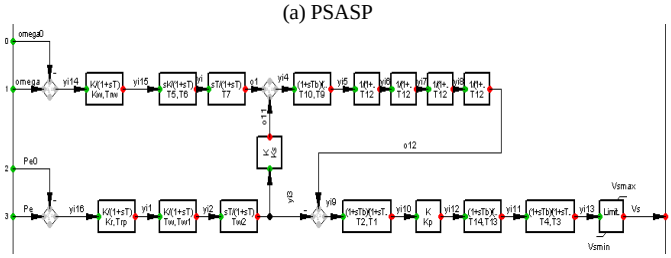
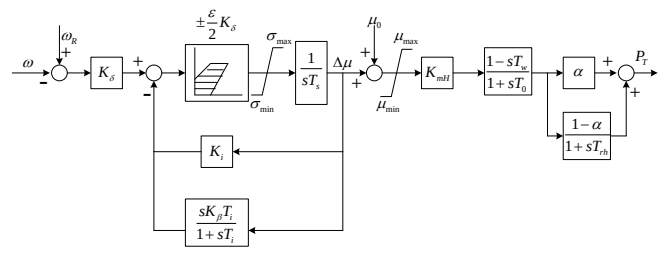


(a) PSASP

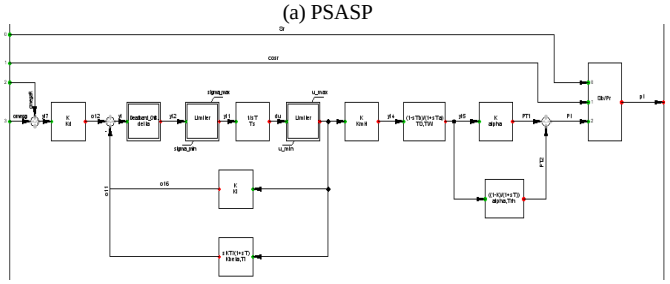


(b) DIgSILENT PowerFactory

Fig. 2. Model of type4 PSS



(a) PSASP



(b) DIgSILENT PowerFactory

Fig. 3. Model of type1 GOV

III. Research System and Comparison Results

To compare the performance of models established in DIgSILENT PowerFactory with PSASP, a two-area four-machine system (see Fig.4) is investigated. For the explanation and parameters of the system, please refer to [15]. Note that all generators are equipped with models established in Section II and the parameters of the generator's control system used in simulation come from field measurement.

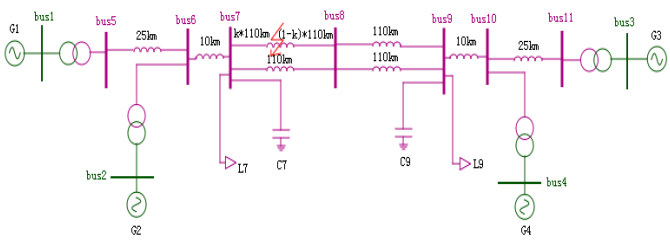


Fig. 4. Two-area four-machine system

Scenario 1 (small perturbation): Suppose that the active load of L7 increases from the initial value 9.67 p.u. to 10.637 p.u. at 1s, and keep it till the end of simulation. Fig.5 shows a comparison between PSASP and DIgSILENT PowerFactory under this scenario.

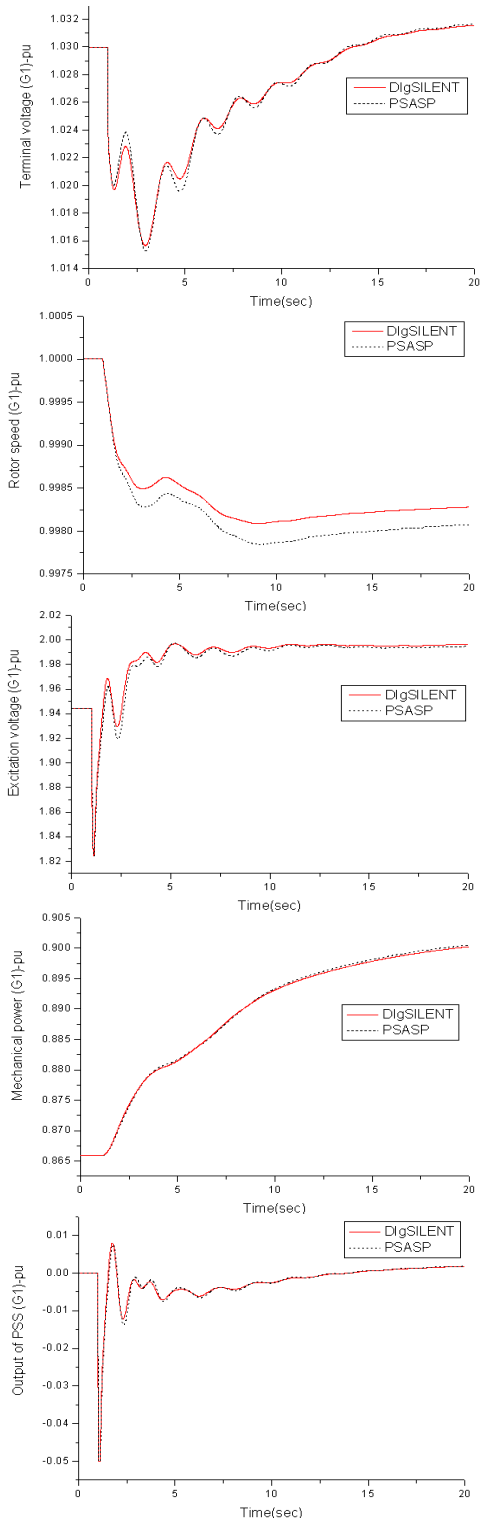


Fig. 5. A comparison between PSASP and DIgSILENT PowerFactory under scenario 1

Scenario 2 (large disturbance): Suppose that a three-phase symmetrical short-circuit happens on one of the lines at point k=0.5 (see Fig. 4). This fault begins at 1s and is cleared at 1.1s. The comparison between PSASP and DIgSILENT PowerFactory under this scenario is described in Fig. 6.

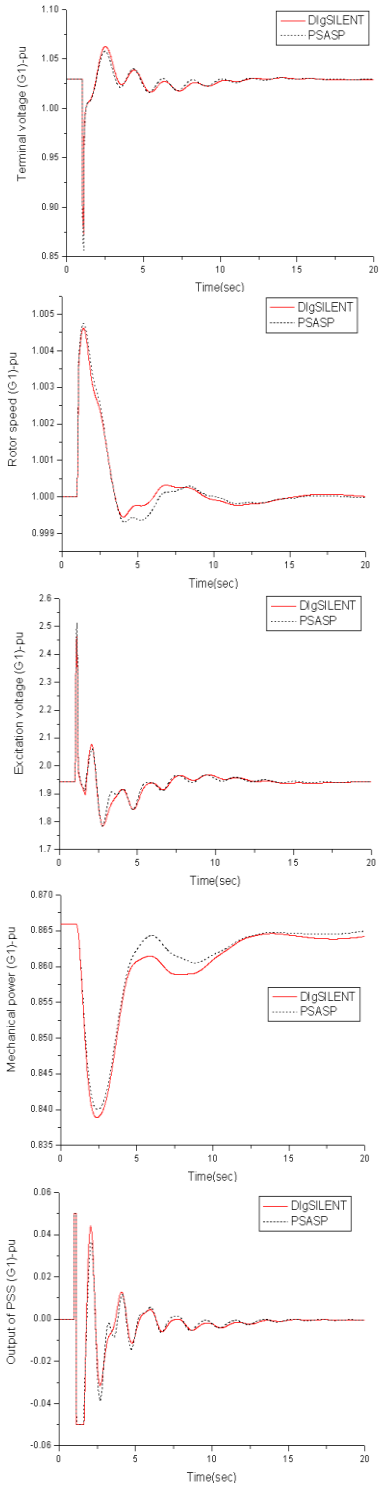


Fig. 6. A comparison between PSASP and DIgSILENT PowerFactory under scenario 2

From Fig. 5 and Fig. 6, it can be seen that the above variables all have same changed trend, and the difference between PSASP and DIgSILENT Power Factory is not big.

IV. Conclusion

PSASP is an extensively used power system analysis software in China. Some commonly used models (type12 AVR, type4 PSS and type1 GOV) in PSASP are established in DIgSILENT Power Factory. The contrast effect is implemented by conducting small perturbation and large disturbance in a two-area four-machine system. The simulation results show that the difference between PSASP and DIgSILENT Power Factory is acceptable.

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