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MULTIMACHINE POWER SYSTEM STABILITY ENHANCEMENT BY USING STATIC SYNCHRONOUS SERIES COMPENSATOR (SSSC) WITH PI CONTROLLER

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ABSTRACT
In recent years power electronics devices has seen many advances, due to this advancement in FACTS devices have increased. Now a days FACTs devices are more efficient and more widely used. Facts devices connected in power system offers many advantages which can solve problems of power system control. FACTs devices can help in improving problems like voltage regulation, transfer capacity enhancement and better power flow control. The main purpose of implementing FACTS devices is to increase transmission line capacity of transmission line. There are two different techniques by which FACTS devices can be made one is by using conventional thyristor, tap changing transformer, reactors and switch capacitors. Whereas second generation uses Gate Turn-Off (GTO) thyristor-switched converters as Voltage Source Converters (VSCs). By using first generation various devices are made viz. SVC, TCSC and TCPS. Second generation has developed few techniques like UPFC, IPFC and SSSC.

INTRODUCTION
Electrical power system comprises of generation, transmission and distribution. In modern power system network all the areas are connected together by means of interconnection. In this area concept of interconnected power system is implemented. Hence, the system becomes very large and various disturbances are imposed on the system. The various system disturbance may have harmful impact on the system which may result in the loss of synchronism. Loss of synchronism is considered as a highest fault in interconnected power system as if loss of synchronism happen, system no longer interconnected. To solve such a kind of problems FACTS device mostly Static Synchronous Series Compensator (SSSC) is used in modern power system.

FACTS devices are most widely used in to control the power flow over the line and also to improve transient stability in interconnected power system. The Static synchronous Series Compensator is used to control the voltage at its terminals this is achieved by using controlling the reactive power injected into system or by absorbing the reactive power from the network. Concept applied in this project is based on simultaneous operation of multi machine system with SSSC converter. FACTS device SSSC is connected at bus number three of the transmission line. The multi machine power systems network is then simulated by using MATLAB and various effect by using SSSC and without using SSSC are studiedin simulink environment.

FACTs devices are known for improving stability of the system, may be an transient stability of the network. Voltage profile improvement is also possible by using transient stability. FACTS devices can control various parameters of the network e.g. series impedance, shunt impedance, voltage, current and phase angle. By improving voltage profile of the network we can improve the security of the system. SSSC maximum state variable can be controlled as compared with STATCOM and TCSC. Following Table 1.2.1 shows various FACTS devices with state variable,

Table no.1 FACTS devices with state variable

Types of FACTS	**State Variables**
STATCOM	P, V_{dc}, I, θ, Q, α
TCSC	P, Be, Qs, Qr,α, I, δ
SSSC	I, θ, Ps, Pr, P, Qs, Qr, Q, V_{dc}, V, δ, β

Where P, Q and I are the active power, reactive power and current received/delivered by FACTS devices. Vdc, α, β, θ are DC voltage magnitude, DC voltage angle, respectively. V and Be are the voltage and susceptance of series components, respectively. Sending and receiving ends are represented by s and r respectively.

POWER SYSTEM UNDER STUDY

In this study focus point is to improve and optimize design parameters of SSSC based damping controller. Multi machine system attached with SSSC is considered in this as shown in fig. 1. The system consists of three generator, the complete system is divided in two sub systems and connected by using intertie. If the disturbance occurs on the system the system will swing one upon other and it may result in instability. To improve the stability of system sectionalized and SSSC is connected at mid point of the interconnecting line. In the Figure, G1, G2 and G3 represent the generators; T/F1−T/F3 represent the transformers and L1, L2 and L3 represent the line sections respectively.

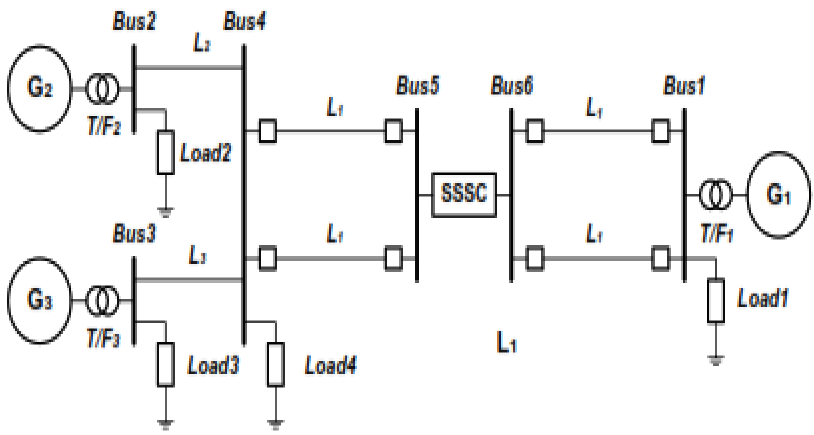

Fig. 1. Multi machine power system with SSSC

THE PROPOSED APPROACH

STRUCTURE OF THE SSSC-BASED DAMPING CONTROLLER

The structure used in SSSC to damp oscillations of the network, it can be achieved by injecting voltage (Vq) in the interconnected network as shown in fig. 2. The structure mainly consists of gain block Ks, two stage face compensation block and signal wash out block As given in Fig. 2. The major purpose of a signal washout block is to behave as a high pass filter and has a time constant of Tw. From the viewpoint of the washout function, the value of TW is not critical and may be in the range of 1 to 20 seconds. The phase compensation blocks (time constants T1S, T2S and T3S, T4S) are sufficiently tuned to optimize the network performance. Vqref is the reference voltage injected into control loop when network is at steady stage. In practice, it is observed that power flow loop in steady state is quite slow as system is stable and hence while performing simulation Vqref is assumed to be constant. The obtain the best value voltage injected ΔVq added by control loop of Vqref.

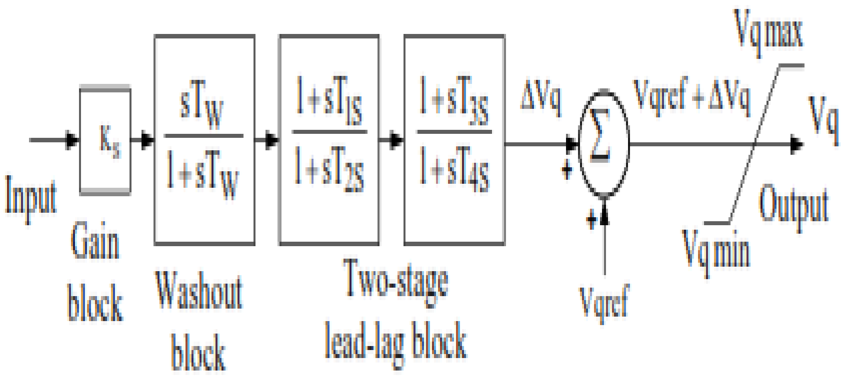

Fig. 2. Structure of the SSSC-based damping controller

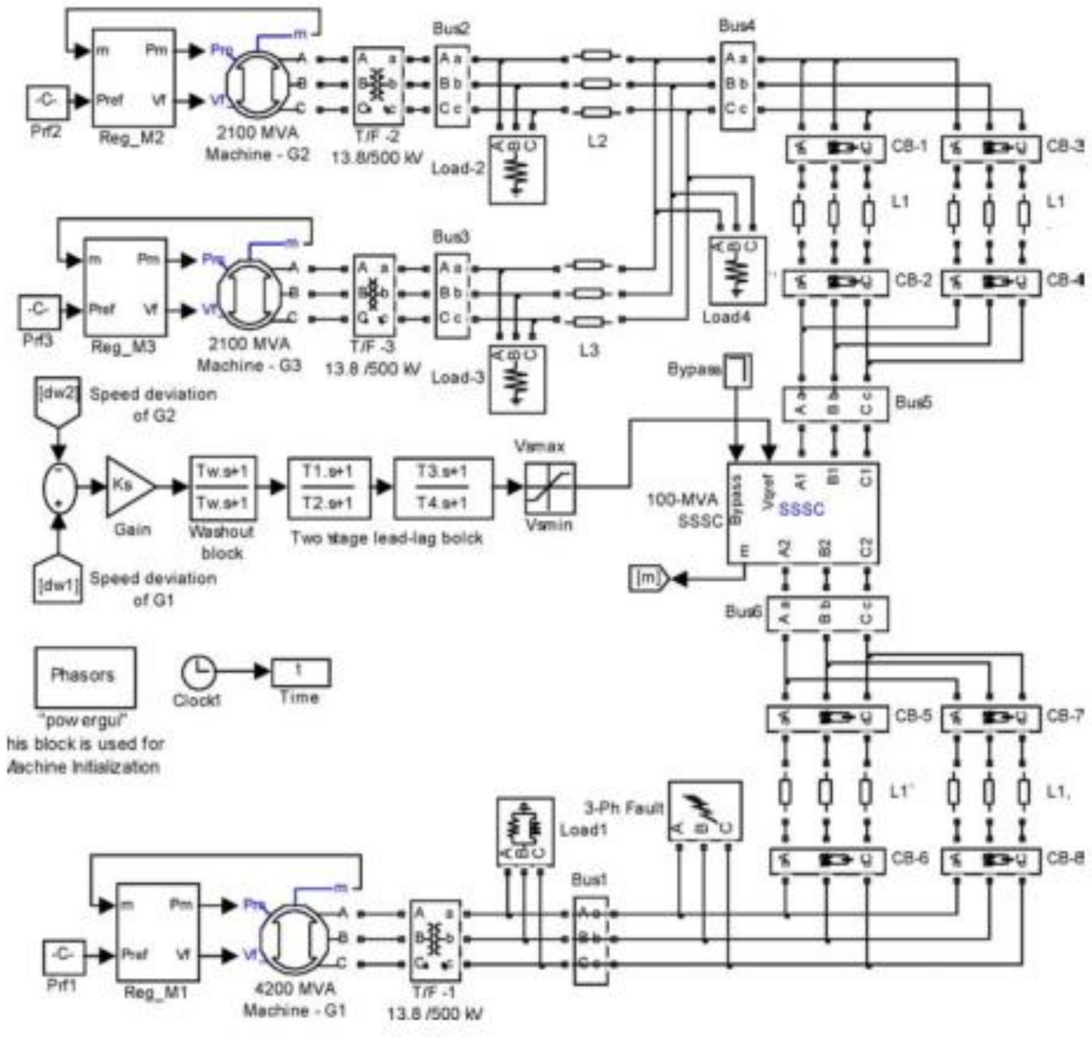

Fig. 3. SIMULINK model of SSSC-based damping controller

CONCLUSION

The proposed system is implemented on MATLAB Simulink environment using sim power system toolbox. From the obtained results it can be concluded that newly designed SSSC damps oscillation in the network only when fault in the system is occurred. Implementation of the PI controller improves the speed of damping oscillations, thus transient and steady state stability can be improved. By tuning the PI controller speed of SSSC controller can be optimized. For tuning the time constants of PI controller, real coded genetic algorithm is used in simulink environment.

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