# Transient stability improvement using svc and pss

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## ABSTRACT

This paper focus on the significance of PSS and SVC(static var compensator) to improve the transient stability of power system in various abnormal conditions. This paper shows the simulation results of model for different fault conditions with PSS and without PSS and shows how the SVC helps to improve the stability when PSS is fail to maintain the stability. Present time power systems are being operated nearer to their stability limits due to economic and environmental reasons. Maintaining a stable and secure operation of a power system is therefore a very important and challenging issue. Transient stability has been given much attention by power system researchers and planners in recent years, and is being regarded as one of the major sources of power system insecurity. Shunt FACTS devices play an important role in improving the transient stability, increasing transmission capacity and damping low frequency oscillations. In this project shunt FACTS device-SVC is used in a two area power system for improving the transient stability. MATLAB software has been used in this study.

The development idea of entropy of random variables and processes by Claude Shannon provided the beginnings of information theory and of the modern age of argotic theory. We shall see that entropy and related information measures provide useful descriptions of the long term behavior of random processes and that this behavior is a key factor in developing the coding theorems of information theory. We introduced the various notions of entropy for random variables, vectors, processes, and dynamical systems and we develop many of the fundamental properties of entropy.

**KEY WORDS: PSS, static var compensator, simulation model, their results with PSS and without PSS, model with SVC.**

## 1. INTRODUCTION

Today's world is continuously growing so that generation, distribution and transmission of power is also simultaneously require to increase in same manner to fulfill the requirement. Power system stability may be broadly defined as that property of a power system that enables it to remain in a state of operating equilibrium under normal operating condition and to regain an acceptable state of equilibrium after being subjected to a disturbance.

Stability of this system needs to be maintained even when subjected to large low-probability disturbances so that the electricity can be supplied to consumers with high reliability. Certain system disturbances may cause loss of synchronism between a generator and the rest of the utility system, or between interconnected power systems of neighboring utilities. Various control methods and controllers have been developed over time that has been used for this purpose.

IN today's power systems reliability and transfer capability are limited by stability constraints such as transient stability and oscillatory stability. Maintaining system stability present new challenges As power systems are operated with more uncertainty than in the past. This stability can be challenged if low frequency Oscillations are present in the system. Low oscillations, if present in the system can drive the system to the verge of instability. This brings the need of the PSSs into the power systems which are efficient tools in damping out oscillations in the range of 0.2 Hz to 2.5 Hz. PSSs minimize the small excursions of the oscillations about a steady operating point. The small excursions about an operating point are due to the system being lightly damped. The generators are equipped with PSSs as supplementary control devices, to provide extra damping and improve the dynamic performance. These oscillations result when rotors of generators swing with respect to each other in the same area and with respect to a group of generators in the other areas. Depending on the oscillations of the generators they are categorized into three main oscillation modes - local mode, inter-area mode and intra-area mode.

Depending on their location in the system, some generators participate in only one oscillation mode, while others participate in more than one mode.

Two types of PSS are used in the model

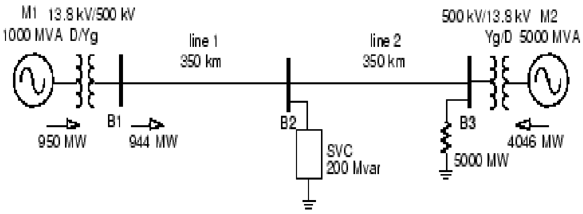
1) Multi-Band power system stabilizer

2) Generic power system stabilizer

In some case PSS are fail to maintain the stability of power system, so that are use the FACT device which give additional support to maintain the stability of power system. So we are show the effect of PSS and SVC in this paper.

## 2. SYSTEM MODEL

1) A Three-phase fault applied on the system.




A 1000 MW hydraulic generation plant (M1) is connected to a load center through a long 500 kV, 700 km transmission line. The load center is modeled by a 5000 MW resistive load. The load is fed by the remote 1000 MVA plant and a local generation of 5000 MVA (plant M2). A load flow has been performed on this system with plant M1 generating 950 MW so that plant M2 produces 4046 MW. The line carries 944 MW which is close to its surge impedance loading (SIL= 977 MW).

Synchronous machine parameters For macine-1 and (M1) and Machine-2(M2)

1. (Nominal power line-line voltage frequency) (1000E6VA 13800V 60Hz).

2. Reactances (Xd Xd′ Xd″ Xq Xq′ Xq″) (1.305 0.296 0.252 0.474 0.243 ).

3. Stator resistance (Rs pu) =2.8544e-3.

4. Inertia co-efficient friction factor pole of pairs (H(s)=3.7 F(pu)=0 P=32) .

5. Initial conditions(dw%=0 th(deg)=-16.681 Ia=0.950218 Ib=0.950218 Ic=0.95021 Pha=48.1093 Phb=-71.8907 Phc(deg)=168.109 Vf(pu)=1.44424 )

6. Reactive power equipment=200Mvar

## 3. POWER SYSTEM STABILIZERS (PSS)

1) MB-PSS with simplified settings Acceleration Power (Delta Pa) PSS. The need for effective damping of such a wide range, almost two decades, of electromechanical oscillations motivated the concept of the multiband power system stabilizer (MB-PSS). As its name reveals, the MB-PSS structure is based on multiple working bands. Three separate bands are used, respectively dedicated to the low-, intermediate-, and high-frequency modes of oscillations: the low band is typically associated with the power system global mode, the intermediate with the inter area modes, and the high with the local modes.

Each of the three bands is made of a differential band pass filter, a gain, and a limiter (see the figure called Conceptual Representation). The outputs of the three bands are summed and passed through a final limiter producing the stabilizer output $V_{stab}$. This signal then modulates the setpoint of the generator voltage regulator so as to improve the damping of the electromechanical oscillations. To ensure robust damping, the MB-PSS should include a moderate phase advance at all frequencies of interest to compensate for the inherent lag between the field excitation and the electrical torque induced by the MB-PSS action.

2) Generic mode stabilizer.

The Generic Power System Stabilizer (PSS) block can be used to add damping to the rotor oscillations of the synchronous machine by controlling its excitation. The disturbances occurring in a power system induce electromechanical oscillations of the electrical generators. These oscillations, also called power swings, must be effectively damped to maintain the system stability. The output signal of the PSS is used as an additional input (vstab) to the Excitation System block. The PSS input signal can be either the machine speed deviation, dw, or its acceleration power, Pa = Pm - Peo (difference between the mechanical power and the electrical power).
The Generic Power System Stabilizer is modeled by the following nonlinear system:

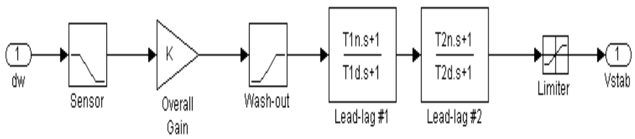



Fig 4.1: generic stabilizer

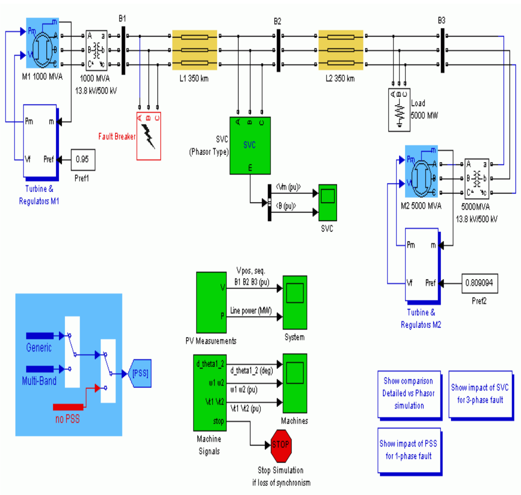
## 4. STATIC VAR COMPENSATOR

In present, power systems are large, complex and interconnected systems, which consist of thousands of buses and hundreds of generator. In present electric power system create a need of flexibility, reliability, accuracy and fast dynamic response. Flexible alternating current transmission system is new device that are capable of increasing transmission capacity, increasing lodability, stability of the transmission system.

Static Var Compensator is thyristor based controller that provides rapid voltage control. The situation has occurred increase transient, oscillatory and voltage instability, which are now these problem can be rectified by using Static Var Compensator. Voltage instability is the cause of voltage collapse.

The only way to save the system of voltage collapse through control reactive power. Various FACTS device are connected in the transmission line to inject and absorb the reactive power. When it will absorb the reactive power TCR are connected in the transmission line. When it will inject the reactive power TSC are connected in the transmission line.

## 5. SIMULATION DIAGRAM



### 5.1 Three-Phase Fault — Impact of SVC — PSS in Service

We will now apply a 3-phase fault and observe the impact of the SVC for stabilizing the network during a severe contingency. First by putting the two PSS are (Generic Pa type) in service. Reprogramming the Fault Breaker block to apply a 3-phase-to-ground fault. Verify that the SVC is in fixed susceptance mode with $B_{ref} = 0$. Start the simulation. By looking at the d_theta1_2 signal, you should observe that the two machines quickly fall out of synchronism after fault clearing. In order not to pursue unnecessary simulation, the Simulink® Stop block is used to stop the simulation when the angle difference reaches 3*360 degrees.

Now open the SVC block menu and change the SVC mode of operation to Voltage regulation. The SVC will now try to support the voltage by injecting reactive power on the line when the voltage is lower than the reference voltage (1.009 pu). The chosen SVC reference voltage corresponds to the bus voltage with the SVC out of service. In steady state the SVC will therefore be floating and waiting for voltage compensation when voltage departs from its reference set point.

## 6. SIMULATION RESULTS FOR WITH OUT PSS AND WITH OUT SVC

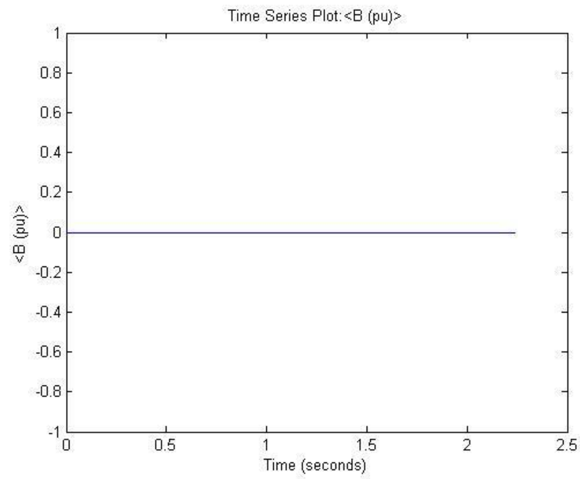



**Fig 1:**Fixed susceptance vs time

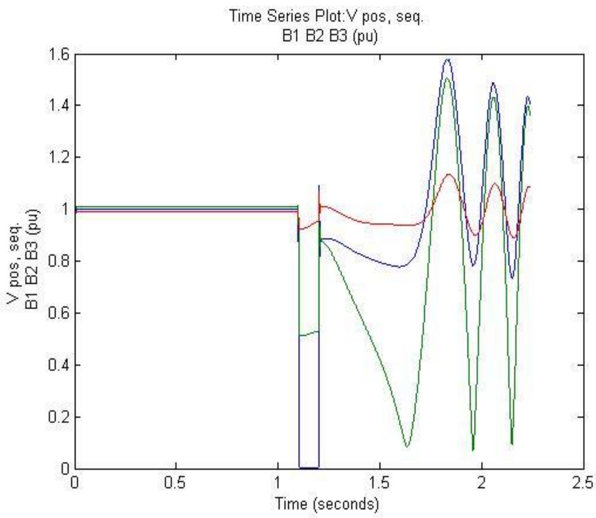



**Fig 2:** Positive sequence voltage vs time

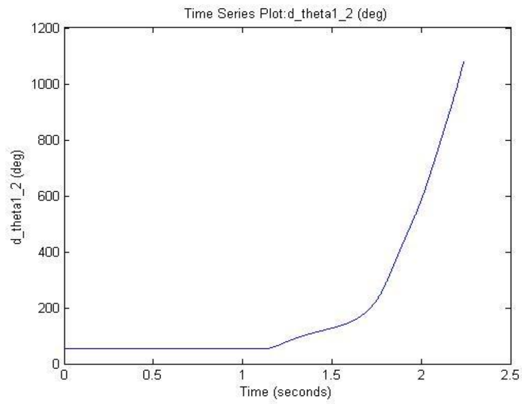



**Fig 3:**Rotor angle difference vs time

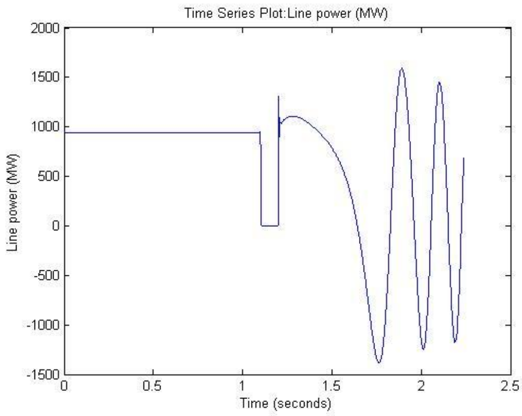



**Fig 4:** Line power vs time

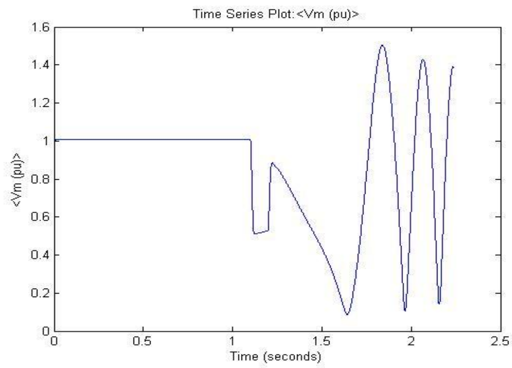



**Fig 5:**SVC measured voltage vs time

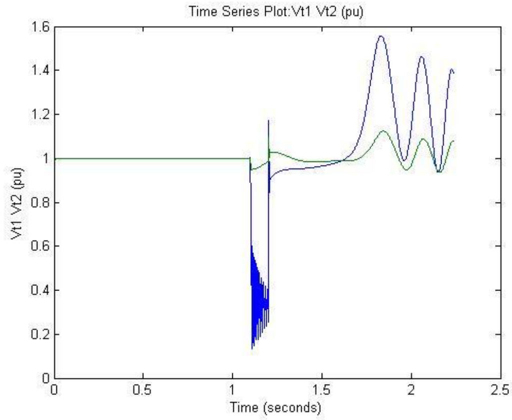



**Fig 6:**Terminal voltages vs time

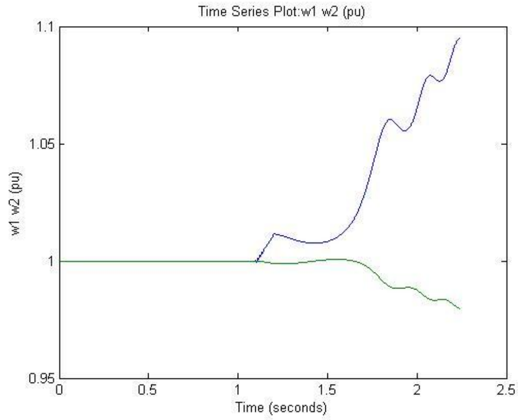



**Fig 7:** Machine speeds vs time

## 7. SIMULATION RESULTS FOR WITH PSS AND SVC

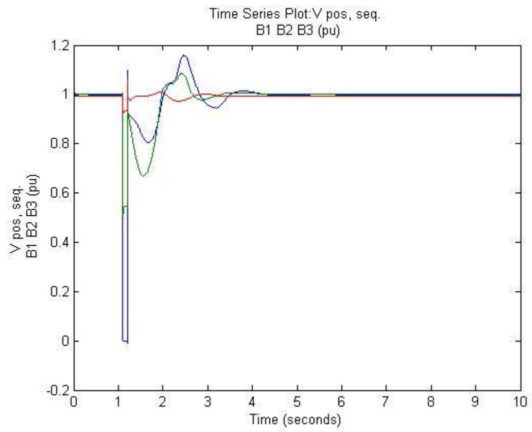



**Fig 1:**Positive sequence voltage vs time

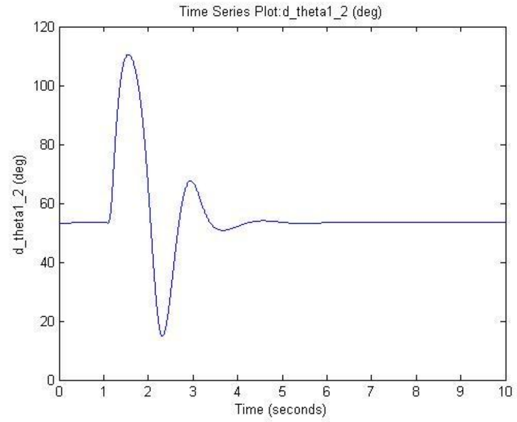



**Fig 2:**Rotor angle difference vs time

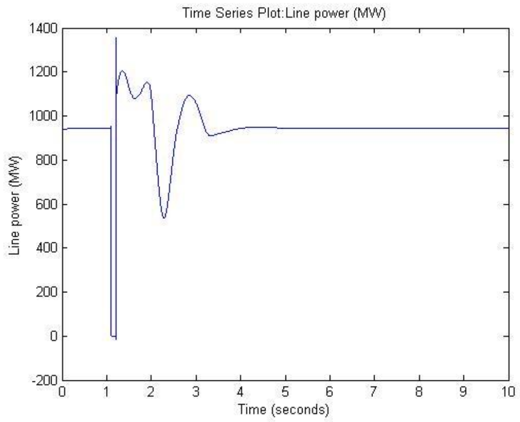



**Fig 3:**Line power vs time

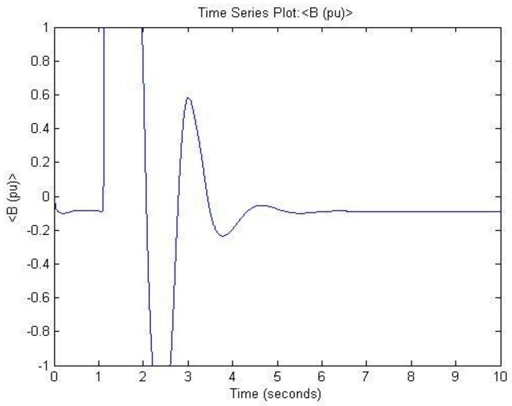



**Fig 4:**Susceptance vs time

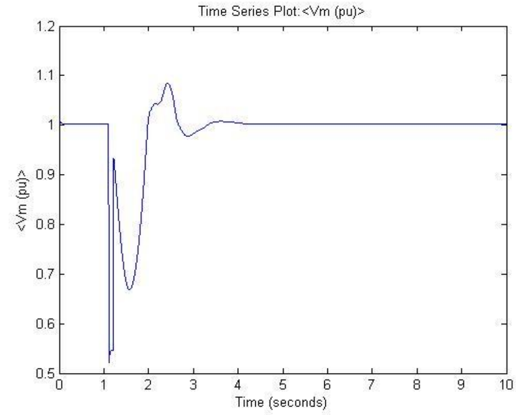



**Fig 5:**SVC measured voltage vs time

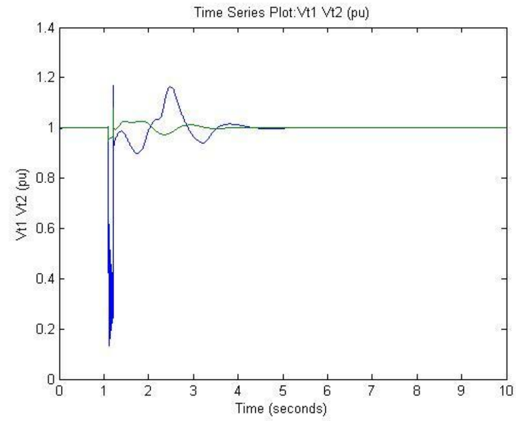



**Fig 6:**Terminal voltages vs time

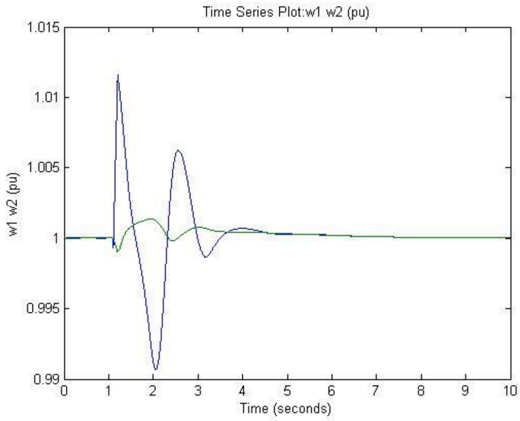



**Fig 7:**Machine speeds vs time

## 8. Entropy introduction

The development of the idea of entropy of random variables and processes by Claude Shannon provided the beginnings of information theory and of the modern age of ergodic theory. We shall see that entropy and related information measures provide useful descriptions of the long term behavior of random processes and that this behavior is a key factor in developing the coding theorems of information theory.
We introduced the various notions of entropy for random variables, vectors, processes, and dynamical systems and we develop many of the fundamental properties of entropy.

There are several ways to introduce the notion of entropy and entropy rate. We take some care at the beginning in order to avoid redefining things later. We also try to use definitions resembling the usual definitions of elementary information theory where possible. Let (; B; P; T) be a dynamical system. Let f be definite alphabet measurement (a simple function) defined on and define the one sided random process fn = fTn; n = 0; 1; 2; : : :. This process can be viewed as a coding of the original space, that is, one produces successive coded values by transforming (e.g., shifting) the points of the space, each time producing an output symbol using the same rule or mapping. In the usual way we can construct an equivalent directly given or Kolmogorov model of this process.

## 9. ENTROPY OBSERVATION TABLE

| s.no | Bus voltages | Detheta | Line power | Svcb |
|---|---|---|---|---|
| No svc no pss | -4.8972e+11 | -4.9904e+11 | -4.9488e+11 | -5.0017e+11 |
| No pss with svc | -4.8957e+11 | -4.9852e+11 | -4.9368e+11 | -4.9385e+11 |
| With pss no svc | -4.9083e+11 | -4.9902e+11 | -4.9481e+11 | -5.0015e+11 |
| With pss with svc | -4.9519e+11 | -4.9798e+11 | -4.9679e+11 | -4.9811e+11 |

| s.no | Svc $v_m$ | $V_{t1}$ $v_{t2}$ | $W_{t1}$ $w_{t2}$ |
|---|---|---|---|
| No svc no pss | -4.9592e+11 | -4.9565e+11 | -4.9970e+11 |
| No pss with svc | -4.9498e+11 | -4.9584e+11 | -4.9806e+11 |
| With pss no svc | -4.9588e+11 | -4.9582e+11 | -4.9884e+11 |
| With pss with svc | -4.9811e+11 | -4.9766e+11 | -4.9726e+11 |

## 10. CONCLUSION

In this project the transient stability of a two machine system was obtained by using the static var compensator and power system stabilizer. The stabilizer improved the damping of ossicilations created in the machine by the three-phase fault and the reactive power improvement was done by static var controller by injecting reactive power in the system or receiving the reactive power by the controller. Hence by improving of the transient stability was done by using Mat Lab simulink software. And the amount of disorder in the waveforms obtained in the simulation were taken to obtain the entropy value. That is the amount of randomness in the waveforms. This proves the performance of different conditions of transient stability by using svc and pss and without svc and pss. The entropy values of the different conditions were tabulated in the table.

## 11. ACKNOWLEDGMENT

I am highly grateful to Mr.K.Ramesh Assistant Prof. for his sincere advice, encouragement and continuous guidance in my work. I warmly acknowledge and express my special thanks for him inspiring discussions and infallible suggestions.

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