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Enhancement of Power Quality and Stability in Power system using FACTS device with FUZZY Controller

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Abstract — In recent years, power demand has increased substantially while the expansion of power generation and transmission has been severely limited due to limited resources and environmental restrictions. In this a 3 machine model with 9 bus and a FACTS device is taken in this model. To compensator the reactive power from the system, we used a FACTS device called SSSC (Series Static Synchronous Compensator). Due to 3 machine a low frequency oscillation is generated which is called Electro-mechanical oscillation. Due to this inter-are mode oscillation a system may get paralyzed. So to minimized or Damp out the oscillation we used Damping Controller with a FUZZY logic. FUZZY Logic Controller is a Artificial Intelligence Controller, which is accurate in output. FUZZY can give better result and output waveform then a PID Proportional Integral Controller. The modeling and simulation of the system is done in the MATLAB Simulation Software. This will reduce transmission line losses and to achieve desired real and reactive power, Damp out the Oscillation, make system stable.

Keywords- ***SSSC-Static Synchronous Series Compensator , PID – Proportional Integral Derivative controller, FLC-Fuzzy Logic Controller.***

I. INTRODUCTION

As the consumption of electricity is increasing day by day the power transmission lines are becoming crowded and this leads to instability in the power system due to overcrowded bus. So it is necessary to grow our technical aspect to deal with the scenario. But we know that the power systems are complex non-linear systems, 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. So we introduce the FACTS device to damp out the oscillation and compensate the required Reactive power to the system. So in this system SSSC second generation FACT device is used in three machine system. For the better performance FUZZY controller is used. We introduce a small disturbance or fault for 4 second in system. The results obtained from simulations validate the effectiveness of proposed modeling and tuning approach for power system stability improvement. The simulation results also show that the proposed SSSC controller is effective in damping a range of small disturbance conditions in the power system**.**

I. POWER SYSTEM UNDER STUDY

The Multi machine Power system with SSSC FACT devices at mid-section is considered in this system. This systemconsist of three generator which is divided in to 2 subsystem through which it is connected with a inter tie line transmission system. All the three generator are Hydraulic turbine and Governor System with Excitation (HTG). A system which have PID controller governor system model and also have a servo-motor with it.All the data of the system is given at the last Appendix. Now a small disturbance is produce at the double circuit tie line of 4 second small fault.

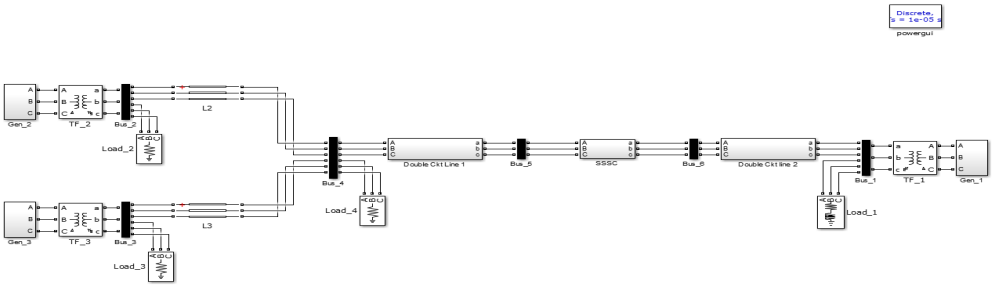

Fig 1. System model circuit with SSSC

A. Modelling of SSSC

As the basic line diagram of SSSC consist of Capacitor (Energy storage device), Invertor, and Transformer. SSSC is installed at Midsection of the system to get better performance. In double circuit line two parallel transmission line are used of 175km in which a small disturbance is introduce in double circuit line 2. Required voltage is given in system by SSSC system.

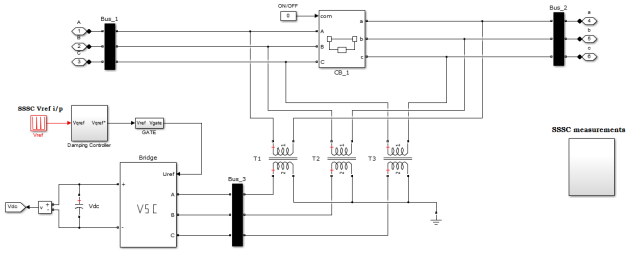

Fig 2. SSSC model circuit

A capacitor (365e-4 f) , Voltage source convertor (Invertor) is a readymade model of Universal Bridge, and three coupling transformer and controlling circuit is used.

B. Referance voltage generator circuit

THREE CIRCUIT ARE PLACED IN A SUBSYSTEM. 1) MEASUREMENT AND CONVERSION , 2) CONTROLLER CKT AND 3) CONVERSION CIRCUIT.

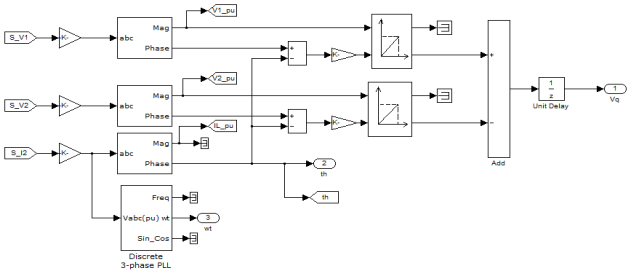

Fig 3. Measurement and conversion circuit.

The voltage and current are taken from the Bus 1 and 2. From this we can identify the required voltage and current in the system. From the abc phasor to Vq and Vd. Vd is terminated because it is not required in the system.

C. Damping control circuit of SSSC

There are main 3 parameter which create oscillation in system. 1) Power, 2) Rotor angle, and 3) Speed of generator. . From these three oscillation I had used to damped out the power (voltage and current) power oscillation. So first take the V2 I2 from the bus2 of system. Using gain block we had convert.

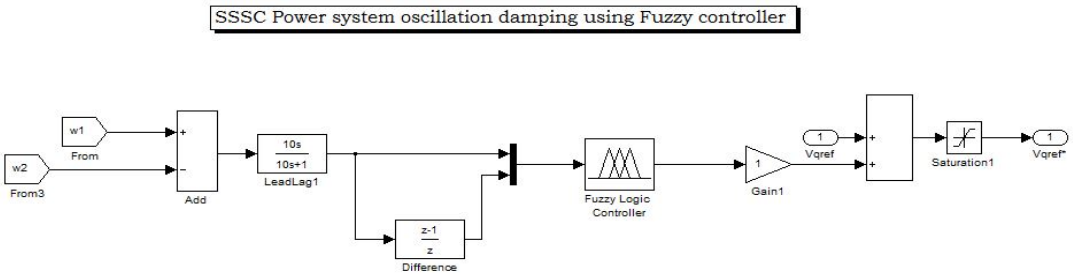

Fig.4 Damping Oscillation using FUZZY CONTROLLER

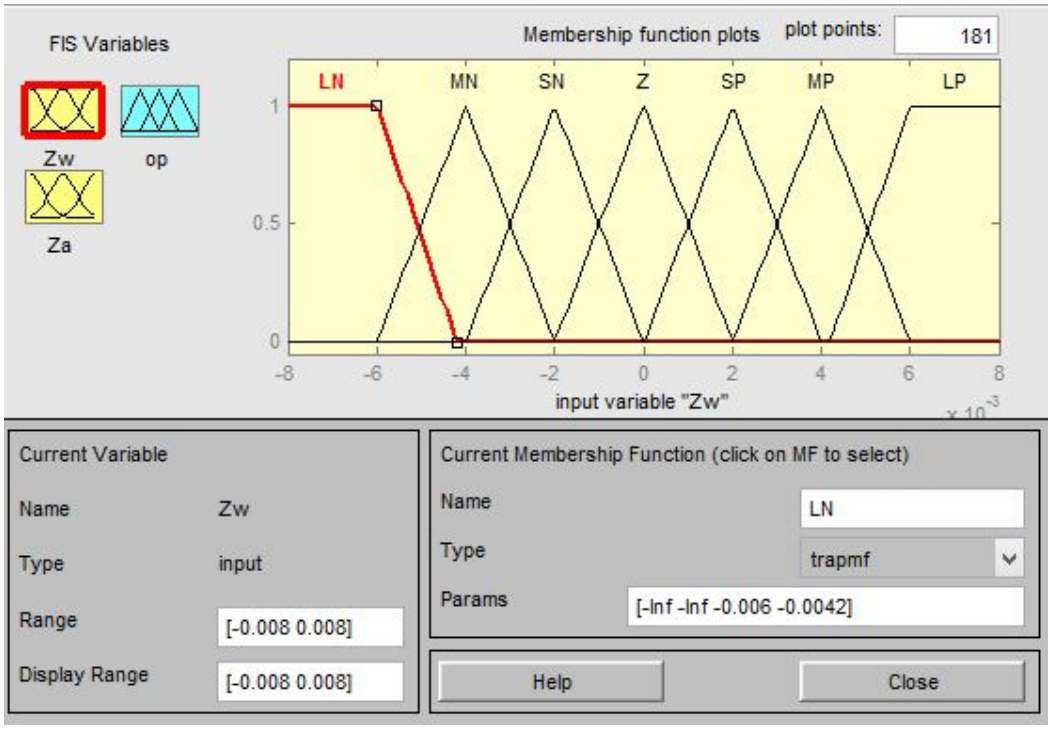

Fig 5. FIS Variable Zw 1st Input

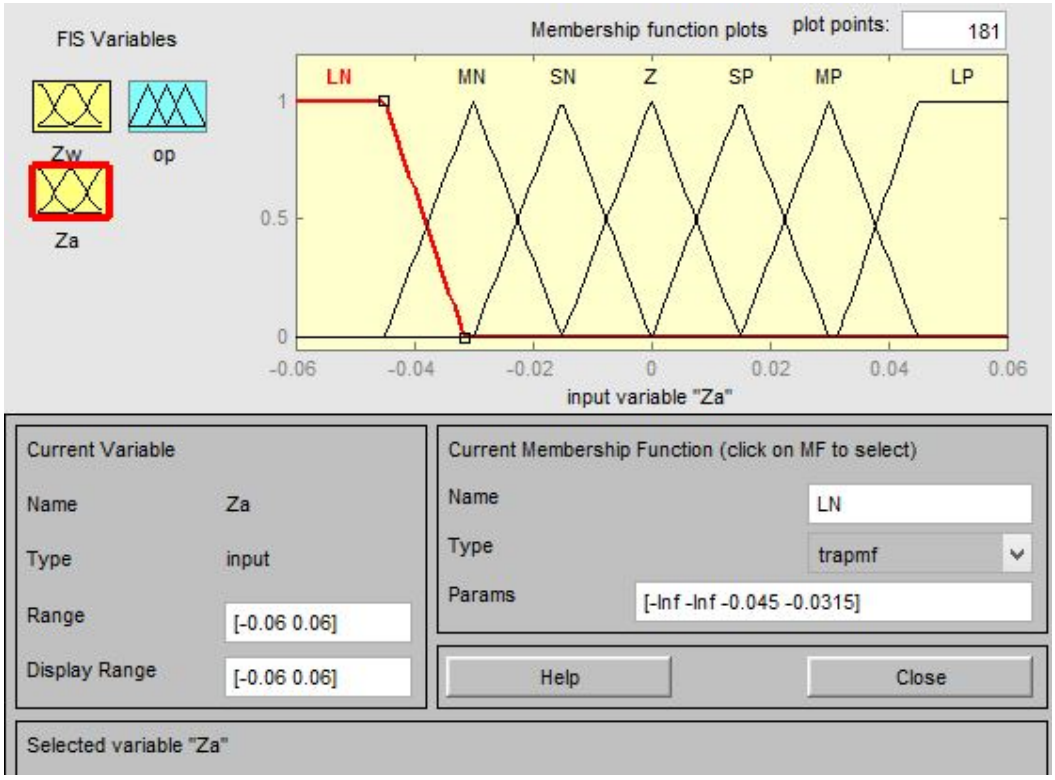

Fig 6. FIS Variable Za 2nd Input

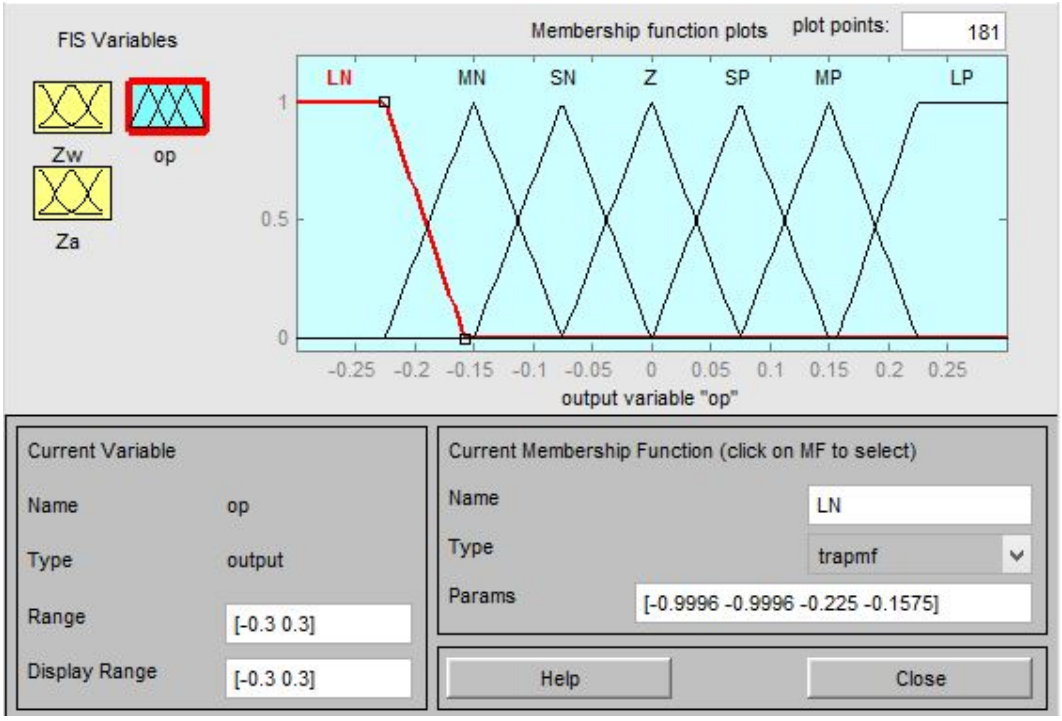

Fig 7. FIS Variable Output

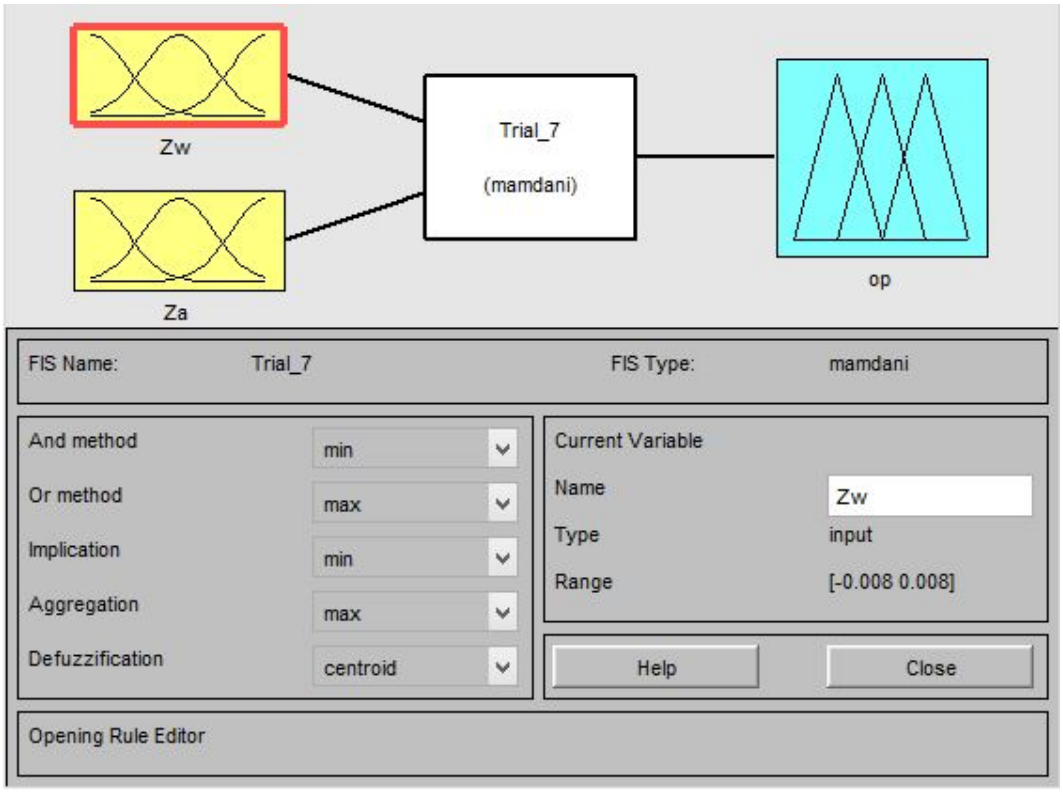

Fig 8. Manmdani method

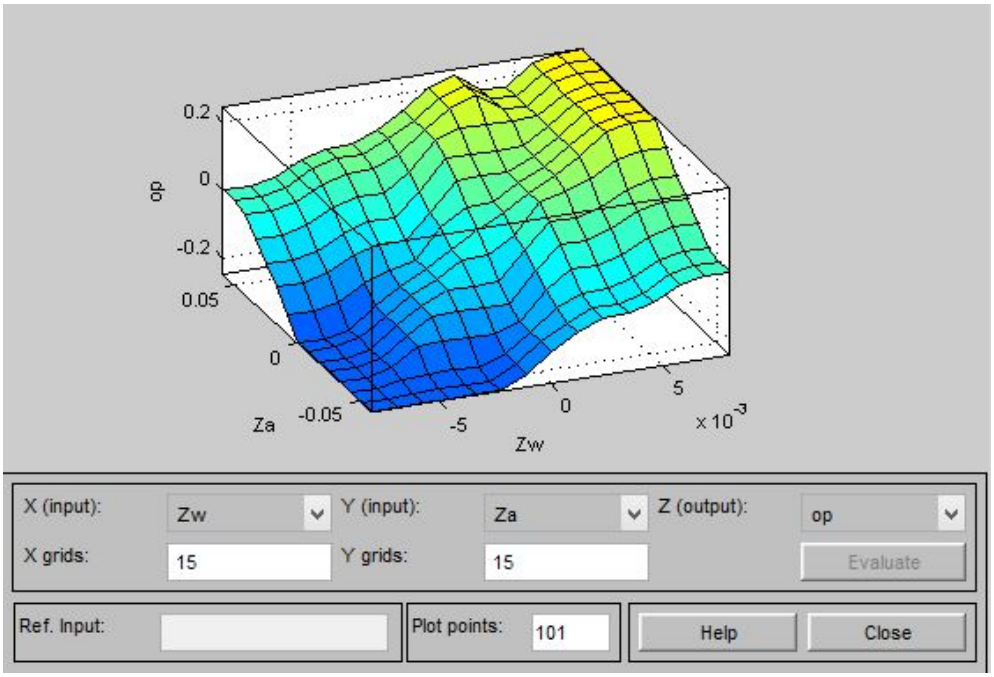

Fig 9. Control Surface of FUZZY

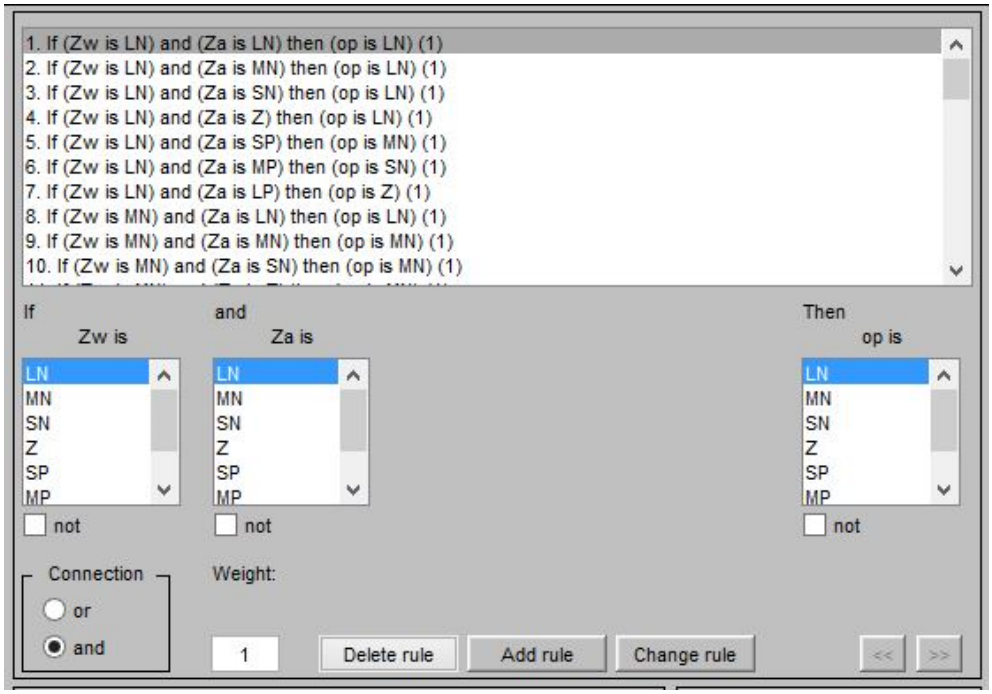

Fig 10. FUZZY LOGICS

Z_s / Z_a	LN	MS	SN	Z	SP	MP	LP
LN	LN	LN	LN	MN	SN	SN	Z
MN	LN	MN	MN	MN	Z	Z	SP
SN	LN	MN	SN	SN	SP	SP	MP
Z	LN	MN	SN	Z	SP	MP	LP
SP	MN	SN	SN	SP	SP	MP	LP
MP	SN	Z	Z	MP	MP	MP	LP
LP	Z	SP	SP	MP	LP	LP	LP

Fig 11. FUZZY LOGIC

D. WAVEFORM

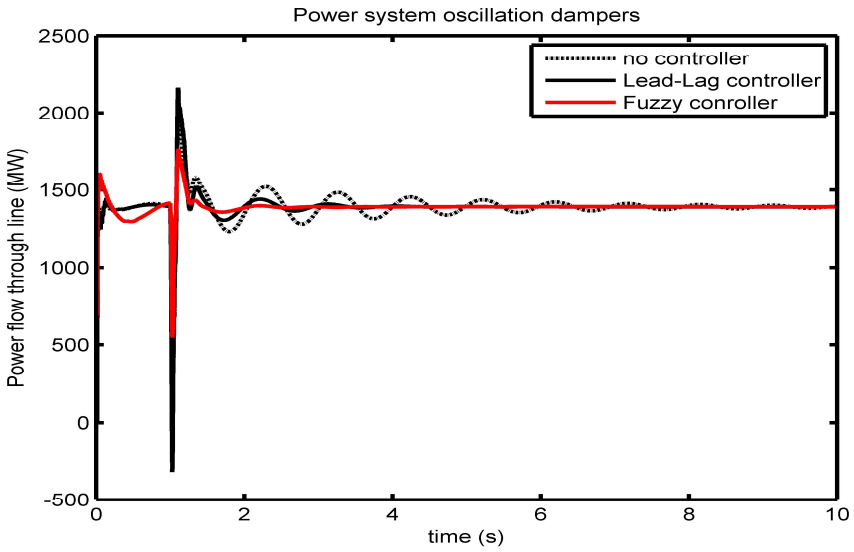

Fig 1. Power P1,P2 (with and without controller)

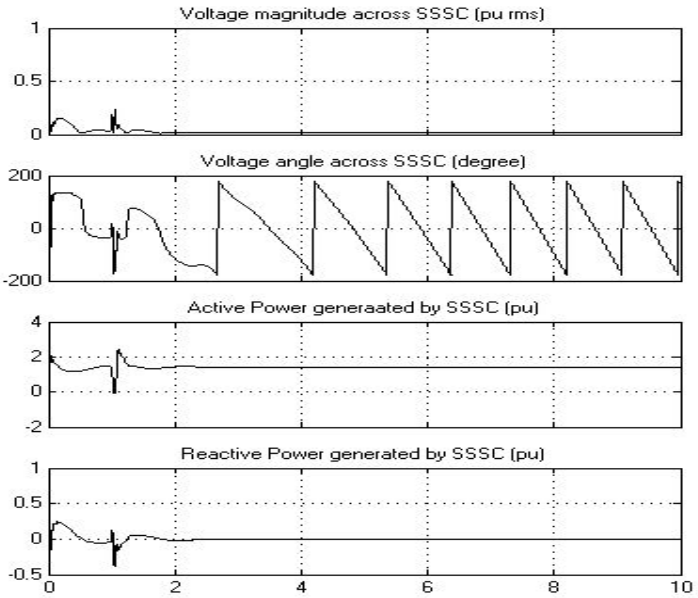

Fig 2. SSSC input output bus data with controller

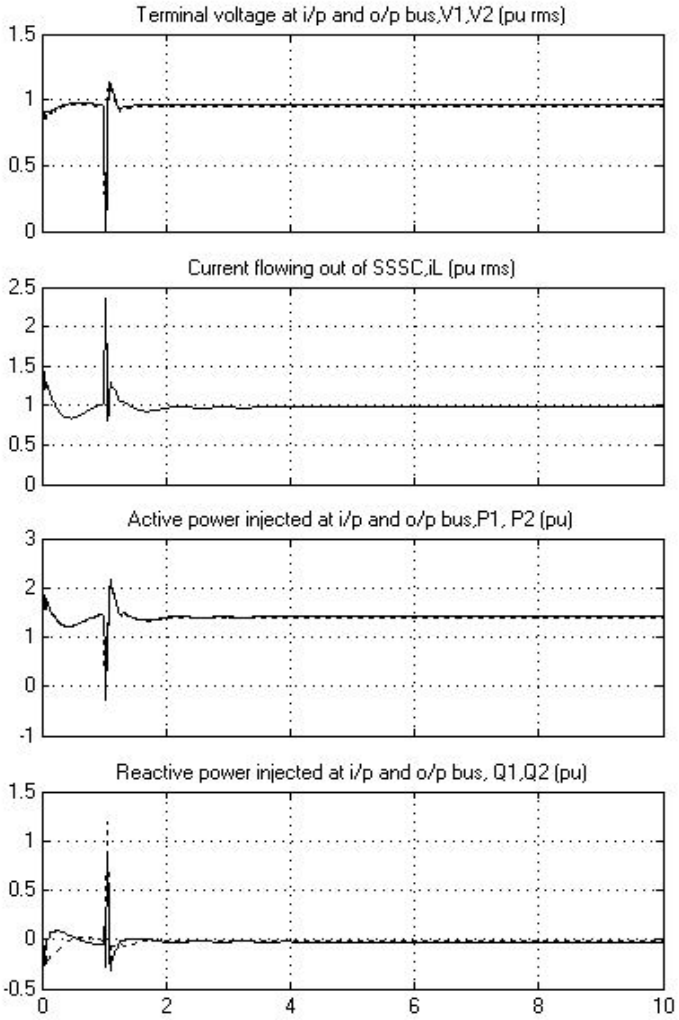

Fig 3. SSSC input output bus data with controller

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