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Optimizing Location of Unified Power Flow Controller (Phasor Model) in Multi-Machine Power System

Sandeep Sharma

Assistant Professor, Bharati Vidyapeeth College of Engineering, A-4, Paschim Vihar, New Delhi, India

***Abstract*— Unified power flow controller (UPFC) is a flexible alternating current transmission system (FACTS) device which can control a combination of parameter such that active and reactive power along with voltage magnitude and phase angle. With this controlling of parameters UPFC have many application in power system such as damping of power system oscillations, voltage regulation and optimal power flow. In this paper a phasor model of UPFC is used to find the optimal power flow between the interconnected power system networks. This is done by optimizing the location of UPFC in the power system. Simulation result made clear that by optimization location of UPFC in power system model optimal power flow is achieved.**

***Keywords*— Optimal location, Optimal power flow, UPFC.**

I. Introduction

UPFC play an important role for the optimal power flow in the interconnected power system. Optimal power flow (OPF) problem was first formulated in 1962. Optimal power flow problem are having some objective function with some constraints. The OPF problems are the main concern of the independent system operator (ISO) and are solved every year by the system planner. As much as the computation technique grown up the finding of solution of OPF problem become easier.

An optimization-based methodology is used to find the key locations of UPFC in the ac network in order to maximize the power transfer capacity[1]. When the system planner comes to installation stage of UPFC its location in the power system become the main concern [2]. A mathematical model based on lagrange multiplier method is used to find the optimal location of UPFC. The system load ability can be maximize by finding the optimal location of UPFC [3].A self adaptive evolutionary programming (SAEP) is used to analyze the non linear mathematical model of UPFC. A multi objective optimization methodology with objective function such that minimization of total fuel cost, power loss and maximize the system load ability is used to find the optimal location of UPFC in[4].

The social welfare in open power market is maximized by formulating a nonlinear optimization problem [5]. This is done with the help of UPFC. To deal with congestion management the installation of UPFC is based on two steps based approach: 1) optimization of location of UPFC 2) finding the optimal control parameter of UPFC.

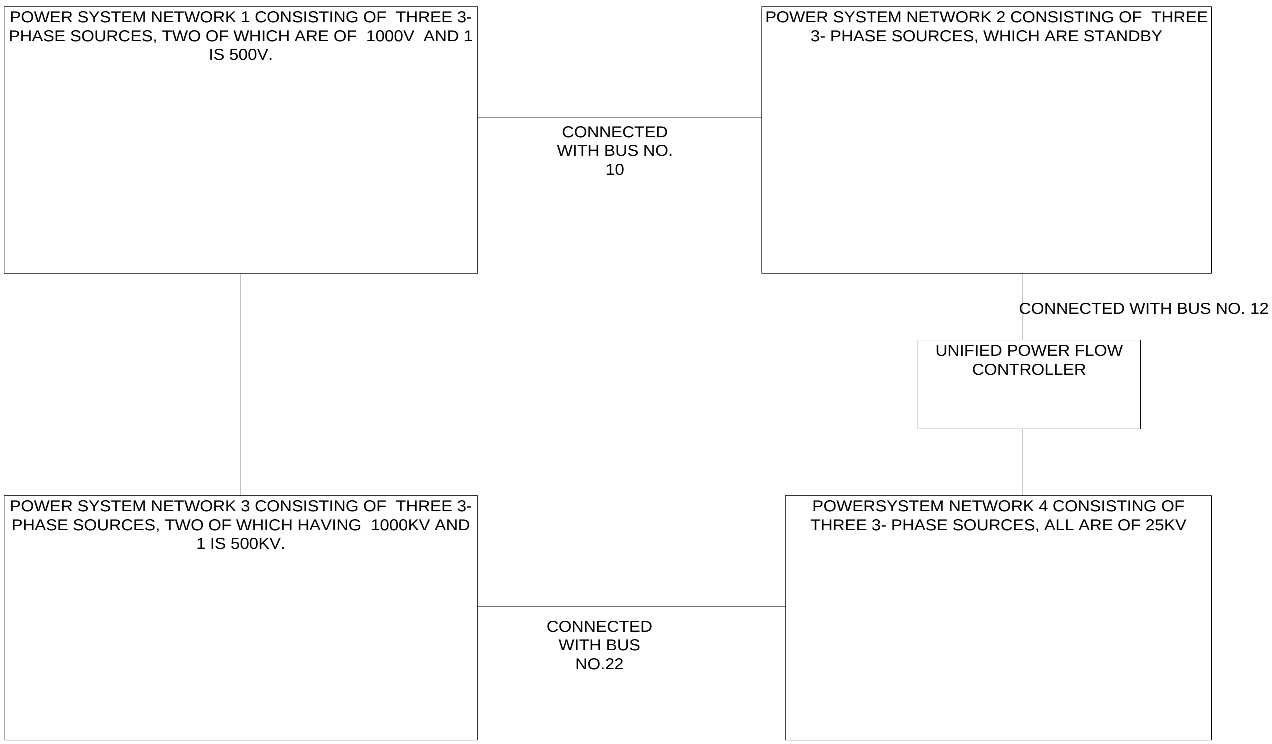
In order to reduce the computation and calculation used in finding the optimal location of UPFC in power system, a screening technique is introduced in [6]. The screening technique is based on derived sensitivity factor of the generation cost with respect to control parameter of UPFC.

In this paper, a multi machine power system consisting of four interconnected power system network with UPFC is modeled in Matlab/Simulink. Each network consists of three 3 ø sources, three 2ø transformer and three 3 ø load. These networks are well connected to each other. The phasor model of UPFC is installed in this model. The phasor model of UPFC is installed at different interconnecting buses. The optimal location of UPFC is obtained by finding the optimal value of power flow through the interconnecting buses.

II. Model Description

The multi machine power system model with UPFC is designed is Matlab/Simulink. In this model as shown in fig.1 four networks are shown which are interconnected with interconnecting buses. Each power system network consists of a combination of three 3 ø sources and three 2ø transformer and three 3 ø load.

The power system network 2 having its all source at standby mode. The interconnecting buses are B10, B12 and B22 as shown in fig. 1. The fig. 1 shows the optimal location of UPFC i.e. at B 12. The simulation results are taken by installing the UPFC at all three interconnecting buses. The optimal value of real power is found when the UPFC is connected at bus B12.



III. Simulation Results

The simulation result consists of 3 tables and 9 waveforms.

Each table shows the different values of real power relative to the installation of UPFC at connecting bus.

Table 1
Value of real power when UPFC is connected at B10

S. no.	Bus no.	Real power (MW)
1.	B10	0.8001
2.	B12	-0.6808
3.	B22	0.119

Table 2
Value of real power when UPFC is connected at B12

S. no.	Bus no.	Real power (MW)
1.	B10	0.8653
2.	B12	0.7899
3.	B22	0.1175

Table 3
Value of real power when UPFC is connected at B22

S. no.	Bus no.	Real power (MW)
1.	B10	0.07172
2.	B12	-0.00591
3.	B22	0.8492

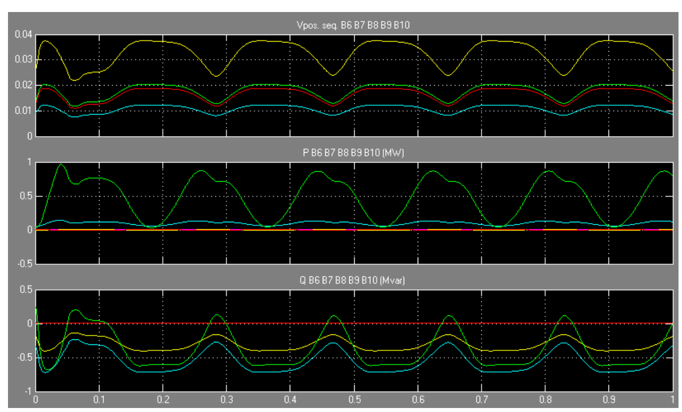


Fig. 2 Waveform of Voltage magnitude, real and reactive power for buses (B6 to B10) when UPFC is connected at bus no. 10

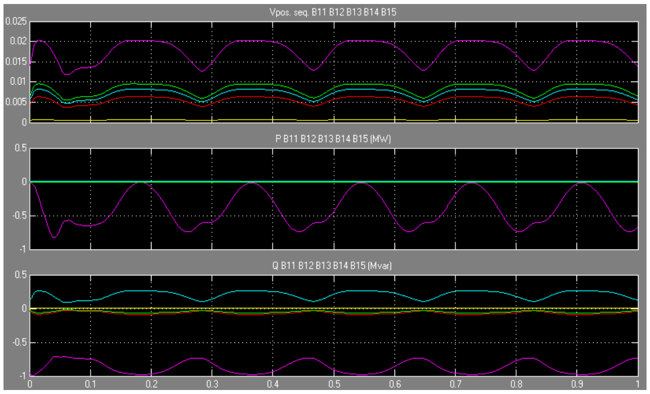


Fig. 3 Waveform of Voltage magnitude, real and reactive power for buses (B11 to B15) when UPFC is connected at bus no. 10

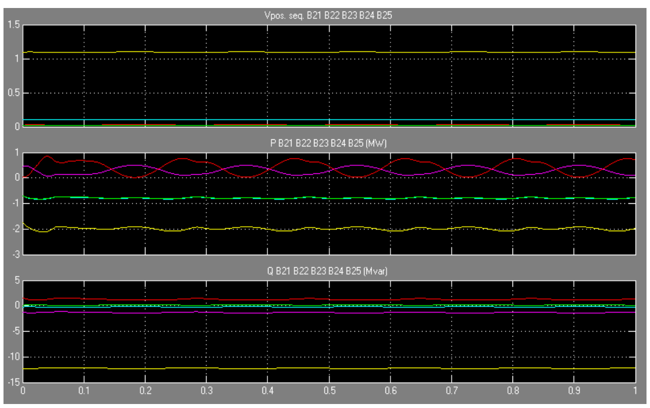


Fig. 4 Waveform of Voltage magnitude, real and reactive power for buses (B21 to B25) when UPFC is connected at bus no. 10

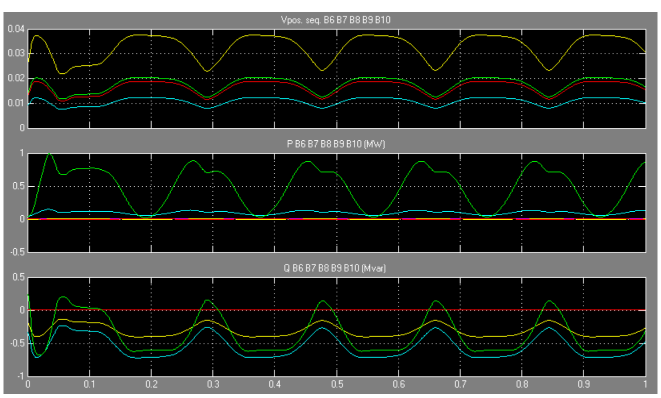


Fig. 5 Waveform of Voltage magnitude, real and reactive power for buses (B6 to B10) when UPFC is connected at bus no. 12.

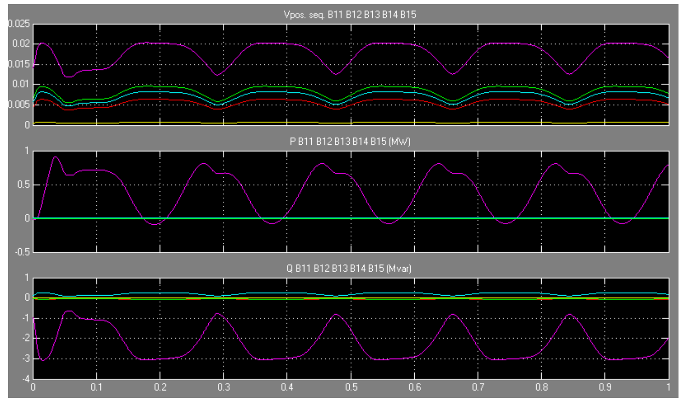


Fig. 6 Waveform of Voltage magnitude, real and reactive power for buses (B11 to B15) when UPFC is connected at bus no. 12.

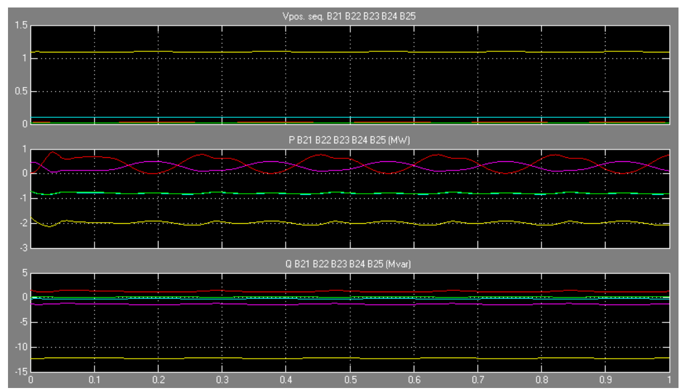


Fig. 7 Waveform of Voltage magnitude, real and reactive power for buses (B21 to B25) when UPFC is connected at bus no. 12

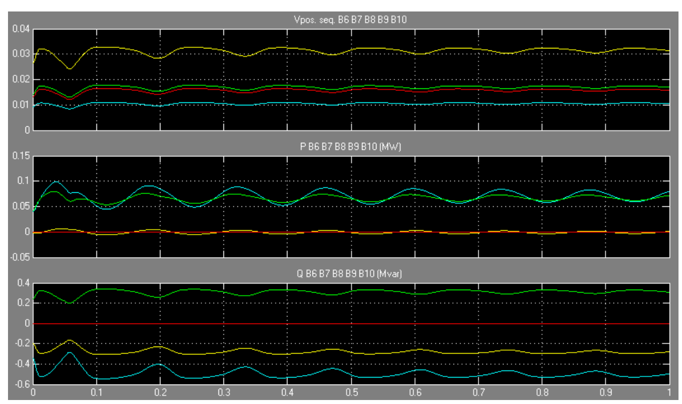


Fig. 8 Waveform of Voltage magnitude, real and reactive power for buses (B6 to B10) when UPFC is connected at bus no. 22

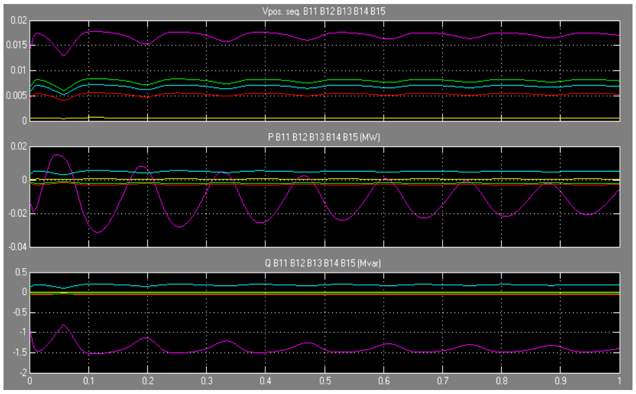


Fig. 9 Waveform of Voltage magnitude, real and reactive power for buses (B11 to B15) when UPFC is connected at bus no. 22

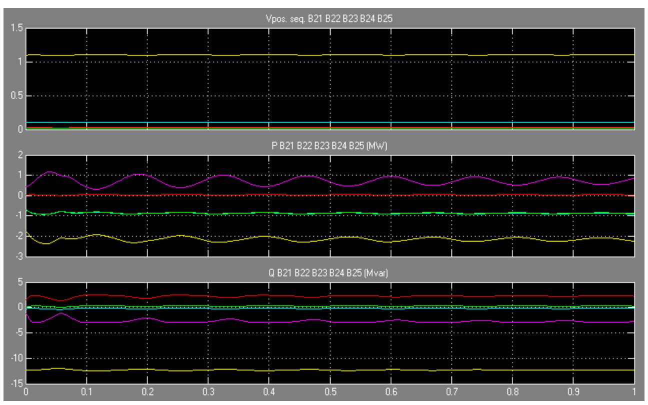


Fig. 10 Waveform of Voltage magnitude, real and reactive power for buses (B21 to B25) when UPFC is connected at bus no. 22

IV. CONCLUSION

In this paper, the phasor model of UPFC is successfully implemented for the optimal power by obtaining its optimal location in multi machine power system. Simulation result has shown very clear value of real power flow through the interconnecting buses. The simulation results conclude that the optimal location of the UPFC is obtained successfully in multi machine power system. Further multi UPFC can be used to enhance the real power flow through all the buses connected in the multi machine power system.

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