IJAREEIE

e-ISSN: 2278-8875
p-ISSN: 2320-3765

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

Volume 11, Issue 8, August 2022

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.18

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.18|

||Volume 11, Issue 8, August 2022||

|DOI:10.15662/IJAREEIE.2022.1108008 |

Stability Performance Analysis of Two Machine Infinite bus Power System using Non Linear Decentralised Controller

Rekha G. Padaki[1], Rashmi H C[2]

Assistant Professor, Dept. of EEE, University of B D T College of Engineering, Davangere, Karnataka, India[1]

PG Student [Power System Engineering], Dept. of EEE, University of B D T College of Engineering, Davangere, Karnataka, India[2]

ABSTRACT: This Paper proposes a decentralized method for non linear control of oscillatory dynamics in the power systems. The method is application for ensuring both ensuring both transient stability and small signal stability. The method uses an optimal control law, which has been derived in the general framework of nonlinear control using normal forms. The method used to derive the control law is the detailed subtransient model of synchronous machines, as recommended by IEEE. Minimal approximations have been made in either the derivation or the application of the control law. The developed method also requires the application of the dynamic state estimation technique. As the employed control and estimation schemes only need local measurements the method remains completely decentralized. The method has been demonstrated as an effective tool to prevent blackouts by simulating a major disturbance in a benchmark power system and model its subsequent control using the proposed method.

KEYWORDS: Decentralised, Nonlinear, Subtransient, Simulation.

I.INTRODUCTION

An interconnected power system is basically consists of several indispensible components. They are namely generating units, the transmission lines, the loads, the transformer, static VAR Compensators and lastly the HVDC lines. During the operation of the generators, there may be some disturbances such as sustained oscillations in the speed or periodic variations in the torque that is applied to the generator. These disturbances may result in voltage or frequency fluctuation that may affect the other parts of the other interconnected power system. External factors, such as lightning, can also cause disturbances to the power system. All these disturbances are termed as fault. When a fault occurs, it causes the motor to lose synchronism if the natural frequency of oscillation coincides with the frequency of oscillation of the generators. With these factors in the mind, the basic condition for a power system with stability is synchronism. Besides this condition, there are other important condition such as steady state stability, transient stability, there are other important condition such as steady state stability, transient stability, harmonics and disturbance, collapse of voltage and the loss of reactive power.

Several essential components are included in an interconnected power system network such as generators, transmission lines, distribution networks, loads like domestic and industry. Main component in generation is alternator which is a synchronous generator rotating at a specific speed to obtain the required frequency of power generation. Transmission consists of transmission lines usually of single circuits or multiple circuits with voltage levels stepped up to minimise transmission losses by using a device called power transformers. In the distribution side again the network plays an important role in distributing the power to the consumer point where the electric power can be utilized in many different ways. Commonly two different types of loads are observed in the power system network namely Domestic loads and Industrial loads. Along with these equipment's many power control devices are also used to control the power flow and for the utilization of electric power inefficient way.

II.PROBLEM STATEMENT AND ASSUMPTIONS

The aim of this project is to identify the various power system stability problems. A proposed technique can be considered to solve the stability problem in the power system. The power system is complex and it is difficult to study

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.18|

||Volume 11, Issue 8, August 2022||

|DOI:10.15662/IJAREEIE.2022.1108008 |

the disturbance and stability problem. In this project a simplified infinite bus with machine power system is considered and stabilities studies are simulated with controller and without controller.
Some components are assumed to be constant while carrying out the project and are assumed they are as follows.

A. Considering only the current and the voltages of the generator stator winding connected to an infinite bus bar system and other parameters like harmonics and other parameters like harmonics and ignoring DC currents.

B. Only symmetrical components are considered for the fault analysis in unsymmetrical cases.

C. Due to variations in the speed of the machine and the generated voltage at the terminals of the generator or alternator connected to an infinite bus bar and it is assumed as not affected with the power system.

III. POWER SYSTEM MODELLING

In this project with the basic control function block the various parts of the function block can be divided into three main blocks. They are explained as follows

1. Transmission line and Generator block mention in the diagram

2. Fault block

3 Control system block

The block diagram in figure is a simplified closed loop control system . The output is sent back to the comparator to be compared with the input. The difference between the feedback and the input is then fed to the controller. The controller will perform and provide the necessary control output. The fault module, which is considered as a disturbance, in the plant module, and the cycle is repeated.

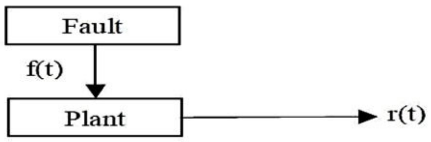

Figure 1: Block diagram representation of power system without controller when the fault occurs

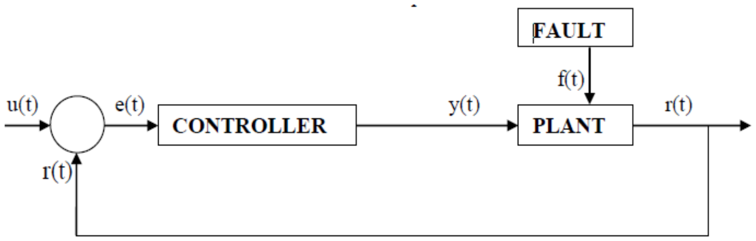

Figure 2: Block diagram representation of power system with controller when the fault occurs

In the above control scheme, the controller module takes the necessary actions and it will be performed by the controller module and it will simulate the controlled output. In the power system fault module will provide the disturbances in the power system and this disturbance is fed back to the generator module, and the stability is identified by this process. This process is repeated for several times until the stability of the system is identified.

IV.SINGLE LINE DIAGRAM OF A POWER SYSTEM CONSIDERED FOR SIMULATION

The power system modeling is based on a two-machine, three bus power system. The performance of the power system will be simulated with the advanced control technique. The performance of the power system is simulated using the software MATLAB and results will be obtained. The operating points and system parameters are varied to test the robustness of the power system and the effectiveness of the controller.

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.18|

||Volume 11, Issue 8, August 2022||

|DOI:10.15662/IJAREEIE.2022.1108008 |

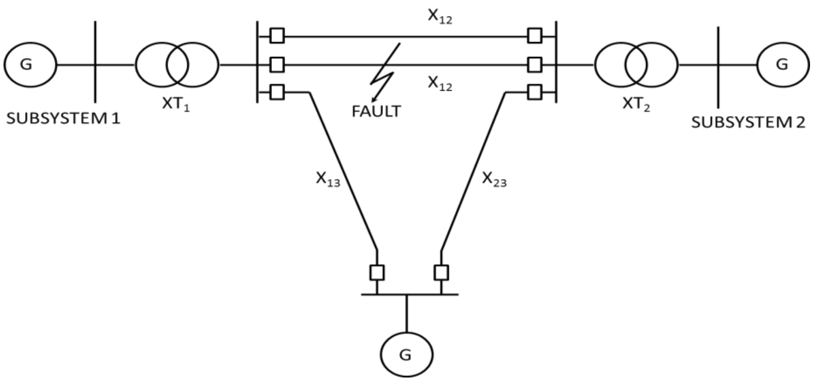

Figure 3: Single line diagram of a power system considered for simulation.

In this Project a controller is introduced for the control application and it is said to be a non linear decentralised controller, due to power system is in non linear in structure . Linear controller is used for the small disturbance application in the power system only. Due to exchange of information between the generators is difficult in case of any technical failures in the communication in the power system.

The Proposed controller is introduced with generator 1 and generator 2 respectively, and it is nonlinear in nature, due to large disturbance causing in the power system. This controller deals with turbine valve control and generator valve control.For the analysis of power system in the case of disturbances occured by external faults and internal equipment failure three phase short circuits is caused at the transmission line connected between generator 1 and generator 2 has been made. The failure of equipment considering a load change is considered to analyse the stability problem. This controller is applied to the power system to regain its stability during the disturbance and the operation of controller is completely in a closed loop system. Below are the set of equations which represents the mathematical modelling of the proposed controller.

$$vf1 = 19.68(\delta 1 - \delta 10) + 20.60\omega 1 - 93.81(Pe1 - Pm10)$$

$$vf2 = 19.69(\delta 2 - \delta 20) + 21.45\omega 2 - 73.95(Pe2 - Pm20)$$

V SIMULATION AND RESULTS

In this chapter power system model is explained in the previous chapter is reffered for the simulation using the equations of power system model with the software package MATLAB. The results of simulation shows the situation of the model derived for power system during the abnormal condition and controller is used for the monitoring of the fault condition and maintain the stability of the system is discussed when the fault or disturbance is occurred in the power system . Various parameters are considered for the simulation purpose and the results are shown below . The parameters considered such as speed of the generator the power angle input given to the controller the power generated in the generator and voltage appeared across the terminal of the generator is considered for the simulation and the same effects on the stability of power system is then discussed.

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.18|

||Volume 11, Issue 8, August 2022||

|DOI:10.15662/IJAREEIE.2022.1108008 |

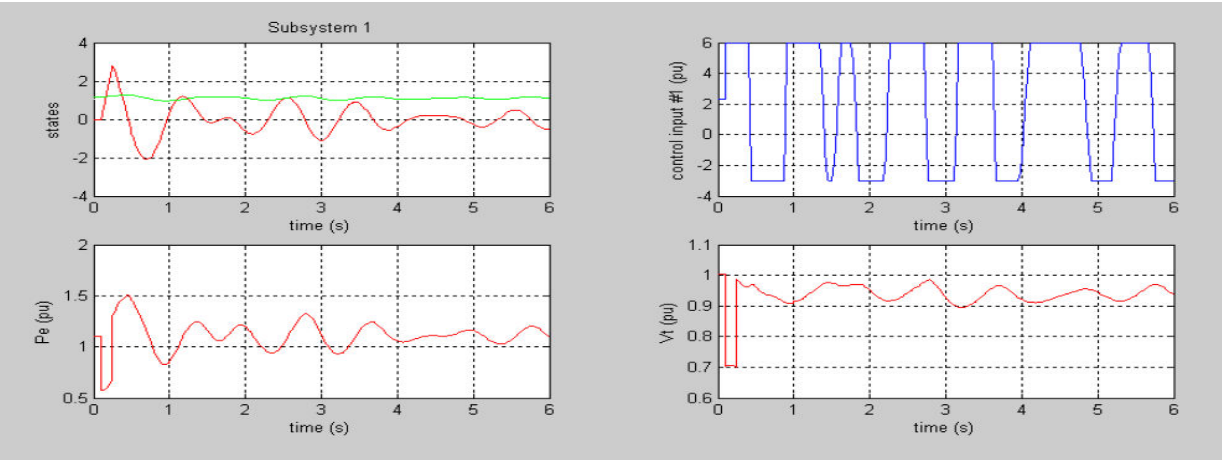

Figure 4:Simulation results of first generator without controller showing Electrical power, terminal voltage of generator input given to the controller one and states (Variation in the system admittance due to fault)

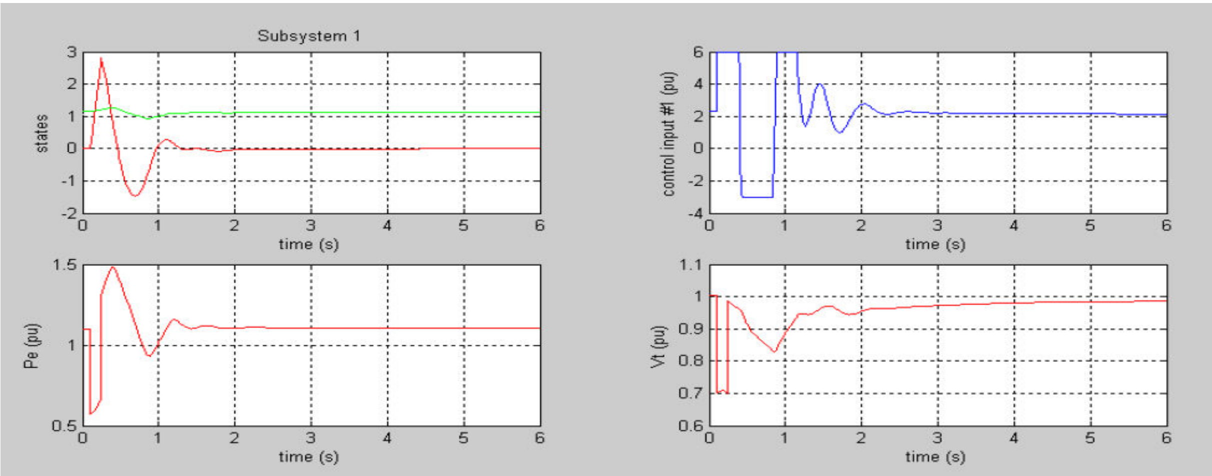

Figure 5:Simulation results of first generator with controller showing Electrical power, terminal voltage of generator input given to the controller one and states (Variation in the system admittance due to fault)

VI.CONCLUSION

This work attempted to provide an insight into the various power system stability issues. Simulations were performed on the power system model to acquire the conditions of system model in an event of an occurrence of a three phase symmetrical fault. A Proposed nonlinear decentralised control scheme was then implemented to the the power system model. Comparisons were the made to examine the effect of controller, various system operating points were also varied to test the robustness of the controller. From the various simulation results, it can be seen that the nonlinear decentralised controller is effective in enhancing the transient stability of the system model.

The simulation results showed that the transient stability of the system model was enhanced and synchronism regained regardless of the location of the three phase symmetrical fault , the variations in the system operating points and network parameters and persistent disturbances.

REFERENCES

[1] Math Track School of Mathematical Sciences Volume 1, Number 1, Pages 72-80

[2] R. C Dorf, R. H. Bishop Modern control Systems. Singapore pearson Education L Fradkov, and A Yu pogromsky Introduction to control of Oacilations and chaos Singapore: world Scientific S. V. Borisenok, Yu.V .Rozhdestvensky.

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.18|

||Volume 11, Issue 8, August 2022||

|DOI:10.15662/IJAREEIE.2022.1108008 |

[3] Transient Stability Analysis of a Three-machine Nine Bus Power System Network, M. A. Salam, M. A. Rashid, Member IAENG, Q. M. Rahman and M. Rizon.
[4] Kundur, P. *Power system stability and control*. New York: McGraw-Hill.
[5] Transient stability analysis of 3 machine 9 bus bus power system network by M.A. Salem, M. A Rashid.
[6] Q. Lu and Y. Sun et al, "Decentralized Nonlinear Optimal Excitation Control," IEEE Transactions on Power Systems, vol. 11, pp. 1957-1962.
[7] T.Lahdhiri and A.T. Alouani, "Nonlinear Stability Controller for a SingleMachine Infinite-Bus Power System," IEEE Transactions on Power Systems, vol. 8, pp. 1014-1019
[8] Transient Stability Analysis of 3-Machine, 7-Bus System Using ETAP, AungZaw Latt1.
[9] A distributed computing approach for real-time transient stability analysis, G. Aloisio University DegliStudi di Lecce, Italy, M.A. Bochicchio, Università DegliStudi di Lecce, Italy; M. La Scala Università degliStudi di Napoli Federico II, Italy; R. Sbrizzai,
[10] Transient stability-constrained optimal power flow for online dispatch and nodal price evaluation in power systems with flexible AC transmission system devices, T.T. Nguyen V.L. NguyenA. Karimishad.
[11] Investigation of Hybrid Particle Swarm Optimization Methods for Solving Transient-Stability ConstrainedOptimal Power Flow Problems, K. Y. Chan, G. T. Y. Pong and K. W. Chan