ENHANCEMENT OF POWER OSCILLATION DAMPING IN A SMIB SYSTEM USING FUZZY LOGIC BASED POWER SYSTEM STABILIZER

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by

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CERTIFICATE

This is to certify that the work contained in this dissertation entitled "ENHANCEMENT OF POWER OSCILLATION DAMPING IN A SMIB SYSTEM USING FUZZY LOGIC BASED POWER SYSTEM STABILIZER" by Shankar Rao has been carried out under our supervision for the award of the degree of "**Master of Technology"** in **Power System** of Delhi Technological University, Delhi.

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ABSTRACT

Power systems are subjected to low frequency disturbances that might cause loss of synchronism and an eventual breakdown of entire system. The oscillations, which are typically in the frequency range of 0.2 to 3.0 Hz, might be excited by the disturbances in the system or, in some cases, might even build up spontaneously. These oscillations limit the power transmission capability of a network and, sometimes, even cause a loss of synchronism and an eventual breakdown of the entire system. For this purpose, Power system stabilizers (PSS) are used in conjunction with the excitation system in order to damp these low frequency power system oscillations.

The use of power system stabilizers has become very common in operation of large electric power systems. The conventional PSS (CPSS) which uses lead-lag compensation, where gain settings designed for special operating conditions exhibits poor performance under different loading conditions. The constantly changing nature of power system makes the design of CPSS a difficult task. Therefore, it is very difficult to design a stabilizer that could present robust performance at all operating conditions of electric power systems. To overcome the drawback of conventional power system stabilizer (CPSS), many techniques such as fuzzy logic, genetic algorithm, neural network etc. have been proposed in the literature.

In an attempt to cover a wide range of operating conditions, fuzzy logic based technique has been suggested as a possible solution to overcome the above problem. Using this technique, complex system mathematical model can be avoided, while giving good performance under different operating conditions. Fuzzy Logic has the features of simple concept, easy implementation and computational efficiency. The fuzzy logic based power system stabilizer model is evaluated on a single machine infinite bus (SMIB) power system, and then the performance of Conventional power system stabilizer (CPSS) and Fuzzy logic based Power system stabilizer (FLPSS) are compared. Results demonstrate that fuzzy logic based power system stabilizer gives better performance than the Conventional Power system stabilizer. It has been shown that both the magnitude of oscillation and the setting time of the oscillation in FLPSS is much less than that of CPSS.

CONTENTS

LIST OF SYMBOLS

Symbols	Quantity
E_B	Infinite Bus Voltage in pu
P_e	Air gap power in pu
P	Active power in pu
I	Line current in pu
Q	Reactive power in pu
R_a	Armature resistance per phase in pu
p	Differential operator
H	Inertia constant in MW-s/MVA
K_S	Synchronizing torque coefficient in pu torque/rad
K_D	Damping torque coefficient in pu torque/pu speed deviation
T_a	Accelerating torque in N-m
T_m	Mechanical torque in N-m
δ	Rotor angle
s	Laplace operator
ω_r	Rotor speed in electrical rad/s
T_e	Electromagnetic torque in N-m
J	Combined moment of inertia of generator and turbine in $Kg\text{-}m^2$
$\Delta\delta$	Rotor angle deviation
$\Delta\omega_r$	Speed deviation in pu
ω_n	Undamped natural frequency , rad/s
ΔT_m	Deviation in mechanical torque
ξ	Damping ratio
E_{fd}	Exciter output voltage

ψ_{fd}	Field circuit flux linkage
I_{fd}	Field current
R_{fd}	Field circuit resistance
ψ_d	Direct-axis flux linkage
ψ_q	Quadrature axis flux linkage
I_d	Direct-axis component of line current
I_q	Quadrature axis component of line current
L_{ads}	Saturated values of d axis mutual inductances
L_{aqs}	Saturated values of q axis mutual inductances
L'_{ads}	Saturated values of d-axis transient inductances
L'_{aqs}	Value of q-axis transient inductances
ψ_{ad}	Air gap flux linkages (d-axis)
ψ_{aq}	Air gap flux linkages (q-axis)
R_E	Transmission line resistance in pu
R_T	Total resistance in pu
X_E	Transmission line reactance in pu
X_T	Total reactance in pu
A_{sat} , B_{sat}	Constants defining saturation characteristics of machine
K_A	Exciter gain
K_1, K_2, K_3, K_4, K_5 ,K_6	K-constants of Phillip Heffron model
T_3	Time constant of field circuit
K_{STAB}	Stabilizer gain
T_w	Time constant of washout
T_1, T_2	Phase compensation time constants

LIST OF FIGURES