MICROPROCESSOR-BASED VARIABLE STRUCTURE POWER SYSTEM STABILIZER

by

K. S. MOHANACHANDRA PANICKER

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Department of Electrical Engineering
INDIAN INSTITUTE OF TECHNOLOGY, DELHI
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TO

MY BELOVED FATHER

IN MEMORIAM

CERTIFICATE

This is to certify that the thesis entitled, "MICROPROCESSOR-BASED VARIABLE STRUCTURE POWER SYSTEM STABILIZER" being submitted by Mr. K.S. Mohanachandra Panicker, for the award of Doctor of Philosophy to the Indian Institute of Technology, Delhi, is a record of bonafide research work he has carried out under our guidance and supervision. The results obtained in this thesis have not been submitted to any other University or Institute for the award of a degree or diploma.

S.I. AHSON
Professor

C.M. BHATIA
Asst. Professor

Department of Electrical Engineering
Indian Institute of Technology, Delhi
New Delhi 110 016

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ABSTRACT

Research in the past several years has shown that the theory of variable structure systems (VSS) provides a powerful approach to control system synthesis. Of particular interest is the specific form of motion - the so-called sliding mode, which is characterized by the motion of the system along the intersection of surfaces containing points of discontinuity of the control functions. By introducing sliding mode one can achieve stabilization, disturbance rejection and low sensitivity to plant parameter variations.

The present thesis is aimed at providing new results on the design and evaluation of power system stabilizer using VSS theory. The main objective of the thesis is to study the applicability of the stabilizer through extensive digital computer simulation and practical implementation on a laboratory micromachine using a microprocessor.

The basic theory of variable structure systems is presented and the methods for constructing switching surfaces are described. The variable structure stabilizer and multivariable variable structure stabilizer have been designed by a geometric approach using linear models of the system. The effectiveness of these stabilizers has been evaluated through computer simulation (ICL 2960) using a detailed nonlinear model of the power system. The results presented in this thesis have shown that the stabilizers designed

by the VSS theory provide improved damping of the system oscillations. The sensitivity studies were also conducted to test the parameter insensitivity of the variable structure systems in the sliding mode.

A micromachine system has been developed to implement the variable structure stabilizer using an Intel 8085A microprocessor. The hardware and software for the instrumentation and control have been developed and tested. Microprocessor-based methods have been used for the measurement of the rotor angle and machine speed. A transmission line fault application unit has also been developed to simulate disturbances in the system.

The variable structure stabilizer has been implemented on the micromachine system and experiments were conducted by applying large disturbances such as a three-phase short-circuit and line switching. The experimental results obtained are reported in this thesis. For the sake of comparison a speed-based stabilizer has also been implemented. It is shown that the system is oscillatory with AVR alone, but the oscillations are damped out fast with the introduction of stabilizing signals. The rotor angle response with variable structure stabilizer is better than that obtained using speed-based stabilizer. The terminal voltage recovery with variable structure stabilizer is acceptable. By conducting sensitivity tests, it has been demonstrated that the performance of the system is less sensitive to parameter variations with variable structure stabilizer. The results of the

experimental studies confirm the theoretical predictions.

For the sake of completion proper background material, review and suggestions for further work in this area are included in this thesis.

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