UNIVERSITI TEKNOLOGI MARA

# APPLICATION OF FUZZY LOGIC CONTROL INTO POWER SYSTEM STABILIZER (PSS) FOR PENINSULAR MALAYSIA'S NATIONAL GRID SYSTEM STABILITY ENHANCEMENT

JOON BIN IBRAHIM

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# ABSTRACT

One of the most important issues arising from large-scale power systems interconnections is the low frequency oscillation between machines. The Peninsular Malaysia National Grid System is characterized by low frequency oscillations that are of particular concern following large disturbances. For this issue and because of their flexibility, simple, and low cost, power system stabilizers (PSS) are widely used to generate supplementary control signal in the excitation system of synchronous generators and thus damp the low frequency oscillations.

This research presents a fuzzy logic power system stabilizer (FPSS) for small signal stability enhancement of The Peninsular Malaysia National Grid System. Simple fuzzy logic control rules are applied. The performance of the FPSS when the system exhibits multi-mode oscillations phenomenon is illustrated. Simulation tests for different operating conditions and disturbances are also discussed. The results are compared with conventional power system stabilizer (CPSS). The comparative results proved the potency of the FPSS. The results demonstrated that the FPSS satisfies two essential properties in the control system field: good damping performance and good robustness. FPSS has enhanced system performances in term of improvement in damping ratio. The system which FPSS had been put into service had exceeded the minimum requirement of 5% damping ratio specified in the Transmission System Reliability Standard. In addition, the system with FPSS had exhibited as much as 18% lower over-shoot. Futhermore, the system with FPSS had an improvement in settling time. Finally, it also has been decisively demonstrated that Fuzzy PSS had enhanced the overall system performance without any needs for re-tuning or changes in setting.

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# INTRODUCTION

## 1.0 Overview

The electrical energy, without any doubt, has become the major form of energy for end use consumption in today's world. In addition, there exists a paramount need of making electric energy generation and transmission, both more economic and reliable. The voltages throughout the system are also controlled to be within ±5% of their rated values by automatic voltage regulators acting on the generator field exciters, and by the sources of reactive power in the network. In addition to voltage control, most electric power systems are alternating current (AC) systems with a frequency that must be held uniform over the whole network. This is achieved by using synchronous AC generators. System frequency is held within tight limits by the speed governing action of the generator prime movers. System voltages are regulated by generator excitation system control [1].

Interconnected AC generators produce torque that depends on the relative angular displacement of their rotors. These torques act to keep the generators in synchronism (synchronizing torques). Thus, if the angular difference between generators increases, an electrical torque is produced which in turn, tries to reduce the angular displacement. The angular displacements should settle to values that maintain the required power flow through the transmission network and supply the system load. If the disturbance is large on the transmission system, the nonlinear nature of the synchronizing torque may not be able to return the generator angles to a steady state. Some or all generators then lose synchronism and the system exhibits transient instability. On the other hand, if the disturbance is small, the synchronizing torques keep the generators nominally in synchronism, but the generators' relative angles oscillate. In a correctly designed and operated system, these oscillations decay. In an overstressed system, small disturbances may result in oscillations that increase exponentially in amplitude.