International Journal of Innovative
Computing, Information and Control
Volume **7**, Number **4**, April **2011**

ICIC International ©2011 ISSN 1349-4198
pp. **1549–1563**

PSO BASED AUTOMATIC WEIGHT SELECTION AND FIXED STRUCTURE ROBUST LOOP SHAPING CONTROL FOR POWER SYSTEM CONTROL APPLICATIONS

Somyot Kaitwanidvilai[1], Piyapong Olranthichachart[1]
and Issarachai Ngamroo[1,2]

[1]Electrical Engineering Department, Faculty of Engineering
[2]Center of Excellence for Innovative Energy Systems
King Mongkut's Institute of Technology Ladkrabang
Chalongkrung Rd., Ladkrabang, Bangkok 10520, Thailand
drsomyotk@gmail.ac.th; kksomyot@kmitl.ac.th; ngamroo@gmail.com

Received November 2009; revised May 2010

Abstract. *This paper proposes a new technique to design a fixed-structure robust loop shaping controller for the power system control applications. The proposed technique uses Particle Swarm Optimization (PSO) to find the optimal controller parameters so that the stability margin of controlled system is maximized. Infinity norm from disturbances to states is formulated as the cost function in our optimization. In addition, weighting function, which is normally difficult to obtain, is automatically determined by PSO. In this paper, the proposed technique is adopted to design the robust controllers for both two areas interconnected power system and VAR compensator connected electric power system. The performance of the proposed controller is investigated in comparison with conventional H_∞ loop shaping controller, robust controller designed by LMI method and reduced order robust controller by Hankel norm model reduction method. As results indicated, the stability margin of the proposed controller is better than that of the controller designed by LMI method and the reduced order robust controller. In addition, the order of the proposed controller is much lower than that of the conventional robust loop shaping controller, making it easy to implement in practical works.*
Keywords: Fixed-structure robust loop shaping control, Particle swarm optimization, H_∞ loop shaping control

1. **Introduction.** At present, stability analysis is an important issue for designing of power system stabilizer. In power systems, various generating and loading conditions, system nonlinearities, unpredictable network structure, various faults, etc cause system uncertainties. The power system controller designed without considering such uncertainties may fail to control the system. Therefore, the controller with high robust performance against system disturbance and uncertainties is highly expected. Normally, in a power system, uncertainties can be occurred by various sources, for example, parametric uncertainty, disturbances, sudden switching, load changing, faults, etc. In power system control applications, the analysis of stability and performance is not easy, but it can be carried out by control system theory. To design an effective controller, many techniques such as fuzzy logic control in [1,2], PI control in [3], GA based fuzzy control in [4], etc have been proposed and designed for many kinds of power systems. In [1], the fuzzy logic was adopted to design a controller for a two areas interconnected power system. As shown in their results, the fuzzy logic can efficiently control the system at any load changing conditions. However, the uncertainty criterion is not considered in this paper. Mathur and Manjunath [2] studied the dynamic performance of thermal units with asynchronous