Application of optimal artificial intelligence based tuned controllers to a class of embedded nonlinear power system

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ABSTRACT

This paper studies the implementation of the Bat Inspired Algorithm (BIA) as an optimization technique to find the optimal parameters of two classes of controllers. The first is the classical Proportional-Integral-Derivative (PID). The second is the hybrid fractional order and Brain Emotional Intelligent controller. The two controllers have been implemented, separately, for the load frequency control of a single area electric power system with three physical imbedded nonlinearities. The first nonlinearity represents the generation's rate constraint (GRC). The second is owing to the governor dead band (GDB). The last is due to the time delay imposed by the governor-turbine link, the thermodynamic process, and the communication channels. These nonlinearities have been embedded in the simulation model of the system under study. Matlab/Simulink software has been applied to obtain the results of applying the two classes of controllers which have been, optimally, tuned using the BIA. The Integral of Square Error (ISE) criterion has been selected as an element of the objective function along with the percentage overshoot and settling time for the optimum tuning technique of the two controllers. The simulation results show that when using the hybrid fractional order and Brain Emotional Intelligent controller, it gives better response and performance indices than the conventional Proportional-Integral-Derivative (PID) controllers.

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1. INTRODUCTION

Due to unremitting development of size and complexity of electrical power system, the problem of maintaining the power and frequency free from oscillations has become rapidly crucial because of irregular load variations and imbedded system nonlinearities [1]. These unexpected load variations result in the mismatch of generated power and load demand for consumption. This will finally distresses the quality and reliability of electric power supply. This can be achieved by the load frequency control (LFC) ideologies. Nowadays, a lot of work is going on to make the systems intelligent so the systems can successfully serve the benefits of mankind [2-3].

The main goal of operation of the LFC in the single area or multi area power systems is to maintain the frequency within the permissible limits. In the past few years, enormous improvement has been made in the area of load frequency control of a single area power system and multi area as well [4-5]. Designing