OPTIMAL LOAD FREQUENCY CONTROL IN SINGLE AREA POWER SYSTEM USING PID CONTROLLER BASED ON BACTERIAL FORAGING & PARTICLE SWARM OPTIMIZATION

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ABSTRACT

In this paper, meta-heuristic optimization based on Particle Swarm (PSO) and Bacterial foraging (BFO) has been used to determine the optimal values of the proportional-integral-deviation (PID) controller for the load frequency control. Single area power system has been designed as a model network for Matlab-Simulink simulation. The comparison has been done between the conventional PI controller and PID controller tuned by Particle Swarm and Bacteria Foraging optimization technique. Based on time settling, transient and overshoot analysis, it can be concluded and profoundly proved that PID tuning by BFO technique is better than PSO technique and conventional PI controller.

Keywords: Particles Swarm optimization, Bacterial Foraging optimization, Load frequency controller

INTRODUCTION

Power networks consist of a number of utilities interconnected together and power is exchanged between the utilities over the tie-line. Tie-line is the transmission lines that connect an area to another neighbouring area. If there is any load perturbation takes place, it will affect all the area which is interconnected together. Thus, LFC helps in maintaining the scheduled system frequency and tie-line power interchange with the other areas within the prescribed limits [1]. A typical large-scale power system is composed of several areas of generating units. In order to enhance the fault tolerance of the entire power system, these generating units are connected via tie-lines. The usage of tie-line power imports a new error into the control problem, i.e., tie-line power exchange error. When a sudden active power load change occurs to an area, the area will obtain energy via tie-lines from other areas. But eventually, the area that is subject to the load change should balance it without external support. Otherwise there would be economic conflicts between the areas. Each area requires a separate load frequency controller to regulate the tie-line power exchange error so that all the areas in an interconnected power system can set their set-points differently. For this purposed, the LFC has two major assignments, which are to maintain the standard value of frequency and to keep the tie-line power exchange under schedule in the presences of any load changes. In addition, the LFC has to be robust against unknown external disturbances and system model and parameter uncertainties. The high-order interconnected power system could also increase the complexity of the controller design of the LFC [2].

In industry, proportional-integral (PI) controllers have been broadly used for decades as the load frequency controllers. A PI controller design on a three-area interconnected power plant is presented in [3], where the controller parameters of the PI controller are tuned using trial-and-error approach. The LFC design based on an entire power system model is considered as centralized method. In [4] and [5], this centralized method is introduced with a simplified multiple-area power plant in order to implement such optimization techniques on the entire model. Many artificial intelligence (AI) based controllers have also been investigated by the various researchers like decentralized controllers such as sliding mode control [6- 9], artificial neural network (ANN) controller [10], fuzzy logic (FL) controller [11-13], and neuro-fuzzy controller [14]. Many optimization techniques have also been applied to tune the parameters of the various controllers such as Differential Evolution (DE) [15],GeneticAlgorithms[GAs],PracticalSwarmOptimizations[PSO][16]Ant Colony Optimization[ACO][17], which are some of the heuristic techniques having immense capability of determining global optimum. In this paper, Particles Swarm Optimization (PSO) and Bacterial foraging optimization (BFO) has been investigated to determine the optimal values of PID controller for single area load frequency controller (LFC). Then, both optimization techniques has been compared in term of time settling, transient and overshoot to determine the best of Kp, Ki and Kd in PID controller.

LOAD FREQUENCY CONTROL

The objectives of the load frequency controller are to maintain reasonably uniform frequency, to divide the load between generators, and to control the tie-line interchange schedules. Basically, single area power system consists of a governor, a turbine and a generator with feedback of regulation constant. The system also includes step load change input to the generator. This work mainly related with the controller unit of a single area power system. Simple block diagram of a single area power system with the controller is shown in Fig. 1.

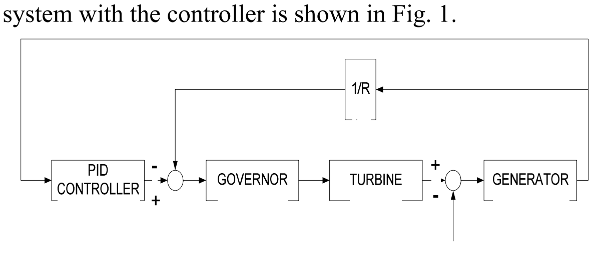

Figure-1. A single Area power system with PID controller.

Ordinary Load Frequency Control generally is designed with proportional integral derivative (PID) controller. The parameter of this PID controller can be tuned using optimization technique which can cause the controller to provide designed control action which meets the requirement. PID controller consists of Proportional