Chapter 7

Automatic Generation Control of Hydro–Hydro Interconnected Power System Based on Ant Colony Optimization

Jagatheesan Kaliannan
Mahendra Institute of Engineering and Technology, India

Nilanjan Dey
Techno India College of Technology, India

Anand B
Hindusthan College of Engg. & Tech., India

Amira S. Ashour
Tanta University, Egypt

Nguyen Gia Nhu
Duy Tan University, Vietnam

Valentina E. Balas
Aurel Vlaicu University of Arad, Romania

ABSTRACT

Each hydropower system incorporates with appropriate hydro turbine, and hydro governor unit. In the current work, an Automatic Generation Control (AGC) of two equal hydropower systems with Proportional-Integral-Derivative (PID) controller was investigated. The gain values of the PID controllers were tuned using Ant Colony Optimization (ACO) technique with one percent Step Load Perturbation (1% SLP) in area 1. The Integral Square Error (ISE), Integral Time Square Error (ITSE), Integral Absolute Error (IAE) and Integral Time Absolute Error (ITAE) were chosen as the objective function in order to optimize the controller’s gain values. The experimental results reported that the IAE based PID controller improved the system performance compared to other objective functions during sudden load disturbance.

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INTRODUCTION

Generally, the power system (power plant) converts one form of energy into electrical energy with the help of appropriate techniques. For example, the thermal power plant operates with heat energy, while the hydro power plant operates with kinetic energy in water. Additionally, the solar power plant operates using sun light and the wind power plant operates using kinetic energy in wind. Based on literature, it is found that few studies have been carried out involving AGC investigation of hydro power system with PID controller. The load frequency control of interconnected hydro power system has been investigated by considering fuzzy Proportional-Integral (PI) controller in Ramanand Kashyap et al. 2013. Load frequency Control (LFC) of hydro power system has been studied by implementing fuzzy PID controller in Ramanand Kashyap and Sankeswari 2014. Meena and Kumar 2014 discussed the LFC crisis in four area interconnected hydro power system. Furthermore, the performance of the system was improved by implementing Superconducting Magnetic Energy Storage (SMES) unit. The PI controller was designed for AGC of hydropower system in Prajod and Carolin Mabel 2014; while the LFC of two area interconnected power system was discussed with SMES unit in Rajaguru 2015. Sahu et al. 2015 designed a fuzzy based PID controller, which implemented in AGC of multi-area power system. In addition, the authors optimized the controller gain values by using Teaching Learning Based Optimization (TLBO) technique. Shabani et al. 2015 implemented a PID controller for LFC of power system. Moreover, the gain values are optimized by using Imperialist Competitive Algorithm (ICA). Ant colony optimization technique based PID controller was implemented in hydro thermal power system (Jagatheesan et al. 2015; Omar et al. 2013). From the preceding literature, it is clearly established that fuzzy logic controller is applied effectively in AGC applications (Gomes et al. 2010; Mohsen Ebrahimian Baydokhty et al. 2016, Madic et al. 2012; Engin Yesil 2014, Bevrani, and Daneshmand 2012; Shweta Tyagi 2014; Yousef 2014; Setiawan, Noor Akhmad 2014). In addition, it is reported that using optimization algorithms has a significant role with the PID controllers.

Related Works to LFC/AGC of Multi-Area Interconnected Power System

Based on the literature survey it is evident that many optimization techniques are developed and implemented for tuning of secondary controller gain values in AGC/LFC of power system. The different optimization techniques for tuning of controller gain values using LFC/AGC of power systems are clearly tabulated in Table 1.
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