DECENTRALIZED AGC STRATEGIES IN INTERCONNECTED POWER SYSTEMS INCORPORATING PARALLEL AC/DC LINKS

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ABSTRACT

Modern Power system consists of large number of generating units interconnected by transmission lines. The interconnection of the power systems enhance the stability and become a viable tool to provide almost uninterruptible power to load consumer from generating stations. A power system is divided into a number of control areas and each area is responsible for its own load and power exchanges. A control area may be described as a power system, a part of a system or combination of system to which a common generation control scheme may be assigned the duty of system control. In an interconnected power system, Automatic Generation Control (AGC) is used to maintain the system frequency and tie-line power flows at the specified nominal values. These days, AGC of interconnected power systems has become more significant as size and complexity of the system is going on increasing to meet out power demand. The limitation of AGC centralized control strategy is that it requires the exchange of information from various control areas spread over distantly connected geographical areas along with their increased computational and storage complexities. The decentralized automatic generation control strategies deals the limitations of centralized power system very effectively.

The work carried out in the thesis presents the design of decentralized Automatic Generation Control for an interconnected power system using Fuzzy Logic Control (FLC). For the investigation, a two-area interconnected power system with identical plants consisting of non-reheat turbines is considered. The areas are interconnected by two types of transmission line. First only AC link is undertaken and secondly parallel AC/DC links are considered as interconnection. The time responses are plotted for various system states with implementation of designed AGC regulators considering1% load perturbation in one of the two areas. The performance of the proposed controller has been compared with the ZN based PID controller. The investigation of the system dynamic

response reveals that PID controllers design using ZN method has better dynamic response result as compared to that of fuzzy logic controllers.

The study also presents the design of AGC regulators for interconnected power systems using stochastic search technique i.e GA. The system performance is investigated with designed AGC regulators of two-area interconnected identical power system consisting of non-reheat thermal turbines considering both AC and AC/DC links as area interconnections. The response plots are obtained for 1% load perturbation with proposed control scheme and compared with conventional AGC regulators designed using Ziegler Nichols method. The results reveal that the controller base on GA provides better transient response as compared to the responses obtained with ZN method based regulators.

The Particle Swarm Optimization (PSO) algorithm has been developed and applied for the design of AGC regulators of two-area interconnected power systems with both AC and parallel AC/DC link as area interconnections. The simulation results show that the proposed controller provides better dynamic responses with minimal frequency and tie-line power deviations, quick settling time and guarantees closed-loop stability margin when it compared with ZN and GA based regulators.

The study is also carried out considering two area interconnected hydro-thermal power system models, first model consists of one reheat thermal and hydro turbine and the second consists of three-area; thermal reheat – thermal reheat – hydro turbine. An optimization algorithm based on modeling-behavior of E.Coli bacteria in human intestine called Bacteria Foraging Optimization Algorithm (BFOA) is applied to tune the gain of the AGC regulators using integral square error cost function. The response plots are obtained for 1% load perturbation in area-1.The response plots are analyzed and compared with those obtained with PSO tuned AGC regulators for both power system models. BFOA is employed to search for controller parameters by minimizing objective function formulated in time domain. The performance of the proposed controller has been compared with the performance of the PID controller tuned by Particle Swarm Optimization (PSO) in order to demonstrate the superiority of the proposed BFOA tuned controllers. Simulation results demonstrate the better performance of the optimized PID controller based on BFOA when compared with optimized PID controller based on PSO.