

## ABSTRACT

Power generating system has the responsibility to ensure that adequate power is delivered to the load, both reliably and economically. Any electrical system must be maintained at the desired operating level characterized by nominal frequency and voltage profile. During the transportation, both the active power balance and the reactive power balance must be maintained between generation and utilization of AC power. These two balances correspond to two equilibrium points: frequency and voltage. When either of the two balances is broken and reset at a new level, the equilibrium points will float. A good quality of the electric power system requires both the frequency and voltage to remain at standard values during operation. Power systems are subject to constant changes due to loading conditions, disturbances or structural changes. Controllers are designed to stabilize or enhance the stability of the system under these conditions.

The control of frequency is achieved primarily through speed governor mechanism aided by Load Frequency control (LFC) for precise control. The Automatic Voltage Regulator (AVR) senses the terminal voltage and adjusts the excitation to maintain a constant terminal voltage. Control strategies such as PID controllers, decentralized controllers, optimal controllers and adaptive controllers are adopted for LFC and AVR to regulate the real and reactive power output. The daily load cycle changes significantly and hence fixed gain controllers will fail to provide best performance under

wide range of operating conditions. But in general, each controller is designed for a specific situation or scenario and is effective under these particular conditions. Hence, it is desirable to increase the capability of controllers to suit the needs of present day applications.

The main reason to develop better methods to design PID controllers is because of the significant impact on the performance improvement. The performance index adopted for problem formulation is settling time, overshoot and oscillations. The primary design goal is to obtain good load disturbance response by optimally selecting the PID controller parameters. Traditionally the control parameters have been obtained by trial and error approach, which consumes more amount of time in optimizing the choice of gains. To reduce the complexity in tuning PID parameters, Evolutionary computation techniques can be used to solve a wide range of practical problems including optimization and design of PID gains. Intelligent computing techniques like Fuzzy, Genetic Algorithm (GA), Particle Swarm Optimization (PSO), Ant Colony Optimization (ACO) and Hybrid Evolutionary Algorithms (EA) have been employed to efficiently search global optimum solutions.

In this research, efficient optimization algorithms are proposed to tune the optimal gains of PID controllers used for LFC and AVR of Power generating systems. The primary aim of the controller is to maintain the frequency and voltage at an optimal level under varying operating conditions. The operating points and system parameters were varied to test the robustness of the power system and the effectiveness of the proposed controller. From

the simulation results it can be found that the EA based controllers can produce relatively better results with faster convergence rate and higher precision. As evident from the graphs and empirical results, the suggested algorithms performed well under changing loads and regulations. The simulation results are found to be satisfactory when compared for settling time, overshoot and oscillations with conventional fixed gain controllers. The combined and synergic use of information yields a promising tool in solving power system control problems that requires optimization of more parameters. With the application of hybrid EA based controllers, the computational time is reduced because of faster convergence of particles towards an optimal solution. Hence, the balance between electric power generation and load demand is achieved satisfactorily, so the voltage magnitude and frequency are maintained at desired level. As a result the quality and reliability in the power system is improved by the application of Evolutionary Algorithms.