It may be that the old astrologers had the truth exactly reversed, when they believed that the stars controlled the destinies of men, the time may come when men control the destinies of stars.

- Arthur C. Clarke

CHAPTER 9

CONCLUSIONS AND FUTURE SCOPE

9.1. CONCLUSIONS

The increasing technological demands of today call for very complex systems, which in turn require highly sophisticated controllers to ensure high performance under adverse conditions. The complex systems, which cannot be tackled by conventional controllers due to lack of precise knowledge, are successfully implemented using soft computing techniques. Moreover, an intelligent control is a well established field in the discipline of control systems.

The stability analysis of fuzzy logic and genetic algorithms based non-linear controllers is discussed in this thesis work. Experiments on various process controllers viz. non-linear and optimal control of AC drive, speed control of turbine compressor system and speed control of DC servo motor have been mathematically modeled, successfully implemented using soft computing techniques viz. fuzzy logic, hybrid
fuzzy logic genetic algorithms and a comparative analysis is made with the conventional techniques.

A non-linear induction motor is controlled using soft computing techniques. A comparative improvement has been noted in controlling the electromagnetic torque and flux errors of a non-linear AC drive using fuzzy logic strategy and hybrid fuzzy logic genetic algorithms techniques.

Speed control of turbine compressor system for controlling the outlet of gas is performed by using fuzzy logic and hybrid fuzzy logic genetic algorithms techniques. When compared to conventional controllers, fuzzy logic provides better control on transient and steady state errors viz. maximum overshoot, settling time and peak time. Further, incorporation of genetic algorithms with fuzzy logic optimizes the controller parameters. A significant reduction in performance indices viz. integral of absolute error (IAE) and integral of time and absolute error (ITAE) has been noted for hybrid fuzzy logic genetic algorithms controller (HFLGA) over standalone fuzzy logic controller (FLC) and conventional proportional integral derivative (PID) controller.

Speed of DC servo motor is optimized using fuzzy logic and hybrid fuzzy logic genetic algorithms techniques and compared with the conventional proportional integral controller. The novel fuzzy logic and hybrid fuzzy logic genetic algorithms techniques outperform the conventional approach in terms of minimization of transient and steady state errors viz. maximum overshoot, settling time and peak time. It is inferred, while comparing the performance indices viz. integral of absolute error and integral of time and absolute error that, hybrid fuzzy logic genetic algorithms controller (HFLGA) shows minimum error over standalone fuzzy logic controller (FLC) and conventional proportional integral (PI) controller.

Abridged, it is evident from the results of the different case studies taken up in this work that the soft computing techniques are a great deal of research for tackling non-linear complex process control systems. A conclusion can be drawn that the fuzzy logic is the most robust and systematic approach for controlling the process. In addition to fuzzy logic, hybridization with genetic algorithms, further provide better optimization of the errors.
9.2. FUTURE SCOPE OF THE WORK

The emergence of fuzzy logic and its applications has dramatically changed the face of industrial control engineering. Fuzzy logic has given an opportunity to control engineers to meet and overcome the challenges of developing effective controllers for complex systems. The area of fuzzy logic is still in its infancy, and is a very fertile area of engineering research. Comparison of genetic algorithms with other evolutionary techniques viz. simulated annealing, chaotic theory is a grey area of research in the field of optimization.

In nutshell, the results reported in this thesis outlined a research direction for software engineering researchers, who had not paid much interest in the application domain of soft computing techniques, where fuzzy logic and genetic algorithms, play a visible role. The aim of this work is to raise the awareness of good results in soft computing and bridge the gap between software engineering and soft computing.