CHAPTER 7

CONCLUSIONS AND SUGGESTIONS FOR FUTURE RESEARCH

7.1 GENERAL

This chapter summarizes the main features and contributions of the research with analysis of simulation results and offers suggestions for future research. It provides a summary of the achievements relating to the multiobjective cascade control system development of regulatory and servo processes and concludes with discussion of the results achieved in terms of the objectives of the research. It highlights the main benefits of employing the multiobjective cascade control system using evolutionary approaches for the servo and regulatory process and discusses the implementation issues. The section also provides insight obtained from computer based simulation results for the proposed multiobjective cascade control system. Suggestions for further research that built upon the developments made during the course of the current research are also made in the final section of this chapter.

7.2 SUMMARY OF THE MAIN CONTRIBUTIONS

In this work, in the case of regulatory process, the mathematical modeling of level and flow process are developed by experimental analysis. PI controllers are used for both the primary and secondary controller of the cascade control system. Multiobjective evolutionary algorithms NSGA-II and NSPSO are developed for the cascade control of liquid level control system. Simulation results of both the evolutionary algorithms in absence and
presence of disturbances of various types (step, ramp, impulse) and magnitudes are compared. The comparative results prove that NSPSO provides better disturbance rejection, less overshoot and less settling time compared to NSGA-II. Time integral performance measures such as ISE, IAE and ITAE are very much reduced in NSPSO compared to NSGA-II. Better set point tracking performances are achieved with NSPSO compared to NSGA-II. Stability analysis is carried out to demonstrate the stability of the proposed system at the operating point considered for analysis and the system is found to be stable. The investigation in this paper reveals that NSPSO performs better than NSGA-II for cascade control of liquid level process in terms of time domain specifications, disturbance rejection characteristics, set point tracking and time integral performance measures.

In case of servo process, mathematical model of DC servo motor is developed based on the differential equations governing the system. The conflicting objectives considered in the thesis are overshoot and settling time. Multiobjective optimization algorithms such as NSGA-II and NSPSO for the servo process are developed. The optimal tuning of PI controllers for cascade control of DC servo motor using evolutionary multiobjective algorithms NSGA-II and NSPSO was performed successfully and constraints are also satisfied. Simulations are carried out in MATLAB and simulation results of both the evolutionary algorithms NSGA-II and NSPSO are compared in the absence and presence of disturbances (step, ramp and impulse) of various types and magnitudes. The comparative results prove that NSPSO provides better disturbance rejection, less overshoot and less settling time than NSGA-II. Excellent set point tracking performances are achieved with NSPSO compared to NSGA-II. Thus NSPSO outperforms NSGA-II in cascade control of level process even in the presence of disturbances of various types and magnitudes and is stable at the operating point considered for analysis.
7.3  SUGGESTIONS FOR FUTURE RESEARCH

As part of the key contribution of the research, the outcome from the research study has also suggested and established some areas of work for other researchers to consider. The current investigation suggests that the other multiobjective optimization algorithms can also be adopted for multiobjective cascade control of servo and regulatory processes. It is suggested that the robustness issues can also be considered for analysis.