Chapter 9 - Conclusions

Based on the experimental results, S/N and ANOVA analysis performed, RSM based mathematical model developed and application of evolutionary algorithms such as SA, PSO, CGA and IGA for the optimization of machining of SS 420, the following conclusions have been arrived to obtain optimal machining parameter to achieve better surface finish characteristics during turning:

The surface roughness in the turning process has been measured for machining of SS 420 under different cutting conditions with a rhombic tooling system having uncoated tungsten carbide tool using Taguchi’s orthogonal array. Comparison of the experimental and analytical results has been carried out.

By incorporating the tool geometry in the model, the validity of the model has been enhanced.

The accuracy of mathematical model developed using response surface methodology shows the effectiveness of the model.

The optimization, carried out in this work, gives an opportunity for the user to select the best tool geometry and cutting condition so as to get the optimum surface quality.

The proposed IGA includes several improvements such as the incorporation of an artificial initial population scheme, a stochastic crossover technique, elitism and scaled fitness function. The IGA has been successfully applied to machining problems. It provided better solutions than the conventional GA.

Moreover, by incorporating all the improvements, it was found to be robust in providing quasi-optimum within a reasonable computation time and yield better solutions. Contrary to the dynamic programming, computation time of the proposed IGA is linearly proportional to the number of stages. The developed IGA method can simultaneously overcome the “curse of
“Dimensionality” and a local optimum trap inherent non-linear problem. The IGA helps the proposed algorithm to efficiently search and actively explore the solution. Therefore, the proposed IGA approach can be used as a practical planning tool for a real problem like machining process. Moreover, the proposed approach has the following merits: simple concept; easy implementation; better effectiveness than previous methods; better efficiency than the CGA. This research presents an improved genetic algorithm optimization approach for solving the machining operations problem with turning of SS 420. The results obtained from comparing the proposed genetic algorithm optimization approach with those taken from recent literature prove its effectiveness. The results of the proposed approach are compared with results of simulated annealing, particle swarm optimization and conventional genetic algorithm. The implication of the encouraging results obtained from the present approach is that such approach can be integrated on-line, with an intelligent manufacturing system for automated process planning. Since the genetic algorithm-based approach can obtain near-optimal solution, it can be used for machining parameter selection of complex machined parts that require many machining constraints. Integration of the proposed approach with an intelligent manufacturing system will lead to reduction in production cost, reduction in production time, flexibility in machining parameter selection, and improvement of product quality.

The application of each approach to obtain optimal machining conditions will be quite useful at the computer-aided process planning (CAPP) stage in the production of high-quality goods with tight tolerances by a variety of automated machining operations, and in adaptive control based machine tools. With the known boundaries of surface roughness and machining conditions, machining can be performed with a relatively high rate of success with the selected machining conditions.

This research definitely indicates some directions for future work. The application of the improved genetic algorithm-based approach in complex as well as flexible machining systems and automated process planning-systems is one of the directions for future research work.