ABSTRACT

Machining is an important entity in the field of manufacturing. It is used in large scale as manufacturing processes in engineering industries. The technology of metal cutting has grown substantially over time with a common goal of achieving higher machining process efficiency and higher degree of accuracy. The study of machining focuses primarily on the features of tools, input work materials and machine parameter settings which influence process efficiency and output quality characteristics. Technology development has led to the advent of many hard to machine and high strength to weight ratio materials which require advanced methods of machining. Traditional machining methods either fail or they are not suitable for machining such materials. A significant improvement in process efficiency of these advanced machining techniques may be obtained by process parameters optimization. This requires identifying and determining the regions of critical process control factors leading to desired outputs or responses with acceptable variations. Thus, the aim of this research is to search for optimal process control parametric combinations for advanced machining methods in order to attain the desired responses without violating any constraints.

In the multiobjective problem where the responses conflict with each other, it is difficult to conclude a single solution point as the optimal solution for the desired responses. This is due to the fact that further optimization of one objective will lead to the deterioration of the other objectives. The most appropriate solution at such cases is a Pareto optimal solution. This research provides a Pareto optimal set of solution points where each solution is a non dominated solution among the group of predicted solution points thus allowing flexibility in operating the machine while maintaining the standard quality.
After conducting an exhaustive literature review of optimization techniques used in various machining processes, the experimental methods are observed to be cumbersome, time consuming, costly and at times not feasible. Genetic Algorithm (GA) an evolutionary soft computing technique is identified to provide a cost effective method for solution of such complex problems. Unlike traditional optimization techniques, GA is robust and performs well in multimodal optimization problems. Furthermore, they are not fundamentally limited by restrictive assumptions about the search space. Considering these multi facet advantages of GA, optimization of various machining processes has been done in this research work using this technique.

Mathematical models for correlating the desired response with the control parameters are developed using Response Surface Methodology. An improved GA incorporating an artificial initial population scheme and elitism based on non dominated sorting GA is designed so as to provide a faster search mechanism. The computational results using GA demonstrates the proposed solution procedure is capable of solving such complicated problems both effectively and efficiently. From the results it is observed that GA provides better results and also more computationally efficient when compared to past researches.

The results help in global optimization of the machining processes. It provides a set of optimal combination of process parameters for optimization of responses with respect to various machining processes. This in turn aid to carry out the machining activity at optimal setting without going for trial experiments for searching out the optimal machining parameters which saves both time and cost. Integration of the proposed optimization technique with an intelligent manufacturing system can lead to reduction in production cost, reduction in production time, flexibility in machining parameter selection and improvement in product quality.