ABSTRACT

Process planning is an interlinking activity between the Design and Manufacturing fields. Alternative Process plans are generated in the Computer Aided Process Planning (CAPP) system owing to the presence of alternative machine tools and processes with required setups for manufacturing the same part type. Process planning and Scheduling are the two important aspects for obtaining high productivity with expected efficiency of the ordered products to be delivered in as per due dates. The aim of identification of the best machining processes sequence is to obtain the designed part with desired quality at the optimum cost and time. Process planning is modeled as a Non Polynomial-hard (NP-hard) combinatorial optimization problem with manufacturing constraints.

Enterprises are required to constantly redesign their products and continuously reconfigure their manufacturing systems in order to meet the customer requirements. But traditional approaches to manufacturing systems do not fully satisfy this new situation. Hence, the proposed Artificial Intelligence (AI) Techniques will bring the flexibility and efficiency needed by manufacturing systems. Therefore the use of AI techniques in integration of the fields like design, planning, shop floor activities, quality control, maintenance, scheduling etc., can result in significant improvements in various product developments.

Process planning and Scheduling are traditionally regarded as separate tasks performed sequentially, but if the two tasks were performed concurrently, greater performance and higher productivity of a manufacturing system can be achieved. Scheduling is another manufacturing function which attempts to assign manufacturing resources to the operations indicated in the process plans in such a way that some relevant criteria, like due date and makespan are met. Although there is a strong interrelation between process planning and scheduling, conventionally the two functions have been studied independently.

In this work, the problem is modeled with two AI techniques: Petrinets and Hybrid algorithm. In first step, a Petrinets Model with Means-Ends Analysis and Penalty Coefficient has been developed and alternative Process plans and schedules are generated. The evaluation or criteria of the Total Machining Cost and time comes
from the combined strengths of operational costs, cutting tool costs, machine change costs, tool change costs and set-up costs with related times.

Similarly in the next step, a Hybrid Algorithm is developed by combining Genetic Algorithm and Simulated Annealing algorithms. This Algorithm is applied for same problem solved in the first step. From the alternative process plans, a few are selected based on minimum machining cost and optimal or near-optimal process plans are identified. The developed optimal process plans are useful in order to produce effective schedules based on the due dates. The software for Petrinets and hybrid algorithm are developed using VC++. In addition to this, MATLAB package is also used to program hybrid algorithm with database connectivity and both the results are compared.

The integration of Process planning and Scheduling can introduce significant improvements to the efficiency of the manufacturing facilities through the reduction of scheduling conflicts, reduction of flow-time and work-in-process, increase in the use of production resources and adaptation to irregular shop floor disturbances.