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OPTIMAL DESIGN OF A PRODUCTION SYSTEM

Abstract

Keywords: Cellular Manufacturing System, Group Technology, Genetic Algorithm, Simulated Annealing, Mean Flow Time, Throughput

Cellular Manufacturing has been emerged as a strong approach for improving operations in batch and job shop environments. In cellular manufacturing, Group Technology is used to form part families based on similar processing requirements. Parts and machines are then grouped together based on sequential or simultaneous techniques. This approach results in cells where machines are located in relative proximity based on processing requirements rather than similar functional aspects. Decision-making and accountability are more locally focused, often resulting in quality and productivity improvements.

The primary objective of this research work was to develop a design methodology which addresses combinational complexity of CM design problem with non linear objectives of the mathematical model. In this research, a mathematical model was first developed. It considers the part flow time between machines, processing time of the part, throughput of the plant. With these variables objective function were developed with constraints. Genetic Algorithm and Simulated Annealing were employed as a part of heuristic which handles large CM design problem in a reasonable amount of time.The author has conducted number of experiments on different manufacturing industries and collected processing time of each part in the cell and total time of completion and weekly production of the Firms and the same are considered by author for this research work to establish the objectivity of this thesis.

Three objectives function namely, minimizing the mean flow time; maximization of throughput; Combination of minimization of mean flow time and maximization of throughput has been developed. Mean flow time and throughput were calculated from conventional techniques as well as optimization techniques namely Genetic Algorithm and Simulating Annealing techniques.

Software is developed in C++ for GA and SA techniques. With the help of the software in GA, Crossover and Mutation can be performed in very short time.The data obtained from Conventional, GA and SA techniques has been compared. It is found that GA and SA provide the better output than conventional technique in respect to the Mean flow time and throughput. Results from both the optimization techniques were also compared with respect to the three objective function, mean flow time and throughput.

From the results obtained by the execution of all the primitive and deterministic approaches on the sample problems with varying complexities, it has been found that the performance of GA offers comparatively better results in terms of minimum mean-flow time and maximum throughput. Furthermore, the problem discussed in this thesis involves several variables and a multi-objective function, therefore the ability of GA to handle this type of objective functions and constraints make it a good approach to solve the problem.

Finally, a graphical scheme has been used for a comparative study of all the techniques under each performance criterion. Ten test problems have been used in this thesis generated from industry specific data inputs. The principle motivations for undertaking this project is the constant desire of the author to study and perform an extensive computational experiments over a set of problems and thereafter suggest a policy that will continuously deliver the optimized in any problem environment of the CMS. Finally the recommendation has been made for future work which has not been considered by author due to certain constraints.