ABSTRACT

A GENETIC ALGORITHM-BASED SCHEDULING SYSTEM FOR DYNAMIC JOB SHOP SCHEDULING PROBLEMS

By

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In manufacturing systems, inputs of resources, such as materials, labor, machines, energy, and information, are transformed to finished products for output. Managing the transformation process in an efficient and effective manner has been recognized as essential to survival in the current competitive marketplace. Among the operations-management functions, scheduling, which is the last step before operations plans are converted into productive activities, is concerned with allocating available resources to specific jobs and orders in the best manner to meet the operations objectives.

The goal of this research is to develop an efficient genetic algorithm-based scheduling system to address a general scheduling problem -- the dynamic job shop scheduling problem. Based on the Giffler and Thompson algorithm, we have extended that approach by providing two new operators, THX crossover and mutation, which better transmit temporal relationships in the schedule. The approach produced excellent results on standard benchmark job shop scheduling problems. We further tested many models and scales of parallel genetic algorithms in the context of job shop scheduling problems. In our experiments, the hybrid model consisting of coarse-grain GAs connected in a fine-grain-GA-style topology performed best, appearing to integrate successfully the advantages of coarse-grain and fine-grain GAs.

In the simulation study, the objective functions examined were weighted flow time, maximum tardiness, weighted tardiness, weighted lateness, weighted number of tardy jobs, and weighted earliness plus weighted tardiness. We further tested the approach under various manufacturing environments with respect to the machine workload, imbalance of machine workload, and due date tightness. The results indicate that the approach performs well and is robust with regard to the objective function and the manufacturing environment in comparison with priority rule approaches.