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A SURVEY ON MACHINE SCHEDULING TECHNIQUES

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ABSTRACT

In this paper the study about the different methodologies and techniques implemented for different types of scheduling problems in single machine, job shop and flow shop scheduling. Every author tells about the different scenario and approach to minimize the Make span, Tardiness and different parameters in scheduling. Every author implements their own algorithms and the strategies to find out the result, it may be positive or negative. This paper gives the clear idea for the future research work.

Keywords: particle swarm optimization, Tabu search, multimodal immune algorithm, genetic algorithm, ant colony optimization.

1. INTRODUCTION

Scheduling is the process where all the jobs are processed in the machines with their given processing times. The main objective of this scheduling is to minimize the make span and also the idle time of the machine and to find out the lateness, tardiness, mean flow time and no of tardy jobs etc. Some Algorithms have also been proposed to get this objective. The main algorithms that are used in scheduling are particle swarm optimization [1-15].

2. SCHEDULING TECHNIQUES

Scheduling can be subdivided into three types namely single machine scheduling, flow shop scheduling and job shop scheduling. In single machine scheduling we can find out the mean flow time, no of tardiness and maximum lateness. In flow shop scheduling we can find out the continuous flow of the jobs in two or three machines etc to find out the make span and the idle time of the machines. In job shop scheduling the jobs will be according to the routing of the jobs and their processing times.

There also different methods to find out the make span, total load on the machines and individual machine work load. The methodologies that are used are adopted are explained in the following section.

A. Particle Swarm Optimization

It is a method where it is compared with the 'birds' as a 'particle' and velocity in which the particle will go around the scheduling area to find out the optimal solution and its position represents the potential solution of the problem. A random candidate solution is conceptualized a particle in the PSO algorithm. Each particle in PSO flies through the own space with its own flying experience and its companions flying experience. It is also called as a velocity displacement model where all the particles in the swarm get the information globally and benefits from the discoveries. The fitness function will find out the fitness value for all particles. The swarm size between 20 to 50 and it is a problem dependent where agents searching through the member's space are called as the members. The p-best and g-best value of the current particle is compared with the fitness value of the particles p-best and g-best. This method was used by the following authors for to minimize the make span in the machines. Various neighborhood structures influences on their performance of the algorithm, ring and star topologies are the most widely used neighborhood structures .Neighborhood of a particle is the social environment a particle encounters. Particles are affected by neighbors not all populations. There will be three particles in ring topology so the each particle can communicates with the other two, whereas in the other topology all the particle can communicate with all the other particles. The star and social neighborhood structure is employed which has an important effect on controlling the convergence of algorithm. In PSO, for the guidance in the particle's search p-best and n-best play a very major role. The selection of best local guide for each particle of the population from a set of pareto-optimal solutions in different multi-objective particle swarm optimization methods has a great impact on the convergence and diversity of solutions. We can also use a sigma method in this approach. In this investigation, a particle swarm optimization (PSO) algorithm and a Tabu search (TS) algorithm were combined to solve the multi-objective flexible job shop problem (FJSP) with several conflicting and incommensurable objectives [1]. Results have proved that the proposed hybrid algorithm is an efficient and effective approach to solve the multi-objective flexible job shop problem (FJSP), especially for the problems on a large scale. This paper presents a new approach based on a hybridization of the particle swarm and local search algorithm to solve the multi-objective flexible job-shop scheduling problem [2]. The results indicate that the proposed algorithm satisfactorily captures the multi-objective flexible job-shop problem and competes well with similar approaches. By combining the chaos particle swarm optimization with genetic algorithm, a hybrid algorithm is proposed in this paper [3]. Experimental results indicate that this method is efficient and competitive compared to some existing methods.

B. Genetic Algorithm

It is the most popular algorithm or the coding used to solve the job-shop scheduling problems. In this 'n' denotes the number of jobs and 'm' denotes the no of machines. A chromosome is indicated by the jobs and the operations of the each job are denoted by the genes. Only

one job can be operated by the machine at a time, no preemption is allowed. To determine the survival probability of a chromosome at the next generation, we have to decide the fitness function. It is function proposed to evaluate the chromosome. To determine the survival probability of a chromosome at the next generation, we have to decide the fitness function. It is function proposed to evaluate the chromosome. A new set of Chromosomes are created by information's exchanged between chromosomes. It is not always simple to exchange strings of genes between selected parents and maintain the permutation properties. In order to strengthen the heritability, a new cross over operator based on the critical path will be designed. The Mutation operator prevents the genetic algorithm from local optimums and retains population diversity. In this approach, a point from the chromosome is chosen randomly and the gene that is in this point is exchanged with its subsequent gene. Roulette wheel selection containing the elite retaining model is used to generate a new population for the next generation. In the elite retaining model, the best chromosome from the previous generation is copied to the next generation. Hence the best produced solution can never become worse from one generation to the next Illegal schedules will happen by new chromosome created by using cross over operator. A repair mechanism is used by the manufacturing agent (MA) to convert these chromosomes to a legal form. When PA creates a new chromosome, it sends it to the MA for repair. The MA replaces repeat operations of the new chromosome with absent operations to ensure that the appearance time of each job. The repaired chromosome is sent to the appropriate PA. The main characteristic of this problem is that the tasks of each job are cyclic and are subjected to linear precedence constraints [4]. This scheduler utilizes a Petri-net modeling. Finally a benchmark and some preliminary results of this approach are presented. The objective is to minimize the global make span over all the FMUs [5]. This paper proposes an Improved Genetic Algorithm to solve the Distributed and Flexible Job-shop Scheduling problem. The proposed approach has been compared with other algorithms for distributed scheduling and evaluated with satisfactory results on a large set of distributed-and-flexible scheduling problems derived from classical job-shop scheduling benchmarks. This problem is characterized as NP-hard. Meta-heuristic methods such as genetic algorithms are widely applied to find optimal or near-optimal solutions for the job shop scheduling problem [6]. Benchmark instances are used to investigate the performance of the proposed approach. The results show that this approach improves the efficiency. Job shop scheduling problem is a typical NP-hard problem [7]. An inventory based two-objective job shop scheduling model was proposed in this paper, in which both the make-span (the total completion time) and the inventory capacity were as objectives and were optimized simultaneously. Job shop scheduling problem is a typical NP-hard problem. An inventory based two-objective job shop scheduling model was proposed in this paper, in which both the make-span (the total completion time) and the inventory capacity were as objectives and were optimized simultaneously.

A. Multi-Modal Immune Algorithm (MMIA)

The most important function of biological immune system is to protect living organisms from invading antigens such as viruses, bacteria and other parasites; those antigens are initially identified by a combination of the innate and adaptive immune systems. Humoral immunity and the cell-mediated immunity are the two types of immunity in our body. When an infectious foreign pathogen attacks the human body, the innate immune system will be activated as the first line of defense. Some phagocytes, such as the macrophage, have the ability to present antigens to other cells. Being termed antigen presenting cell (APC).The APC interprets the antigen appendage and then extracts the features, by processing and presenting antigen peptides on its surface to the B-cell. These antigen peptides are a kind of molecules called MHC (Major Histo compatibility complex) to distinguish a "self" from other "non-self" (antigen).Several different representation including job-oriented list representations, random key representations and the disjunctive graph representation have been employed for chromosome-based representation for job-shop scheduling problem. An immune algorithm utilizing operation-based representation is adopted for sizes. The machines have identical capacity of size and processing velocity. We propose a novel ant colony optimization method where the Metropolis Criterion is used to select the paths of ants to overcome the immature convergence. Finally, we generate different scales of instances to test the performance. The computational results show the effectiveness of the algorithm, especially for large-scale instances.

B. ANT Colony Optimization (ACO)

When solving combinational optimization problems, the execution of traditional ACO can be explained in this type method. There are S ants which are designed to search the solution space. In the iteration, the ants search paths and leave pheromone on the obtained paths. The pheromone on the path transmits messages to other ants when they intent to follow. The pheromone on a path evaporates with a fixed velocity. However when a new ant moves through it the pheromone increases, at a node, the ant selects the next path according to two factors 1.The pheromone information 2.The heuristic information. The performance of ACO and antibodies serve as objective for the job-shop optimization problem. A novel approach multi-modal immune algorithm is proposed for finding optimal solutions to job-shop scheduling problems emulating the features of a biological immune system [8].To improve the balance between exploitation and exploration, solving the multi-modal immune job-shop scheduling problem. The proposed scheme has the capability of seeking out the best solution and maintaining diversity in the search space. The antigen relies on the

initial solutions but ants tend to select the best path which has minimum pheromone in the early revolution. When assigning the jobs into batches we will be using the first fit heuristics to generate batches. When scheduling the batches onto machines, we propose a longest batch processing time first rule. So we denote the proposed algorithm as FLA (first-fit and longest-first ACO). In this paper we consider the problem of scheduling parallel batching machines with jobs of arbitrary [20].

C. Tabu Search

Tabu search is a meta-heuristic algorithm that has been successfully applied to a variety of scheduling problems among other combinational problems. It does not allow the objective function value to decrease if the solutions are not forbidden and it also allows the search to explore solutions. It consists of several elements called the specification of a neighborhood structure, the move attributes, the tabu list length, aspiration criterion and stopping rules. Tabu search is the most efficient local search strategy for scheduling problems. The neighborhood function is very efficient and very easy to implement. It is based on small displacement of the operations on a critical path in the disjunctive graph. For finding an optimal schedule a heuristic method is presented for solving the m-machine, n-job shop scheduling problem with tooling constraints [21]. This method named TOMATO, is based on an adaptation of tabu search techniques and is an improvement on the JEST algorithm proposed by [11]. Develop a model of problem difficulty for tabu search in the JSP, borrowing from similar models developed for SAT and other NP-complete problems. Our research represents the first attempt to quantitatively model the cost of tabu search for any NP-complete problem, and may possibly be leveraged in an effort to understand tabu search in problems other than job-shop scheduling. This paper proposes an effective hybrid tabu search algorithm (HTSA) to solve the flexible job-shop scheduling problem [12]. Three minimization objectives-the maximum completion time (make span), the total workload of machines and the workload of the critical machine are considered simultaneously. The statistical analysis of performance comparisons shows that the proposed HTSA is superior to four existing algorithms including the AL + CGA algorithm), the PSO + SA algorithm, the PSO + TS algorithm and the Xing's algorithm in terms of both solution quality and efficiency. The objective is the minimization of two criteria, the make span and the maximum lateness, and we are interested in finding an approximation of the Pareto frontier [13]. Both the genetic and the tabu search algorithms are tested on benchmark instances from flexible job shop literature and computational results show the interest of both methods to obtain an efficient and effective resolution method. This paper presents a tabu search approach to minimize total tardiness for the job shop scheduling problem [14]. The method uses dispatching rules to obtain an initial solution and searches for new solutions in a neighborhood based on the critical paths of the job. The solutions quality is evaluated against optimal solution values and for large problems the tabu search performance is compared with two heuristics proposed in the literature. This paper aims at solving a real-world job shop scheduling problem with two characteristics, i.e., the existence of pending due dates and job batches [15]. A two-stage local search algorithm based on the PMBGA (probabilistic model building genetic algorithm) and parameter perturbation is proposed to solve the integrated scheduling problem and its superiority is revealed by the applications to a real-world mechanical factory.

3. GRAPHICAL REPRESENTATION

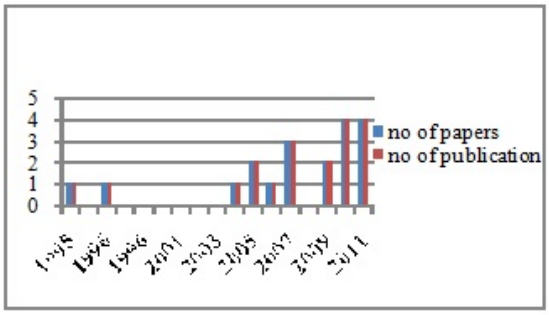

Figure-1. No. of publication vs No. of papers.

4. CONCLUSIONS

This paper tells about the overall algorithms that are used to find out the difficulties in scheduling process. The approach used by the different authors and their measures to find out the parameters in scheduling. Every author has their own idea and their strategies.

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