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A Review on Comparative Performance Analysis of Metaheuristics for Optimum Parallel Scheduling of Agv's and Machines in FMS

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ABSTRACT

In the recent past manufacturing sector, there are two most important items in manufacturing systems in which both are crucial elements for flexible manufacturing system (FMS) are automation and flexibility. An augment in the concert of FMS in the thought has been estimated as a result of modifying the schedule of AGV'S along with overall machine scheduling. There is great impact on scheduling activity by various material handling systems. Hence, AGVs are one of the material handling equipment's in FMS. The simultaneous scheduling of AGVs and machines is a vital factor which increase the efficiency of the FMS. Method planning and forecasting have been playing an important role in industrial sector as they stimulus other events of working organizations. Appropriate practice, planning and arrangement structures can progress and optimize the concert of manufacturing organizations. Scheduling refers to a set of strategies and procedures to govern the direction of effort to be done by industrial systems. Of all the resources in an industrial system that are scheduled before use, the Central Processing system is the most imperative.

This exploration advises in what way the differential evolution (DE) and simulated annealing (SA) algorithm module for simultaneous scheduling is connected with the competent allocation of resources over time for industry as Scheduling problems arise whenever a common and finite set of resources like labour, material and equipment must be used to make a variety of different products during same period of time. The objective of scheduling is to find a way to assign and sequence the use of these shared resources such that production constraints are satisfied and production costs are minimized.

Keyword: - Flexible Manufacturing System, Simultaneous scheduling, Machines, AGV's, Metaheuristics, Differential Evolution, Simulated Annealing, Tabu Search.

1.INTRODUCTION

The FMS consists of a set of different machines performing the tasks and a set of identical AGVs performing the material handling and transportation tasks between the machines. All the unprocessed jobs and AGVs are assumed to be located at the load/unload (L/U) station at the beginning of the schedule. Scheduling is the process of allocating shared resources over time for competing activities is known as scheduling. It has been the subject of a significant amount of literature in the operations research field. A flexible manufacturing system (FMS) is a highly automated manufacturing system well suited for the simultaneous production of a wide variety of part types in low to mid volume quantities at a low cost while maintaining a high quality of the finished products.

1.1. SCHEDULING OF MACHINES AND AGV'S IN FMS

The model of AGV'S studied in this work is different from traditional AGVS. Traditional AGV'S is usually applied in a limited space such as workshops and terminal yards, but in non-traditional AGV system where vehicles are controlled by computer. Unit load and buffer storage are mostly considered in a traditional AGVS. In comparison, our model expands the applications of AGVS, where vehicles are not necessary to be driverless, demand quantity is measured by the unit of weight or volume, buffer storage does not exist in the system. Thus, most methods in non-traditional AGVS are suitable for our model. One of the most typical examples is the operation of delivery express. Express companies usually establish regional distribution centers in high demand areas. There are many mutual transportation tasks among these distribution centers for the purpose of fulfilling the different requirements in each region. When scheduling centers are established to dispatch vehicles in the transportation system, the vehicles will be guided like automated guided vehicles and the whole system can be studied as a general AGVS. Many other applications could also be found in flight scheduling, shipping management and those areas where transport vehicle resource is absent to handle large quantities of orders.

1.2. AGV's in FMS

Today Flexible Manufacturing System (FMS) seem to be a very promising technology as they provide a variety of flexibility that is essential for design of planning for simultaneous scheduling of machines and automated guided vehicles (AGVs) to stay competitive in the highly dynamic and changing design environment. A synchronous material transfer is one of the most often phenomenon in most of the FMS. Material transfer between machines is performed by a number of identical automated guided vehicles (AGVs). In the literature reported, the subject of design of planning for simultaneous scheduling of machines and automated guided vehicles (AGVs) using non optimization technique system has generally been set out either as a comparison of various vehicle dispatching rules in relation to a prespecified schedule and on a particular layout , or in relation with the design job set . Egbelu and Tanchoco evaluated a number of dispatching rules for AGVs via a simulation scheduling model applied to a particular layout. Simultaneous scheduling of machines and automated guided vehicles in FMS becomes difficult due to the sequence dependent nature of travel times for dead heading trips between successive loaded trips of AGVs. The problem is NP hard and is attempted by a heuristic algorithm which considers both machine and vehicle scheduling constraints and determines the starting and completion times of operations for each job and the trips between the workstations together with the vehicle assignment with an objective to minimize the makespan, mean makespan, mean tardiness and CPU time Static structural analysis of the existing crankshaft was done using the finite element analysis approach. The finite element method is a numerical analysis technique for obtaining approximate solutions to a wide variety of engineering problems, because of its diversity and flexibility as an analysis tool. It is receiving much attention in engineering school and industries. In more and more engineering situations today, we find that it is necessary to obtain approximate solutions to problems rather than the exact closed form solution.

2. SCHEDULING

Given a set of activities or tasks, a set of resources, a set of constraints and a measurement of performance, scheduling can be defined in general, as finding the best way to assign the resources to the activities such that all the constraints are satisfied and the performance criteria are fulfilled.

In the context of manufacturing environment scheduling is concerned with allocation of resources like machines, tools, fixtures, material handling system etc. to tasks over a period of time with performance criteria such as minimizing makespan, minimizing mean flow time, number of tardy jobs, reducing the due date related penalty etc.

2.1. TERMINOLOGY AND DEFINATIONS

Processing time:

The forecasted estimate of how long it will take to complete a job, "j" is known as processing time. Here it is assumed that the processing time also includes set-up time required for the job (Bedworth, 1987).

Due date :

The committed shipping or completion date by which a job, "j" is supposed to be finished is known as due date. A job is allowed to be completed even after due date but in this case penalty is incurred. When it is compulsory to meet the due date then it is referred to as deadline.

Completion time:

The span between the beginning of work on the first job at which the time is referred as t=0, and the time at which the job, "j" is finished known as completion time Makespan: The makespan is defined as the completion time of the last job, before it leaves the system and is equal to the max of (C1, C2 …Cn).

Flow time:

The time span between the point at which a job is available for processing and the point at which it is completed. Thus, it equals the processing time plus the time that the job waits before being processed.

Lateness :

The deviation between the job completion time and its due date. A job will have positive lateness if it is completed after its due date and negative lateness if it is completed before its due date .

Tardiness :

It is the measure of positive lateness. If a job is completed early, it has negative lateness but zero tardiness. If a job has positive lateness, it has equal positive tardiness.

2.2 Types of Scheduling

Scheduling problems may vary based on the type of shop floor environment such as flow shop scheduling, flexible flow shop scheduling, open shop scheduling and job shop scheduling.

2.2.1 Flow Shop Scheduling:

The manufacturing environment where a number of operations are to be performed on each job and also all the operations of different jobs are to be performed in the same order and hence the arrangement of machines in this order is known as flow shop. Every job has to be processed on each one of the machines and all of them follow the same route, i.e. they have to be processed first on machine 1, then on machine 2 and so on. Once the operations on first machine are completed, the job joins the queue at the next machine. Usually all jobs are assumed to operate under the first in first out (FIFO) strategy.

2.2.2 Flexible Flow Shop Scheduling:

A flexible flow shop can be considered as a special case of the flow shop. Even though it is similar to flow shop, the major difference here is instead of machines in series, stages which consist of a group of identical machines are in series. If a job enters the system it is to be processed first in stage1 and then in stage 2 and so on. A stage functions as a bank of parallel machines and the job which enters in to the stage can be processed by any of the machines in that stage. Here also the jobs follow the FIFO strategy between different stages of the shop floor.

2.2.3 Open Shop Scheduling:

An open shop environment is one, where machines are present and a job visits all the machines for its completion without any restriction on the route followed by it. Hence different jobs entering in to the system may have different routes.

2.2.4 Job Shop Scheduling:

A job shop involves “m” different machines on which “n” jobs are to be processed. Here each job consists of a number of operations and for every operation the corresponding machine is predefined. It is also assumed that the processing time of all the operations is known in advance. The peculiarity of job shop is that every job may have a different route from that of the other job and a job may visit a machine more than once, if necessary. Another important feature of the job shop is that here certain constraints may be imposed on the job like precedence relations among the operations of a job, job release dates, job due dates etc. because of which certain solutions become infeasible.

3. OPERATING CONDITIONS

- The types and number of machines are known, operations are non-pre-emptive. There is sufficient input/output buffer space at each machine.
- Processing, setup, loading, unloading times are available and are deterministic.
- The number of AGVs is known and the AGVs are all identical in the sense that they have the same speed and load carrying characteristics.
- The flow path layout is given and travel times on each segment of the path are known.
- All vehicles start form the L/U station initially and return there after accomplishing all their assignments. There is sufficient input/output buffer space at the loading/unloading station.
- AGVs carry a single unit-load at a time. They move along predetermined shortest paths, with the assumption of no delay because of congestion.
- Ready times of all jobs are known. Initially, partially processed parts might be available at machines waiting for further processing, and they can be treated as jobs having zero ready times and their routing consists of the remaining operations.

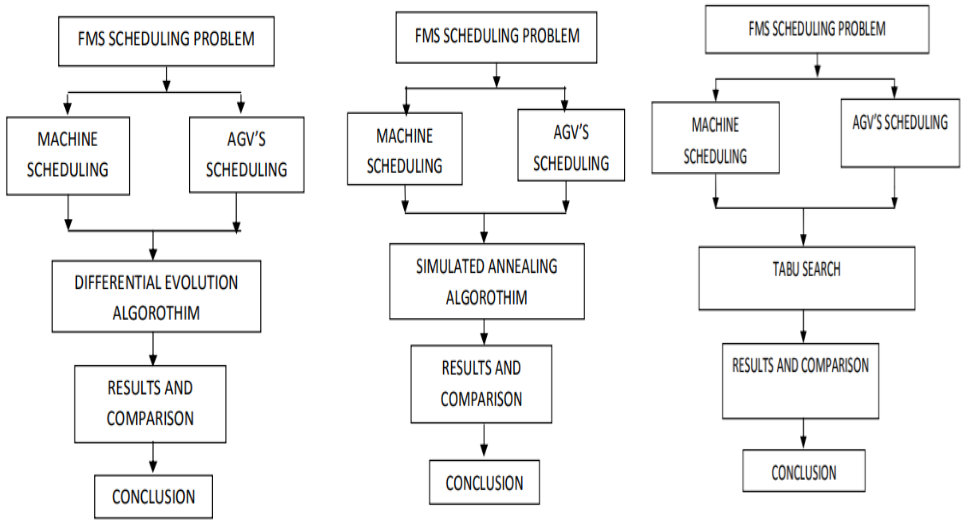
3.1 Algorithms

The algorithms applied for the present study are differential evolution (DE), simulated algorithm (SA) and Tabu Search. DE is found that the proposed algorithm referred to as the multistage genetic operation. For example, operational schedule of one machine for several consecutive generations and populations, and a whole chromosome presents the operational schedule of multiple machines for multiple generations and populations. So as to cope with this kind of special method structure, DE operations are introduced.

i Simulated Annealing

ii. Differential Evolution
iii. Stochastic Algorithm
iv. Deterministic Algorithm v. Genetic Algorithm
vi. Tabu Search
vii. Partial Swarm Optimization
viii. Artificial Neural Network
ix. Particle Swarm method

Among the above methods, authors interested to focus and implement the algorithms like- Differential Evolution, Simulated Annealing and Tabu Search for the present work as per the suitability's of these algorithms to the problem area.



3.1 Basic model for DE SA TB

4. CONCLUSIONS

Simultaneous scheduling of machines and AGV's in an FMS environment has an important issue considered in this research for diminishing the make span for different objectives which leads to improve in through input. Authors have considered different standard problems gathered from literature for measuring the effectiveness of proposed methodology. Here Flexibility in manufacturing system plays key role in improving the utilization of resources for yielding good products in terms of part varieties and part mix which will enhance production volume. Therefore it is treated as good substitute to move against the threats from other manufacturing competitors globally and can be implemented effectively. It is known that in an FMS very complex issues may come out from scheduling only because it involves material handling and assigning other systems rather than machines which leads to further complexity.

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