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# Comparison of Dynamic Scheduling Techniques in Flexible Manufacturing System

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**Abstract:**
Scheduling is an important tool in the manufacturing area since productivity is inherently linked to how well the resources are used to increase efficiency and reduce waste. The present article analyzes and provides comparison of modern techniques used for solving dynamic scheduling problem in flexible manufacturing system. These techniques are often impractical in dynamic real world environments where there are complex constraints and a variety of unexpected disruptions.

This paper defines the modern techniques of dynamic scheduling and provides a literature survey of scheduling which are presented in recent few years. The principles of several dynamic scheduling techniques, namely dispatching rules, heuristics, genetic algorithms and artificial intelligence techniques are describe in details and comparison of their potential.

**Key words**: FMS, scheduling, scheduling techniques

## I. INTRODUCTION:

FMS is actually an automated set of numerically controlled machine tools and material handling systems including AGVs and other handling devices. "A FMS is a highly automated group technology machine cell, consisting of a group of processing workstations that are interconnected by an automated material handling and storage system and controlled by a distributed computer system [1]. the main objectives is creating and operating to a flexible manufacturing system are determining the job size, resources needed ,equipment and process layout, routing sequence and process scheduling These problems must be solving before it is implemented in real factory.Scheduling is defined as an important tool in the manufacturing area since productivity is inherently linked to how well the resource are used to increase efficiency and reduce waste[2].The scheduling task during the operation is of importance owing to the dynamic nature of FMS such as flexible parts , tools, AGV routings and AS/RS storage assignments. These are primarily concerned with scheduling problem of FMS. In FMS scheduling, decision that need to be made include not only sequencing of jobs on machines but also routing of the jobs through the system. Apart from the machines, other resources in the system like that AGVs and AS/RS must be considered.

Most of the real world scheduling problems consist simultaneous optimization of multiple objectives. Dealing with multiple objectives and unpredictable real-time events has received much attention over the last few years. Example of such real-time events include machine failures, arrival of urgent jobs, due date changes, etc. [3]. The primary objective of an effective dynamic scheduling system is to produce the right parts, at the right time at a competitive cost by minimizing the make span time and overhead cost. In the recent years, a lot of research effort has been devoted to solve both static and dynamic job scheduling problem. The production environment is a dynamic mode where unforeseen events can happen at any time. These disturbances will have an impact on the production statement. A good scheduling system is a one that has the capability of dynamically decision making for the suitable scheduling function is a timely and high quality fashion while simultaneously maximizing throughput, customer desires and need and minimizing direct operating cost [4].

## II. Modern Production Techniques:

### 2.1. Dispatching Rule:

A simple dispatching rule is a rule that all jobs to be processed on a machine, i.e. the prioritization may be the job machine's attributes as well as the current time. The dispatching rule may be static in nature when they are not time dependent and dynamic in nature when they are time dependent [4].

Dispatching rule has played a significant role within dynamic contexts. In order to assess the performance of various dispatching rule dynamically under different dynamic and stochastic condition of the shop floor, simulation was used. Simulation allows the execution of several dispatching rules, and

the rule that yields best performance is selected. Jung and Kim used simulation and dispatching rules for real time scheduling of a manufacturing system in the presence arrivals of urgent jobs, machine breakdowns. Simulation evaluates the dispatching rules and based on this evaluation scheduler selects the best dispatching rule.

**2.2 Heuristics:**

Heuristics technique is a specific schedule repair method, which does not guarantee to find an optimal schedule, but have the ability to find reasonably good solution in a short time. The most common schedule repair heuristics are: right-shift schedule repair, match-up schedule repaired partial schedule repair. By the conclusion of various researches that the affected heuristic reduced much of the deviation and computational complexity associated with complete rescheduling and right shifting.

A high level heuristics are known as meta-heuristics which guide local search heuristics to escape from local optima. In recent years meta-heuristics (tabu search, simulation annealing, fuzzy logic etc) have been successfully used to solve production scheduling problems. Local search heuristics are neighborhood search methods based on the idea of searching neighborhoods. In local neighborhood search, the search starts from some given solution and tries iteratively to move a better neighborhood in an appropriately defined neighborhood of the current solution using move operators. The search process stops when no better solution can be found in the neighborhoods of the current solution which is the local optimum [5].

**2.3 Genetic Algorithms:**

The genetic algorithm is a technique inspired by the biological mechanism, based on the principles of natural evolution and selection. Although the genetic algorithms have been designed to respond to specific needs in the biology field, they have quickly adopted to a large variety of problems [2]

**G**enetic algorithms are representing a computer simulation of a population of abstract representation (called chromosomes) of the candidate solution (called individuals) to an optimization problem that evolves toward better solution. The algorithm starts with complete or partial randomly generated population. The evolution is simulated in generations. Each individual in this population has attached a fitness function that represents the individual performance based on a number of criteria [6].

Genetic algorithms have proven to be effective for FMS scheduling problem. Genetic algorithms are consists of four main basics, chromosomes, representation, initialization recombination and generation. The genetic algorithms goal is to obtain a detailed plan that represents the task's order and the completion time for each resource. The application aim is the identification of the best allocation of resources that minimize the make span for a predetermined quantity of products, considering the system restrictions.

**2.4. Artificial intelligence:**

A number of dynamic scheduling problem have adopted artificial intelligence techniques such as fuzzy logic, Petri nets, case-based reasoning, and knowledge-based-system.

**a. Fuzzy logic**:

Fuzzy logic theory provides a formal solution for representing and reasoning with uncertain information and the sets of fuzzy are actually functions that map a value which might be a member of the set to a number between zero and one indicating it actual degree of membership.

**b. Petri nets:**

A Petri nets is graphical and mathematical model in tool. It consists of places, transitions, and arcs that connected them.

**c. Case-based reasoning:**

Case-based reasoning (CBR) is a problem solving approach that takes the advantages of the knowledge gained from previous attempts to solve a particular scheduling problem. A record of each past attempt is stored as a case. The collection of historical cases, the case base then become model.

**d. Knowledge-based system:**

Knowledge-based system provides the potential for automating human expert reasoning and heuristic knowledge to run production scheduling system. Knowledge-based systems focus on capturing the expertise or the experience of the expert in a specific domain and an inference mechanism is used to derive conclusion regarding the corrective action to undertake.

In terms of effectiveness of decision making capability, knowledge-based system is limited by the quality and integrating of the specific domain knowledge. Fuzzy logic has not yet been explored to its fullest potential and neural network is also another artificial intelligence approach which cannot guarantee to provide optimal decisions, but their learning capability makes them ideally suited for rapidly changing system.

## III. Literature Survey:

A. prakash, et al., [7] proposed a complex scheduling problem in flexible manufacturing system has been addressed with a novel approach called knowledge based genetic algorithm (KBCA). This was attempting to improve the effectiveness of FMS scheduling problem with the throughput and mean flow time as the key performance of the system. Muhammad hafiz, et al., [8]used Binary Particle Swarm Optimization (BPSO) to optimize

simultaneous machines and AGVs scheduling process with make span minimization function. Jonghyun Lee and Jin S. Lee [9] was proposed heuristics search for scheduling flexible manufacturing systems using lower bound reach ability matrix which is make to efficient scheduling and also minimize the relative difference. David Appligate et al., [10] was proposed a computational study of the job-shop scheduling problem. They has designed and implemented a new heuristic procedure for finding schedule. Zahiri Taha, et al., [11] proposed job sequencing and layout optimization in virtual production line and provide the integration of two optimization models by using genetic algorithm and they concluded that the sequence model offer better cycle time than user input. Mohsen Bayati, et al., [12] provide iterative scheduling algorithm. They described that such algorithms allowing flexibility in manufacturing system in terms of the throughput and delay with possibility of efficient implement.

## IV. Comparison of Scheduling Techniques:

Most important modern dynamic scheduling techniques have been identified including: dispatching rules, heuristics, genetic algorithms and artificial intelligence techniques (as fuzzy logic, Petri nets, case-based reasoning and knowledge-based system). All these above described techniques have been widely used to solve static deterministic production scheduling problems in several domains including job shops, open shops, flow shops, flexible manufacturing system and batch processing etc. in order to ascertain the value of the various solution techniques. There has been some published work comparing some of these techniques. These comparisons help us reason about what techniques are most suitable for dynamic scheduling. Advantages and disadvantages of these techniques are provided by previous published work.

Dispatching rules are easy and can find reasonable solution rapidly. However, their main drawback is that the solution quality is usually poor due to their myopic nature.

Heuristics has been widely used to react to the presence of real time events because of their simplicity, but they may become stuck in poor local optima. To overcome this problem meta- heuristic approach has been proposed.

The performance of genetic algorithms is significantly superior to that of the common dispatching rules. Rossi and Dini (2000) used GA for dynamic batch scheduling of flexible manufacturing system. They consider some real time events the results shows that GA greatly reduce the make span. Wu et al. compared the performance of genetic algorithm and local search heuristic to generate robust schedules. The result shows that the performance of GA is generating scheduling with much better make span and stability than local search heuristics.

Artificial intelligence techniques make to easy to the finding of optimal scheduling.AI reduce the scheduler's effort by computerized simulation and other approaches such as fuzzy logic, Petri nets, case-based reasoning, and knowledge-based system. Finally AI provide better automated environment for solving scheduling problems in dynamic nature compare than other techniques.

## V. Conclusion and Discussion:

The most majority of this article dealing with dynamic scheduling has primarily been focused on finding the criteria of the applications, advantages limitations and future possibilities in some modern dynamic scheduling techniques consisting dispatching rules, heuristics, genetic algorithm and artificial intelligence.

We have discussed comparison of scheduling techniques in the state of real-time events and defined the most important AI approaches including fuzzy logic, Petri nets, case-based reasoning and knowledge-based system. The comparative study provides evidence that what types of techniques are beneficial and suitable in dynamic scheduling. Although there have been various research on dynamic scheduling, literature survey are also considered in this article, more work is still needed in this research area.

As a future suggestion of this article that in developing practical integrated dynamic scheduling system it is necessary to combine different techniques such as operation research, artificial intelligence with expert system, together to endow the scheduling system with the required flexibility, robustness and rescheduling strategies.

## Reference:

[1.] Mani shivhare and Sunita Bansal "Layout Optimization in Flexible Manufacturing System using Particle Swarm Optimization in Matlab" International Journal of Software Engineering and its Applications, Vol.8, No.7(2014), pp.55-64.

[2.] Florentina Alina Chircu "Using Genetic Algorithms for Production Scheduling"BULETINUL Universitatii petrol-gaze din Ploiesti, Vol. LXII, No1/2010, pp.113-118.

[3.] Udaykumara and P.Sukumaran "Task Scheduling of AGV in FMS Using Non-Tradition Optimization Techniques," Int j simul model 9 (2010)1,28-39 ISSN 1726-4529.

[4.] Hamdy Elwany, Mohamed Shouman, Mohamed Aboul-Ali, "Production Scheduling Techniques- A REVIEW,"

Deparment of Production Engineering, Alexandra University, Alexandra, Egypt.

[5.] Djamila Ouelhadj. Sanja Ptrovic, "Asurvey of dynamic scheduling in manufacturing system," J sched(2009)12:417-431.

[6.] Oprea, M., Nicoara, S. – Artificial intelligence, Petroeum-Gas University of Ploiesti,2005.

[7.] A,Prakash, Felix T.S. Chan, S.G. Deshmukh, "FMS scheduling with knowledge based genetic algorithm approach," Expert Systems With Applications 38(2011)3161-3171.

[8.] Muhammad Hafidz Fazli bin Md Fauadi and Tomohiro Murata, "Makespan Minimization of Machines and Automated Guided Vehicles Schedule Using Binary Particle Swarm Optimization."Proceedings of the International Multiconference of Engineers and Computer Scientists 2010 Vol III,IMECS 2010.

[9.] Jonghyun Lee, Jin S. Lee, "Heuristic search for scheduling flexible manufacturing systems using lower bound reachability matrix," Computer&Industrial Engineering 59(2010)799-806.

[10.] Devid Applegate and William Cook, "A Computational Study of the Job-Shop Scheduling problem,"ORSA Journal on Computing Vol.3, No.2, Spring 1991.

[11.] Zahari Taha, Farzad Tahriri and Aliq Zuhdi, "JobSequencing and Layout Optimization in Virtual Production Line," Journal of Quality Vol.18, No.4(2011).

[12.] Mohsen Bayati, Balaji Prabhakar, Devarat shah, Mayank Shrma, "Iterative Scheduling Algorithms"IEEE Communications Society subject matter experts for publication in the IEEE INFOCOM 2007.