A computational Study on Local Search Algorithm in Smart Manufacturing

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Abstract.

Extensive research has been conducted on the Cooperation Mission (FMS) program, the primary emphasis has been on the well-established learning process. In the context of the JSSE (Computer Scheduling Environment), where interaction options frequently rely on simplistic models, there is a notable absence of comprehensive guidance in the FMS program's documentation. This article is dedicated to the analysis of machine and AGV (Automated Guided Vehicle) planning, with the aim of establishing criteria for mitigating the average delay within the FMS system. This is achieved through the application of the Local Search Algorithm (LSA). The feasibility of this approach can be assessed across a range of scenarios using the 40-question FMS entertainment model.

Keywords: Hadoop Scheduler, Task scheduling, Artificial intelligence and Makespan

1. Introduction

Throughout the lifecycle of FMS, it deals with various challenges. Buzacott and Yao (1985), Suri (1985), and Kusiak (1986a) acknowledge and evaluate some of these issues, which can be categorized based on tasks, values, and concepts. FMS can be likened to a sophisticated computerized store, although its operation involves equipment, tools, robotic vehicles (AGVs), workstations, and more. Balancing machines and materials is essential due to their intertwined nature.When devising strategies for FMS, several factors need consideration, such as job selection and course scheduling. Furthermore, the intricate concept of FMS amplifies these challenges. This article concentrates on research design centered around the FMS reservation problem, which is recognized as a significant challenge within the realm of reservation problems in the business world.Planning policies for FMS have been established, with the average flow time frequently employed as a representation model. Special methods include online planning of machinery and equipment transportation based on real-time operations, as well as offline planning algorithms. Panwalkar and Iskander (1977) introduced a substantial number of rules, categorizing them into assignment rules, allocation rules, and priority rules. There is ample literature available concerning these policies (Conway et al. 1967, Blackstone et al. 1982, Kiran and Smith 1984a, b).Scheduling rules play a pivotal role in prioritizing the completion time, encompassing travel time, of both machines and AGVs. Notably, machine planning in the office environment mainly considers historical data. Egbelu and Tanchoco (1984) estimated planning policies for AGV deployment, while Acree and Smith (1985) delved into the issue of policy selection within FMS.Comparatively, the current research differentiates itself from experimental studies in shopping mall and FMS scheduling by incorporating intelligent machines into the scheduling problem (Sabuncuoğlu and Hommertzheim 1989b). Stecke and Solberg (1981) explored heuristic rules for automation in FMS, deploying ten machines alongside two AGVs.

2. Local Search Algorithm Design

The concepts explored in this study draw inspiration from a research conducted by Bilge and Ulusoy in 1995. Their research involved data that included details about different machines, their operational time, and a matrix that illustrated the travel times between these systems. Figure 1 depicts the arrangement, which comprises four CNC machines equipped with pallet changers and tool setters.

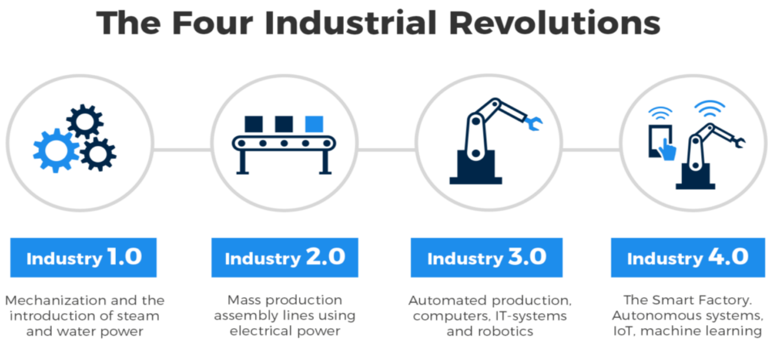

Figure 1: Basic structure of Industry 4.0

2.1. Methodology

Scheme 4 and task 5are responsible for executing LSA using movement time as an example. 4. Setting Decisions

Step 2: Put position "12" first in the main line 12-13-10-11-7-8-9-1-2-3-4-5-6

Stage 3: Find the time to reach maximum performance. It refers to the completion time (makespan) of a group of tasks. Stability estimates of different parameters for each activity are shown in Table 1.

Table 1. Completion Time Using LSA

O.No	M.No	V.No	TT	Job Ready	PT	OCT
12	3	1	0	3	3	9
13	1	2	9	11	9	29
10	4	1	7	11	6	23
11	2	1	23	27	15	57
7	3	2	17	20	9	38
8	4	2	38	40	3	46
9	1	1	46	50	12	74
1	1	2	44	74	6	86
2	2	2	86	87	12	111
3	4	1	111	113	9	131
4	1	2	93	94	18	130
5	3	2	130	132	6	144
6	2	1	144	146	15	176

Table 1 shows activity planning of through LSA rule for work set 4 designs 2 is appeared with process time triple and process time double. The operational culmination time (makespan) is 176

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3. Results and Discussion

The FMS workshop situation introduced here with exhibits the job set EX1 and layout4. In last digits 0 or 1 represents process time double and triple in two cases travel times are half only.

TABLE 2. Execution examination

Job	Layout	(Di)	(Li)	(Ti)	No of Operations	Avg No of Operations are Tardy
1	11	421	-72	0	13	0
2	11	421	-122	0	15	0
3	11	421	52	52	16	3
4	11	421	46	46	19	2
5	11	421	-159	0	13	0
6	11	421	-23	0	17	0
7	11	421	-87	0	19	0
8	11	421	67	67	20	3
9	11	421	100	100	17	6
10	11	421	196	196	21	9
1	22	406	-67	0	13	0
2	22	406	-130	0	15	0
3	22	406	51	51	16	3
4	22	406	44	44	19	2
5	22	406	-154	0	13	0
6	22	406	-29	0	17	0
7	22	406	-91	0	19	0
8	22	406	63	63	20	3
9	22	406	103	103	17	6
10	22	406	206	206	21	10
1	33	407	-67	0	13	0
2	33	407	-128	0	15	0
3	33	407	51	51	16	3
4	33	407	46	46	19	2
5	33	407	-154	0	13	0
6	33	407	-29	0	17	0
7	33	407	-89	0	19	0
8	33	407	63	63	20	3
9	33	407	103	103	17	6
10	33	407	208	208	21	10
1	44	429	-73	0	13	0
2	44	429	-122	0	15	0
3	44	429	47	47	16	3
4	44	429	42	42	19	2

5	44	429	-160	0	13	0
6	44	429	-24	0	17	0
7	44	429	-85	0	19	0
8	44	429	64	64	20	3
9	44	429	104	104	17	6
10	44	429	204	204	21	10

Within the context of optimizing the configuration of Automated Guided Vehicles (AGVs) and machines, priority rules are utilized to handle three distinct processing time values. These rules are detailed in two separate tables. An examination of the make span and mean flow time for various job sets and layouts is visually depicted in Figures 2.

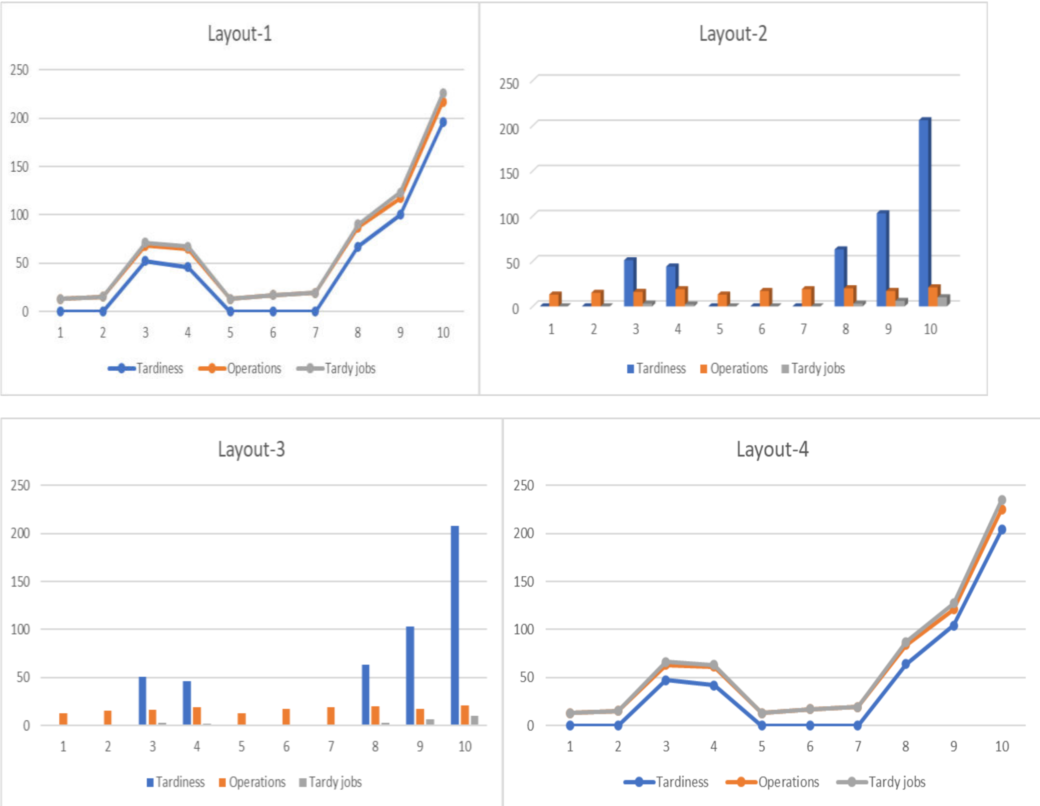

Figure 2: No of Operations in Local Search Algorithm

4. Conclusions.

The FMS problem was effectively addressed by utilizing the Local Search Algorithm (LSA), resulting in a reduction of tardy tasks within the system. This study involved four distinct layouts, each comprising four identical machines and two transport machines. Notably, this research encompassed not only the programming of machines but also the programming of Automated Guided Vehicles (AGVs). The findings are as follows: As per the research, an increase in activity within the system prompts corresponding adjustments. This entails an increase in both the number of machines and AGVs, which is a crucial consideration during FMS completion to ensure that no tasks run behind schedule. Furthermore, it's emphasized that the transportation of products by AGVs and machines becomes a sensitive issue as the complexity of scheduling rises. The number of tasks within the system is of significant importance as well. The utilization of the FMS system is directly correlated with an increase in the number of delayed tasks. The Local Search Algorithm (LSA) rule was rigorously tested 40 times, considering various aspects of the system. The most optimal results were achieved when combining the LSA rule with the AGV rule, demonstrating the effectiveness of this approach. This suggests the potential for the creation or application of new rules to address the diverse challenges encountered in the daily operations of the Flexible Manufacturing System (FMS) environment.

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References

E.S. Acree and M.L. Smith, "Simulation of flexible manufacturing system applications of computer operating system techniques," in the 18th Annual Simulation Symposium, pp. 205-216, IEEE Computer Society Press, Tampa, Florida, 1985.

J.A. Buzacott and D.D. Yao, "Flexible manufacturing systems: a review of analytical models," Management Science, vol. 32, no. 7, pp. 890-905, 1985.

J.H. Blackstone et al., "A state-of-the-art survey of dispatching rules for manufacturing job shop operations," International Journal of Production Research, vol. 20, no. 1, pp. 27-45, 1982.

J. Browne et al., "Classification of flexible manufacturing systems," The FMS Magazine, April, pp. 114-117, 1984.

H.C. Co, T. Jaw, and S.K. Chen, "Sequencing in flexible manufacturing systems and other short queue-length systems," Journal of Manufacturing Systems, vol. 7, no. 1, pp. 1-7, 1988.

R.H. Choi and E.M. Malstrom, "Evaluation of traditional work scheduling rules in a flexible manufacturing system with a physical simulator," Journal of Manufacturing Systems, vol. 7, no. 1, pp. 33-45, 1988.

R.W. Conway, "Some tactical problems in digital simulation," Management Science, vol. 10, no. 1, pp. 47-61, 1963.

R.W. Conway et al., "Theory of Scheduling," Addison-Wesley, Reading, Mass., 1967.

G.C. Dupon, "A survey of flexible manufacturing systems," Journal of Manufacturing Systems, vol. 1, no. 1, pp. 1-16, 1982.

P.J. Egbelu, "Pull versus push strategy for automated guided vehicle load movement in a batch manufacturing system," Journal of Manufacturing Systems, vol. 6, no. 3, pp. 209-221, 1987.

P.J. Egbelu and J.M.A. Tanchoco, "Characterization of automated guided vehicle dispatching rules," International Journal of Production Research, vol. 22, no. 3, pp. 359-374, 1984.

P.A. Kumar et al., "Scheduling of machines and automated guided vehicles in FMS using scatter search algorithm," International Journal of Mechanical Engineering and Technology, vol. 8(5), pp. 471-481, 2017.

K.V. Subbaiah, M. Nageswara Rao, K. Narayana Rao, "Scheduling of AGVs and Machines in FMS with Make Span Criteria Using Sheep Flock Heredity Algorithm," International Journal of Physical Sciences, vol. 4(2), pp. 139-148, 2009.

M. Nageswara Rao, S. Vara Kumari, P. Manohar, B. Madesh, P. Naveen Krishna, R. Suraj Krishna, "Simultaneous Scheduling of Machines and AGVs in FMS Through Ant Colony Optimization Algorithm," International Journal of Engineering and Advanced Technology, vol. 9(3), pp. 1392-1397, 2020.

M. Nageswara Rao et al., "Simultaneous Scheduling of Machines and AGVs in FMS through Simulated Annealing Algorithm," International Journal of Innovative Technology and Exploring Engineering, vol. 9(4), pp. 2235-2240, 2020.

M. Nageswara Rao, et al., "Application of BPSO in flexible manufacturing system scheduling," International Journal of Mechanical Engineering and Technology, vol. 8(5), pp. 186-195, 2017.

M. Nageswara Rao and K. Narayana Rao and G. Ranga Janardhana, " Integrated Scheduling of Machines and AGVs in FMS by Using Dispatching Rules," Journal of Production Engineering, vol. 20(1), pp. 75-84, 2017.

M. Nageswara Rao and K. Narayana Rao and G. Ranga Janardhana,. "Machines and AGVs Scheduling in Flexible Manufacturing System with Mean Tardiness Criterion," International journal of Advanced Materials Manufacturing and Characterization, vol. 4, pp. 100-105, 2014.

M. Nageswara Rao, K. Dileep, Shaik Khadar Basha, Vara Kumari S., "Modrak Algorithm to Minimize Completion Time for n-Jobs m-Machines Problem in Flexible Manufacturing System," International Journal of Emerging Trends in Engineering Research, vol. 8(8), pp. 4560-4566, 2020.

M. Nageswara Rao, et al., "Simultaneous Scheduling in FMS through priority rules," Journal of Advanced Research in Dynamical and Control Systems, vol. 9, pp. 1995-2008, 2017.

M. Nageswara Rao, K. Dileep, Shaik Khadar Basha, Vara Kumari S., "Application of BPSO in flexible manufacturing system scheduling," International Journal of Mechanical Engineering and Technology, vol. 8(5), pp. 496–503, 2017.

M.Nageswara Rao et al., "Scheduling of Machines and Automated Guided Vehicles in FMS using Shuffled Frog Leap Algorithm," International Journal of Mechanical Engineering and Technology, vol. 8(5), pp. 496–503, 2017.

M. Nageswara Rao, "Simultaneous Scheduling through Heuristic Algorithm," International Journal of Engineering & Technology, vol. 7 (2.32), pp. 125-130, 2018.

M. Nageswara Rao and K. Narayana Rao and G. Ranga Janardhana, "Machines and AGVs Scheduling in Flexible Manufacturing System with Mean Tardiness Criterion," International journal of Advanced Materials Manufacturing and Characterization, vol. 4, pp. 100-105, 2014.

M. Nageswara Rao, K. Narayana Rao and G. Ranga Janardhana, " Integrated Scheduling of Machines and AGVs in FMS by Using Dispatching Rules," Journal of Production Engineering, vol. 20(1), pp. 75-84, 2017.

M. Nageswara Rao, K. Narayana Rao and G. Ranga Janardhana,. "Machines and AGVs Scheduling in Flexible Manufacturing System with Mean Tardiness Criterion," International journal of Advanced Materials Manufacturing and Characterization, vol. 4, pp. 100-105, 2014.

M. Nageswara Rao, K. Narayana Rao and G. Ranga Janardhana, " Integrated Scheduling of Machines and AGVs in FMS by Using Dispatching Rules," Journal of Production Engineering, vol. 20(1), pp. 75-84, 2017.

M. Nageswara Rao and K. Narayana Rao and G. Ranga Janardhana,. "Machines and AGVs Scheduling in Flexible Manufacturing System with Mean Tardiness Criterion," International journal of Advanced Materials Manufacturing and Characterization, vol. 4, pp. 100-105, 2014.

M. Nageswara Rao, K. Narayana Rao and G. Ranga Janardhana, "Machines and AGVs Scheduling in Flexible Manufacturing System with Mean Tardiness Criterion," International journal of Advanced Materials Manufacturing and Characterization, vol. 4, pp. 100-105, 2014.