Volume : 2 | Issue : 3 | Mar 2013 • ISSN No 2277 - 8179

Research Paper

Engineering

KEYWORDS : Load balancing, Group Technology, Cellular manufacturing, etc.

Productivity Improvement by Load Balancing of Machines

Ram Kumar Yadav — Department of Mechanical Engineering, Arya Group of Colleges, Jaipur

Deepak Kumar — Department of Mechanical Engineering, Poornima College of Engineering, Jaipur

ABSTRACT

Manufacturing process consists of raw material including machining, labour, power etc. The manufacturing process may be done by casting, powder metallurgy, plastic technology. The alignment or load balancing of a machine shop should be in proper manner. The productivity of industries depends upon the type of process used, machining time, cost, labour involvement, utilization of raw material etc.

In older times (before 1960s) there was no method to improve the productivity but nowadays several techniques like Cellular manufacturing, Group technology are widely used in manufacturing industries to improve the productivity. The proper alignment or load balancing of machines is an important factor for improving the productivity. So In my research paper, I will try to improve the productivity of a industry by the proper alignment or load balancing of machines.

1. Introduction:

This paper deals with a load-balancing problem among several operators in a semi-automatic parallel machine shop in which two types of machine are operated. The objective is to assign jobs to the proper machines and allocate machines to operators in order to minimize the unbalance of the workloads among operators under the constraints of available machine- and operator-time. There are two types of parallel machines and jobs are classified into the two types. However, operator can handle machines of both types.

Line Balancing is leveling the workload across all processes in a cell or value stream to remove bottlenecks and excess capacity. A constraint slows the process down and results if waiting for downstream operations and excess capacity results in waiting and absorption of fixed costs.[3]

This paper presents a new approach towards the machine selection problem. This approach utilizes a decision support system (DSS) for advising the production manager which machine to select. The DSS is of special kind: its machine selection rules are modified to ensure equal load on the machines. The basic structure of the decision tree is defined by process experts and the rules threshold values are dynamically evaluated. [4]

2. Load balancing with FMS:

Machine-loading problem of a flexible manufacturing system (FMS) is known for its complexity. This problem encompasses various types of flexibility aspects pertaining to part selection and operation assignments along with constraints ranging from simple algebraic to potentially very complex conditional constraints. From the literature, it has been seen that simple genetic-algorithm-based heuristics for this problem lead to constraint violations and large number of generations. This paper extends the simple genetic algorithm and proposes a new methodology, constraint-based genetic algorithm (CBGA) to handle a complex variety of variables and constraints in a typical FMS-loading problem. To achieve this aim, three new genetic operators—constraint based: initialization, crossover, and mutation are introduced. The methodology developed here helps avoid getting trapped at local minima. The application of the algorithm is tested on standard data sets and its superiority is demonstrated.[5]

This paper considers combined scheduling and machine layout problems in a flexible manufacturing system (FMS). All machines have the capability of performing several different types of operation. However, each operation type is to be assigned to only one of the machines, which are to be positioned around a unidirectional conveyor belt loop. For a known set of products, the primary objective is to maximize the throughput and the secondary objective is to minimize the movement of work between machines. Throughput is maximized by balancing workload, which indicates that the primary objective is equivalent to minimizing the bottleneck workload. A three-phase integer programming model is derived. The first phase balances the machine workload by assigning operations to machines. The second phase minimizes inter-machine travel, while respecting the workload balance attained in the first phase. In the third phase, machines are assigned to positions in the loop layout so that the total number of circuits made by the products is minimized. It is shown that this phase can be modelled as a linear ordering problem. The three-phase method is applied to a case study.[11]

3. Branch And Bound Procedure:

The branch and bound procedure for the Simple Assembly Line Balancing Problem Type 2 (SALBP-2) is described in this section. Some problem consists of assigning tasks to a given number of work stations of a paced assembly line so that the production rate is maximized. Besides, possible precedence constraints between the tasks have to be considered. Existing solution procedures for SALBP-2 are mainly based on repeatedly solving instances of the closely related SALBP-1, which is to minimize the number of stations for a given production rate. The proposed branch and bound procedure directly solves SALBP-2 by using a new enumeration technique, the Local Lower Bound Method, which is complemented by a number of bounding and dominance rules. Computational results indicate that the new procedure is very efficient.[1]

4. Graphical representation of process with or without load balancing:

The representations of different process without applying load balancing technique are shown in the fig. 4.1. The figure shows the improper load distribution between the machines. The process 2 shown in figure gives us information that the load on process 2 is very less as compared to the process 1.

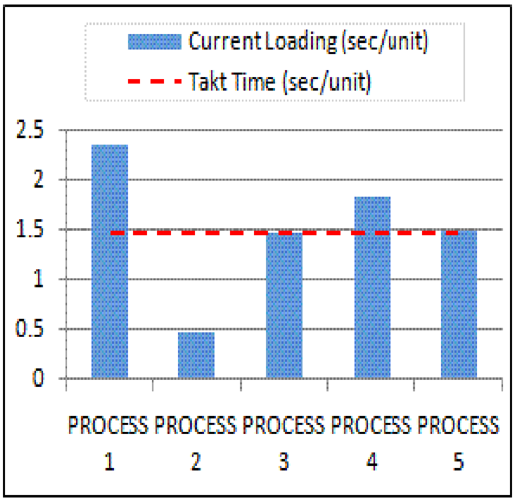

Fig. 4.1 Process representation without load balancing

After implementation of load balancing on different process the work or load distribution on each process is almost equal and hence each process is useful for same period of time which is shown in fig. 4.2.

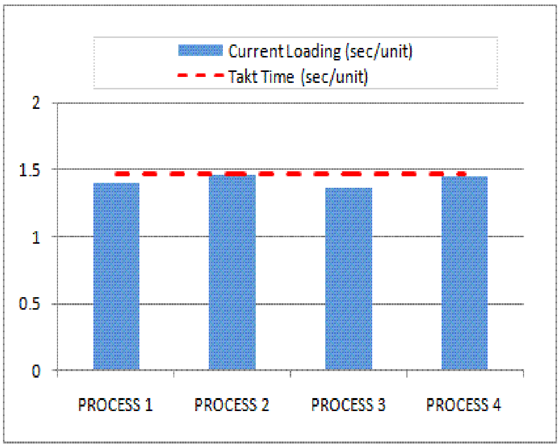

Fig. 4.2 Process representation with load balancing

5. Conclusion

We can conclude about the productivity improvement by some following factors:-

- To line balancing of machines.
- To reduce the work load on higher work loaded machine.
- To maintain the load distribution between higher and less work loaded machines.

REFERENCE

1. Maximizing the production rate in simple assembly line balancing — A branch and bound procedure European Journal of Operational Research, Volume 91, Issue 2, 7 June 1996, Pages 367-385 Robert Klein, Armin Scholl. | 2. Rate of change load balancing in distributed and parallel systems Original Research Article Parallel Computing, Volume 26, Issue 9, July 2000, Pages 1213-1230 Luis Miguel Campos, Isaac D Scherson. | 3. An operator load-balancing problem in a semi automatic parallel machine shop Original Research Article Computers & Industrial Engineering, Volume 46, Issue 2, April 2004, Pages 355-362 Dug Hee Moon, Dae Kyoung Kim, Jong Yun Jung. | 4. A decision support system for machine selection with load balancing Original Research Article Computers & Industrial Engineering, Volume 22, Issue4, October 1992, Pages 459-467D.BenArieh, Isaac Balaila. | 5. Solving machine-loading problem of a flexible manufacturing system with constraint-based genetic algorithm Original Research Article European Journal of Operational Research, Volume 175, Issue 2, 1 December 2006, Pages 1043-1069 Akhilesh Kumar, Prakash, M.K. Tiwari, Ravi Shankar, Alok Baveja. | 6. Load balancing in project assignment Original Research Article Computers & Operations Research, Volume 37, Issue 12, December 2010, Pages 2248-2256 Zhirong Liang, Yanzhi Li, Andrew Lim, Songshan Guo. | 7. A classification of assembly line balancing problems Original Research Article European Journal of Operational Research, Volume 183, Issue 2, 1 December 2007, Pages 674-693 Nils Boysen, Malte Fliedner, Armin Scholl. | 8. Parallel dynamic load balancing strategies for adaptive irregular applications Applied Mathematical Modelling 25 (2000) 109±122Rupak Biswas a,*, Sajal K. Das b, Daniel J. Harvey b, Leonid Oliker. | 9. Efficient schemes for nearest neighbor load balancing Parallel Computing 25 (1999) 789±812 Ralf Diekmanna,*,1, Andreas Frommerb,2, Burkhard Moniena,3. | 10. Load Balancing Parallel Explicit State Model Checking Electronic Notes in Theoretical Computer Science 128 (2005) 19–34 Rahul Kumar 1 and Eric G. Mercer. | 11. Workload balancing and loop layout in the design of a flexible manufacturing system European Journal of Operational Research, Volume 129, Issue 2, 1 March 2001, Pages 326-336 C.N. Potts, J.D. Whitehead. | 12. Modeling and solving constrained two-sided assembly line balancing problem via bee algorithms Applied Soft Computing, Volume 12, Issue 11, November 2012, Pages 3343-3355 Pinar Tapkan, Lale Ozbakir, Adil Baykasoglu. | 13. A decision support system for machine selection with load balancing | Computers & Industrial Engineering Volume 22, Issue 4, October 1992, Pages 459-467 D. Ben-Arieh, Isaac Balaila.. | 14. Performance evaluation for systems of pooled machines of unequal sizes: Unbalancing versus balancing European Journal of Operational Research, Volume 42, Issue 1, 5 September 1989, Pages 22-38 | Kathryn E. Stecke, Ilyong Kim. | 15. Expert Line Balancing System (ELBS) Computers & Industrial Engineering, Volume33,Issues 1–2, October 1997, Pages 303-306 Keytack H. Oh. | 16. The optimality of balancing workloads in certain types of flexible manufacturing systems European Journal of Operational Research, Volume 20, Issue 1, April 1985, Pages 68-82 Kathryn E. Stecke, Thomas L. Morin. | 17. Load balancing for group technology planning and control Original Research Article International Journal of machine Tool Design and Research, Volume 19, Issue 4, 1979, Pages 259-274 E. Oliva-Lopez, G.F. Purcheck. | 18. A classification of assembly line balancing problems Original Research Article European Journal of Operational Research, Volume 183, Issue 2, 1 December 2007, Pages 674-693 Nils Boysen, Malte Fliedner, Armin Scholl. | 19. The peak load minimization problem in cyclic production Computers & Operations Research, Volume 28, Issue 14, December 2001, Pages 1441-1460 Ming- Jong Yao |