Global Journal of Engineering Design & Technology

Extended Abstract

An Effective Harmony Search Algorithm for Solving a No-Wait Hybrid Flow Shop Scheduling Problem with Machine Availability Constraint

Mohammad Rahmanidoust

Abstract

This research investigates a no-wait hybrid flow shop scheduling problem. Minimizing the mean tardiness is considered as the objective to develop the optimal scheduling algorithm. Characteristics of our considered problem lead to the complexity of problem .First, no-wait operations. Second, setup time of each job is separated from its processing time and depends upon its preceding job. Third, all of jobs aren't available at the first of scheduling. In other word, each job has individual ready time. Finally, machines are not continuously available due to the preventive maintenance. An effective harmony search algorithm is used to tackle the mentioned problem. A series of computational experiments is conducted by comparing our algorithm with previous meta-heuristic algorithms like population based simulated annealing (PBSA), Adopted imperialist competitive algorithm (ICA) and hybridization of PBSA and ICA (ICA+PBSA). To achieve reliable results, Taguchi approach is used to define robust parameters' values for our proposed algorithm. The computational results with random test problems suggest that our proposed harmony search outperforms the three foregoing algorithms.

Keywords:

Scheduling; No-wait; Flow shop; Harmony search; Taguchi

Introduction

Production scheduling is one of the prominent decision-making process in the operation level of each manufacture or service companies. It can be defined as sequencing of a number of jobs on one or several machines aiming to optimally utilizing the resources while meeting the customer's demands in an efficient manner. Such a frequently occurring scheduling problem is difficult to solve due its complex nature. In recent years, researchers have focus in solving new challenges of machine scheduling problems.

One of the very noticeable processes to make decision is the planning for production in service companies .This is actually a classification of jobs for one or more machines to best use of the capabilities in operation and reach the customer's satisfaction at the same time. This planning problem that is often occurring is interacted to solve since the environment is so.

One of the most applicable problems in scheduling area in both theory and practice is flexible flow shop (FFS), or a hybrid flow shop (HFS), or a flow shop with multiple processors (FSMP). A typical FFS problem can be defined as follows: there are N jobs passing through a K stage flow line with one or more parallel machines at each stage. No-wait flow shop and flexible flow shop scheduling problem has been studied by many researchers. For a literature review in this area the readers are referred to those conducted by Richard and Zhang, Ruiz ET al. and Ribas et al.

Hybrid Harmony Search (HHS)

Recently, the meta-heuristics have become quite popular over the other approximate, exact or heuristic methods for solving complex combinatorial optimization problems such as job shop, flow shop scheduling problem and too many other hard problems. In this paper, a new algorithm called 'hybrid algorithm' (HA)" is proposed to solve the described problem.

Results

In this section the results of tested experiments for all algorithms are presented and the performance of the proposed algorithms is compared to each other in terms of the performance metrics. All algorithms

Mohammad Rahmanidoust
Donghua University, rahmanidoust@hotmail.com

were coded using MATLAB 2013a and run on personal computer with a 2.66 GHz CPU and 4 GB main memory.

The effectiveness of the algorithms was testified by solving 15 different problems. Tables 3-5 show the comparative results of the three algorithms with respect to five performance measures for small and large scale problem respectively

Conclusion and Further Researches

This paper presents an industrial scheduling problem as a no- wait hybrid flow shop problem with sequence dependent setup times, different ready times and machine availability time. This problem has many applications in wide ranges of modern manufacturing and service industries. To our knowledge, there is no other published work that considers finding an optimal schedule for this problem. We propose an effective harmony search algorithm to tackle the considered problem. To validate the proposed algorithm, we used fifteen test problems and evaluated the performance and the reliability of the proposed algorithm. Computational simulations and comparisons demonstrated the effectiveness and efficiency of the proposed HS algorithm. There are a number of research directions that can be considered as useful extensions of this approach. As a direction for further researches in this area, the influence of the starting solution should be investigated. Moreover, hybrid algorithms should be developed by using a local search like simulated annealing or variable neighborhood search within a HS. Other issues that are worthy of future research includes d enveloping and testing of novel meta-heuristics like firefly algorithm, graph coloring-based algorithm. Developing models with some practical assumptions like emergency maintenance, learning effect and deterioration may be other fruitful topics for future investigations.

References

1. Marichelvam MK, Tosun Ö, Geetha M (2017) Hybrid monkey search algorithm for flow shop scheduling problem under makespan and total flow time. Applied Soft Computing 55: 82-92.
2. Fanjul-Peyro L, Perea F, Ruiz R (2017) MIP models and mataheuristics for the unrelated parallel machine scheduling problem with additional resources. European Journal of Operational Research.
3. Low C, Wu GH (2016) Unrelated parallel-machine scheduling with controllable processing times and eligibility constraints to minimize the makespan. Journal of Industrial and Production Engineering 33: 286-293.

Mohammad Rahmanidoust
Donghua University, rahmanidoust@hotmail.com