Available online at www.sciencedirect.com

SciVerse ScienceDirect

Procedia Engineering 29 (2012) 3340 – 3347

Procedia Engineering

www.elsevier.com/locate/procedia

2012 International Workshop on Information and Electronics Engineering (IWIEE)

Integrated Optimization of Production Planning and Scheduling in Mixed Model Assembly Line

QiaoYing Dong[a*], JianSha Lu[a], YuanKun Gui[b]

[a]*Coll. of Mech. Eng., Zhejiang Univ. of Technol., Hangzhou, 310000, P.R.China*
[b]*Key Lab. for Mech. Manuf. & Autom. of Ministry of Educ., Zhejiang Univ. of Technol., Hangzhou, 310000, P.R.China*

Abstract

In order to solve the separation in the traditional serial production planning and scheduling in mixed model assembly line, the integrated optimization complete model of production planning and scheduling based on multiple objectives and constraints was constructed. Since the integrated optimization complete model is difficult to solve, the heuristic approach was adopt, and the modified discrete particle swarm optimization(MDPSO) was presented to solve the model. The experiments verifies the presented model and algorithm can realize the simultaneously optimization of production planning and scheduling in mixed model assembly line and contribute to performance improvement and the application scope expand of the new intelligent optimization.

Keyword: Mixed model assembly line; Production planning; Scheduling; Integrated optimizaiton model; Intelligent algorithm

1. Introduction

In the actual production environment, production planning and scheduling are closely linked and interacted. However, in the traditional serial production planning and scheduling, the two levels are split. In order to eliminate the separation, the integrated optimization modelling of production planning and scheduling is presented. As the final production unit, the mixed model assembly line takes a very important role in manufacturing system. Therefore, in this paper, the integrated optimization of production planning and scheduling in he mixed model assembly line was studied.

* * Corresponding author.
E-mail address: dqy0910@163.com

1877-7058 © 2011 Published by Elsevier Ltd.
doi:10.1016/j.proeng.2012.01.491

The integrated optimization of production planning and scheduling can be divided into 4 categories[1]. The complete model is one of them, namely construct the integrated optimization model of production planning and scheduling directly and can describe problems precisely. Therefore, in this paper, the complete integrated optimization model of production planning and scheduling in mixed model assembly line will be proposed.

Complete integrated model is very difficult to solve, we select the heuristic method to solve it. The studies on integrated optimization in assembly line are seldom. Yan et al. [2] presented three heuristic methods to achieve simultaneously optimization of production planning and scheduling in assembly line. L. Chen et al[3] used the heuristic method to optimize the production planning and scheduling simultaneously in assembly shops. Particle swarm optimization(*PSO*) is an evolutionary computation algorithm based on populations[4] in 1995. *PSO* is an excellent optimization algorithm in continuous space which has many advantages. The integrated optimization of production planning and scheduling is discrete combination optimization. However, *PSO* should be modified to adapt the discrete combination optimization. Currently, the discretization strategies of *PSO* can be divided into three categories: (1) take the speed as the probability of position changes[5,6]. (2)redefine the *PSO* operations [7]. (3)apply in discrete situation [8] directly. Different from the above methods, we will present new encoding and decoding scheme to achieve algorithm discretization and improve the algorithm performance. The modified discrete particle swarm optimization(*MDPSO*) will be proposed to solve the integrated optimization model.

2. Problem Description

The integrated optimization of production planning and scheduling in mixed model assembly line focuses on two topics: (1)construct the production plan and conduct the batch split or merge; (2) determine the MPS production set of products. Assuming that there are $M(m=1,\ldots,M)$ type of products, and the ith type of product have $MF(i)$ workstations. M types of products are produced on the assembly line according to the sequence and flow to each workstation in sequence. The production planning and scheduling can be divided into $NTF(T=1,2,\ldots,NTF)$ cycles and a cycle consists of nt time unit.

Firstly, the batch split or merge on ***demand***(i,T) are conducted to obtain the production planning ***production***(i,T); And then aiming at an equipment set and a job set $\boldsymbol{D}_m$ $(m=1,\ldots, M)$, the mixed model assembly line scheduling is conducted. We use the Minimum Part Set(*MPS*) to describe a complete production process. *MPS* is a vector representing a product mix, such that $(d_1, \ldots, d_M) = (D_1/H, \ldots, D_M/H)$, where M is the total number of models, D_m $(m=1,\ldots, M)$ is the number of products of model type m that need to be assembled during the entire planning horizon and H is the greatest common divisor or highest common factor of $D_1, D_2, \ldots, D_m$. This strategy operates in a cyclical manner. The number of products produced in one cycle is given by D: $D = \sum_{m=1}^{Nm} d_m$. Assuming that the total demand for products is H and demand for models is M in the planned period. Obviously, H/D times the repetition of producing the MPS products can meet the total demand in the planning horizon.

3. Integrated Optimization Modeling of Production Planning and Scheduling in Mixed Model Assembly Line

3.1. Assumptions

According to characteristics of mixed model assembly line, we make the following assumptions:

(1) each working process content and production time of each product are known before planning; (2) the products are produced in sequence and have same production sequence on each workstation;(3) the products arrives at the same time in a cycle and the pre-emptive production is not permitted; (4) a