A hybrid metaheuristic algorithm to optimise a real-world robotic cell

Shi Qiang Liu, Erhan Kozan

www.elsevier.com/locate/caor

PII: S0305-0548(16)30233-7
DOI: http://dx.doi.org/10.1016/j.cor.2016.09.011
Reference: CAOR4084

To appear in: *Computers and Operation Research*

Received date: 28 September 2015
Revised date: 29 April 2016
Accepted date: 17 September 2016

Cite this article as: Shi Qiang Liu and Erhan Kozan, A hybrid metaheuristic algorithm to optimise a real-world robotic cell, *Computers and Operation Research,* http://dx.doi.org/10.1016/j.cor.2016.09.011

A hybrid metaheuristic algorithm to optimise a real-world robotic cell

Shi Qiang Liu and Erhan Kozan*

Mathematical Sciences School, Queensland University of Technology, 2 George St GPO Box 2434, Brisbane Qld 4001 Australia

Emails: sq.liu@qut.edu.au

e.kozan@qut.edu.au

*Corresponding author. Tel: +61 7 3138 1029; fax: +61 7 3138 2310.

Abstract

In this paper, a real-world robotic cell is investigated by transforming it into a special job shop with a set of stationary robots for manufacturing the parts of a product (i.e., operations of a job) at multiple operational stages. In addition, this robotic cell contains a particular mobile robot to transport the parts among stationary robots inside the cell as well as a depot (for initialising the production) and a stockpile (for stocking the complete products) outside the cell. Thus, a new scheduling problem called *Blocking Job Shop Scheduling problem with Robotic Transportation* (*BJSSRT*) is proposed. A numerical example is presented to illustrate the characteristics and complexity of *BJSSRT*. According to the problem properties, four types of robotic movements are defined for a mobile robot in an operation's execution: processing-purpose, depot-purpose, return-purpose and stocking-purpose. By satisfying complex feasibility conditions, an innovative graph-based constructive algorithm is developed to produce a good feasible *BJSSRT* schedule. Embedded with the constructive algorithm, a hybrid Tabu Search and Threshold Accepting metaheuristic algorithm is developed to find a near-optimal solution in an efficient way. The proposed *BJSSRT* methodology has practical benefits in modelling the automated production system using stationary and mobile robots, especially in manufacturing and mining industries.

Keywords

Robotic Cell; Stationary Robot; Mobile Robot; Job Shop Scheduling; Robotic Transportation; Metaheuristics