UNIVERSITI PUTRA MALAYSIA

FLEXIBLE JOB SHOP SCHEDULING USING PRIORITY HEURISTICS AND GENETIC ALGORITHM

HAMID GHAANI FARASHAHI

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By

HAMID GHAANI FARASHAHI

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Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia in Fulfilment of the Requirements for the Degree of Master of Science

November 2010

DEDICATION

This thesis is dedicated to: who their true love and support were behind my success

My dearest parents: for all of the times you were by my side to teach me the value of diligence, courage and decency and help me to celebrate my successes.

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia
in fulfilment of the requirement for the degree of Master of Science

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HAMID GHAANI FARASHAHI

November 2010

Chairman: B.T.Hang Tuah Baharudin, PhD

Faculty: Engineering

In this research, flexible job shop scheduling problem has been studied. The aim of this research is to minimize the maximum completion time (makespan). The job shop scheduling is very common in practice and uniform machines (parallel machines with different speeds) have been used in job shop environment for flexibility. Flexible job shop scheduling consists of multistage which in each stage there are one or several parallel machines with different speeds. Each job crosses all these stages based on distinct routing which is fixed and known in advance. The relevant operation is processed by only one of the uniform machines in that stage.

Due to Non-deterministic Polynomial-time hard (NP-hard) nature of problem, in order to generate good solution in a reasonable computation time two solution methodologies are proposed. In the first method, five heuristic procedures based on priority rules have been presented and the performances of proposed heuristics have

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been compared with each other in order to minimize the makespan. Experimental results over all instances indicated that the most work remaining rule with earliest completion time rule (MWKR-ECT) and earliest completion time rule (ECT) achieved the minimum of makespan up to 65% and 34% of all instances in comparison with other proposed heuristic procedures. In the next method, a genetic algorithm has been developed. It has been shown that proposed genetic algorithm with a reinforced initial population (GA2) has better efficiency compared to a proposed genetic algorithm with fully random initial population (GA0). Then, the validation of proposed genetic algorithm with reinforced initial population (GA2) has been checked with random keys genetic algorithm (RKGA). The results of computations showed that an improved rate of 27% has been achieved according to average of loss.

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Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Master Sains

PENJADUALAN BENGKEL KERJA FLEKSIBEL MENGGUNAKAN PRIORITI HEURISTIK DAN ALGOTRITMA GENETIK

Oleh

HAMID GHAANI FARASHAHI

November 2010

Pengerusi: B.T.Hang Tuah Baharudin, PhD

Fakulti: Kejuruteraan

Dalam penyelidikan ini, masalah penjadualan bengkel kerja fleksibel telah dikaji. Tujuan penyelidikan ini ialah untuk meminimumkan masa siap maksimum (makespan). Penjadualan bengkel kerja sangat biasa bagi praktikal dan mesin-mesin seragam (mesin-mesin selari dengan kelajuan yang berbeza) telah digunakan dalam persekitaran bengkel kerja untuk fleksibiliti. Penjadualan bengkel kerja fleksibel mengandungi berbilang tahap yang dimana setiap tahap terdapat satu atau beberapa mesin selari dengan kelajuan berbeza. Setiap kerja melintasi semua peringkat ini berdasarkan penghalaan berbeza yang ditetapkan dan mengetahui dahulu. Operasi berkaitan diproses oleh hanya salah satu mesin seragam dalam peringkat itu.

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Disebabkan sifat masalah NP-hard, dua kaedah berdasarkan peraturan-peraturan prioriti dan algoritma genetik telah dicadangkan untuk mencapai penyelesaian hampir optimum. Dalam kaedah pertama, lima prosedur heuristik berdasarkan peraturan-peraturan prioriti telah dibentangkan dan prestasi heuristik dicadangkan telah dibandingkan dengan satu sama lain supaya meminimumkan makespan. Hasil percubaan mengenai semua contoh menunjukkan bahawa kebanyakan kerja baki dengan masa siap terawal (MWKR-ECT) dan masa siap terawal (ECT) mencapai minimum makespan sehingga 65% dan 34% bagi semua contoh dalam perbandingan dengan prosedur-prosedur heuristik lain yang dicadangkan. Dalam kaedah kedua, algoritma genetik telah disampaikan. Pertama, ia telah mentunjukkan algoritma genetik yang dincadangkan dengan satu memperkukuhkan populasi awal mempunyai kecekapan lebih baik berbanding dengan satu algoritma genetik yang dicadangkan dengan populasi awal yang rawak sepenuhnya. Kemudian, pengesahan algoritma genetik yang dicadangkan dengan memperkukuhkan populasi awal telah diperiksa dengan kunci-kunci rawak algoritma genetik (RKGA). Keputusan pengiraan telah membuktikan satu kadar bertambah baik iaitu 27% telah mencapai mengikuti purata “loss”.

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APPROVAL

I certify that an Examination Committee met on 15 November 2010 to conduct the final examination of Hamid Ghaani Farashahi on his thesis entitled "Flexible Job Shop Scheduling Using Priority Heuristics And Genetic Algorithm" in accordance with the Universitis and University Colleges Act 1971 and the Constitution of Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

Members of the Thesis Examination Committee were as follows:

Tang Sai Hong, PhD
Associate Professor
Faculty of Engineering
Universiti Putra Malaysia
(Chairperson)

Napsiah Ismail, PhD
Associate Professor
Faculty of Engineering
Universiti Putra Malaysia
(Internal Examiner)

Faieza Abdul Aziz, PhD
Senior Lecturer
Faculty of Engineering
Universiti Putra Malaysia
(Internal Examiner)

Mohd Amin Abd Majid, PhD
Associate Professor
Faculty of Mechanical Engineering
Universiti Teknologi Petronas
Malaysia
(External Examiner)

SHAMSUDDIN SULAIMAN, PhD
Professor and Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

B.T.Hang Tuah Baharudin, PhD
Senior Lecturer
Faculty of Engineering
Universiti Putra Malaysia
(Chairman)

Rosnah Mohd.Yusuff, PhD
Associate Professor
Faculty of Engineering
Universiti Putra Malaysia
(Member)

Md.Yusof Ismail, PhD
Professor
Faculty of Manufacturing Engineering
Universiti Malaysia Pahang
(External Member)

HASANAH MOHD GHAZALI,PhD
Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

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DECLARATION

I declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institution.

HAMID GHAANI FARASHAHI

Date: 15 November 2011

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