UNIVERSITI PUTRA MALAYSIA

HYBRID ANT COLONY OPTIMIZATION ALGORITHM FOR CONTAINER LOADING PROBLEM

YAP CHING NEI

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MASTER OF SCIENCE
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HYBRID ANT COLONY OPTIMIZATION ALGORITHM FOR CONTAINER LOADING PROBLEM

By

YAP CHING NEI

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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

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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

HYBRID ANT COLONY OPTIMIZATION ALGORITHM FOR CONTAINER LOADING PROBLEM

By

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October 2012

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In this study, a Tower Building (TB) heuristic with less complexity, inspired by the stack building heuristic, is proposed to hybridize with an Ant Colony Optimization (ACO) for solving the Container Loading Problem (CLP). This approach is called, the Hybrid Ant Colony Optimization with Tower Building Heuristic (HACO). The aim of the CLP is to pack a subset of given three-dimensional rectangular boxes of different sizes into a three-dimensional rectangular container of fixed dimensions in order to achieve optimal space utilization. The TB heuristic placed the base box on the container floor and packed the boxes on the base box by stacking them one by one until the container is full, whereas other researchers used the stack building heuristic to generate a set of box towers from all of the given boxes then only arranged them into the container. The HACO is applied with its probabilistic decision rule and pheromone feedback, together with the TB heuristic to construct towers of boxes to be arranged into the container in order to find the optimal solution. The pheromone evaporation will reduce the chances of the other ants selecting the same solution and consequently the search will be diversified. Preliminary

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computational experiments were conducted on a subset of benchmark data sets as to find the appropriate parameters setting for the developed HACO. The proposed algorithm is tested on two standard benchmark data sets to evaluate the performance and to determine the effectiveness of the algorithm. The results in space utilization obtained were comparable with other heuristic and metaheuristic approaches from the literature. It was showed that the proposed HACO algorithm has the capability in solving the CLP.

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

HIBRID ALGORITMA PENGOPTIMUMAN KOLONI SEMUT UNTUK MASALAH MUATAN KONTENA

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Dalam kajian ini, heuristik pembinaan menara (TB) yang kurang kompleks dan diinspirasikan oleh heuristik pembinaan timbunan telah dicadangkan untuk dihibridkan dengan pengoptimuman koloni semut (ACO) bagi menyelesaikan masalah muatan kontena (CLP). Pendekatan ini dinamakan hibrid pengoptimuman koloni semut dengan heuristik pembinaan menara (HACO). CLP bertujuan untuk mengisikan subset kotak segiempat tiga dimensi yang diberikan dan berlainan saiz ke dalam satu kontena segiempat tiga dimensi yang ditetapkan saiz untuk mencapai penggunaan ruang yang optimum. Heuristik TB meletakkan kotak asas di atas lantai kontena dan menyusunkan kotak-kotak satu demi satu di atas kotak asas sehingga kontena penuh, sedangkan penyelidik lain menggunakan heuristik pembinaan timbunan untuk membina satu set menara kotak-kotak dari semua kotak yang diberikan barulah mengaturkan mereka ke dalam kontena. HACO diaplikasikan dengan keputusan peraturan kebarangkalian dan feromon maklum balas, bersama dengan heuristik TB untuk membina menara kotak-kotak bagi disusun ke dalam kontena untuk mencari penyelesaian optimum. Penyejatan feromon akan

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mengurangkan peluang semut lain memilih penyelesaian yang sama dan carian akan dipelbagaikan. Eksperimen komputasi awal telah dijalankan ke atas subset penanda aras set data untuk mencari parameter yang sesuai untuk HACO. Algoritma yang dicadangkan akan diuji dengan dua penanda aras set data yang piawai untuk menilai prestasi dan menentukan keberkesanannya. Keputusan penggunaan ruang yang diperolehi adalah setanding dengan heuristik dan metaheuristik yang lain dalam literatur. HACO telah menunjukkan mempunyai keupayaan untuk menyelesaikan CLP.

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I certify that a Thesis Examination Committee has met on 18 October 2012 to conduct the final examination of Yap Ching Nei on her thesis entitled "Hybrid Ant Colony Optimization Algorithm for Container Loading Problem" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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DECLARATION

I declare that the thesis is 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.

YAP CHING NEI

Date: 18 October 2012

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TABLE OF CONTENTS

		Page
ABSTRACT		ii
ABSTRAK		iv
ACKNOWLEDGEMENTS		vi
APPROVAL		vii
DECLARATION		ix
LIST OF TABLES		xii
LIST OF FIGURES		xv
LIST OF ABBREVIATIONS		xvii
CHAPTER		
1	**INTRODUCTION**	
	1.1 Background	1
	1.2 Problem Statement	6
	1.3 Scope and Limitation of the Thesis	8
	1.4 Objectives of the Thesis	8
	1.5 Overview of the Thesis	9
2	**LITERATURE REVIEW**	
	2.1 Heuristic Approaches	10
	2.2 Metaheuristic Approaches	17
	2.3 Ant Colony Optimization	20
	2.3.1 The ACO Metaheuristic	21
3	**HYBRID ANT COLONY OPTIMIZATION**	
	3.1 Introduction	30
	3.2 Tower Building Heuristic	31
	3.3 Hybrid Ant Colony Optimization with Tower Building Heuristic (HACO)	40
	3.3.1 Probability Function	40
	3.3.2 Pheromone Update	42
	3.3.3 Procedure of HACO	42
	3.4 Summary	43
4	**COMPUTATIONAL EXPERIMENTS**	
	4.1 Introduction	44
	4.2 Benchmark Data Set	44
	4.3 Parameters Setting and Experimental Design	47
	4.4 Computational Experiments	48
	4.4.1 Initial Investigation	48
	4.4.2 Comprehensive Experiment	50
	4.5 Discussion	55
5	**CONCLUSION AND FUTURE RESEARCH**	
	5.1 Conclusion	57
	5.2 Future Research	59

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REFERENCES 60
APPENDIX A 64
BIODATA OF STUDENT 109
LIST OF PUBLICATIONS 110

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