PERFORMANCE COMPARISON OF PARALLEL BEES ALGORITHM ON ROSENBROCK FUNCTION

A project submitted to Dean of Awang Had Salleh Graduate College of Arts and Sciences In Partial Fulfillment of the requirements the degree of Master of Science (Information Technology) University Utara Malaysia

By

Nayif Mohammed Hammash

PERMISSION TO USE

In presenting this project in partial fulfillment of the requirements for a postgraduate degree from Universiti Utara Malaysia, I agree that the Universiti Utara Malaysia the Library may make it freely available for inspection. I further agree that permission for copying of this thesis in any manner, in whole or in part, for scholarly purpose may be granted by my supervisor or, in her absence by the dean of the Faculty of Information Technology. It is understood that any copying or publication or use of this thesis or parts thereof for financial gain should not be allowed without my written permission. It is also understood that due recognition shall be given to me and to Universiti Utara Malaysia for any scholarly use may be made of any material from my thesis.

Request for permission to copy or to make use of material in this thesis, in whole or in part should be addressed to:

Dean of the Awang Had Salleh Graduate School

College of Arts & Sciences

University Utara Malaysia

06010 UUM Sintok

Kedah Darul Aman

ABSTRACT

The optimization algorithms that imitate nature have acquired much attention principally mechanisms for solving the difficult issues for example the travelling salesman problem (TSP) which is containing routing and scheduling of the tasks. This thesis presents the parallel Bees Algorithm as a new approach for optimizing the last results for the Bees Algorithm.

Bees Algorithm is one of the optimization algorithms inspired from the natural foraging ways of the honey bees of finding the best solution. It is a series of activities based on the searching algorithm in order to access the best solutions. It is an iteration algorithm; therefore, it is suffering from slow convergence. The other downside of the Bee Algorithm is that it has needless computation. This means that it spends a long time for the bees algorithm converge the optimum solution. In this study, the parallel bees algorithm technique is proposed for overcoming of this issue. Due to that, this would lead to reduce the required time to get a solution with faster results accuracy than original Bees Algorithm.

ACKNOWLEDGEMENTS

“ In the name of Allah the Most Beneficent and Most Merciful”

All praises and thanks to the Almighty, Allah (SWT), who helps me to finish this project, Allah gives me the opportunity, strength and the ability to complete my study for Master degree after a long time of continuous work.

I wish to express my thanks and appreciations to all my lectures at University Utara Malaysia and very special thanks to Dr Massudi Mahmuddin who give me friendship beside supervision, and who was very supportive and cooperative all the time. Also I want to express my thanks for my evaluator Dr. Adib M. Monzer Habbal for their valuable and constructive comments.

Finally, it would not been possible for me to complete the program and this project without supporting and encourage from my family and friends. First and foremost, my gratitude goes to my mother and father for motivation me and for their prayers for me, may Allah bless them. To my brothers and sister for supporting me and had a great influence to finish my master study. To My friend Ihab Ahmed thanks for standing beside me and giving support in all period of study. Thanks for all persons who helped or contributed to finish my Master program.

Nayif Alhammash 2012

TABLE OF CONTENT

CHAPTER 2: LITERATURE REVIEW

CHAPTER 3: RESEARCH METHODOLOGY

CHAPTER 4: FINDINGS

CHAPTER 5: CONCLUSION

LIST OF FIGURES

LIST OF TABLE

LIST OF ABBREVIATIONS

ABC	Artificial Bee Colony
AI	Artificial Immune algorithm
BA	Bees Algorithm
GA	Genetic Algorithm
IWO	Invasive Weed Optimization algorithm
MPICH2	Message Passing Interface Chameleon version 2
MPI	Message Passing Interface
MSM	Master – Slave Model
PSO	Particle Swarm Optimization
QAP	Quadratic Assignment Problem
SI	Swarm Intelligence
TSP	Traveling Salesman Problem

LIST OF APPENDICES

CHAPTER ONE

INTRODUCTION

In this chapter, Bees Algorithm (BA) is studied in order to improve it's speed performance. This chapter is divided into a few sections. The chapter starts by introducing the original Bees Algorithm and continues with it speed performance problem which specify the research problem that aming to tackle. In this chapter also discuss, the main objective and contribution of the proposed work. In last section, draws the summary of the study.

1.1 Background

Bees algorithm is one of the enhancement methods, which is inspired by the nature of the food bees foraging activities. This algorithm has been suceessfully applied in some optimization problems , especially in the function optimization and parameters optimization (Mahmuddin & Yusof, 2009).

The bees algorithm optimisation that was suggested by Pham et.al in 2005 aims to optimise the numerical problems. It is inspired from the food foraging behavior for the swarm of honey bees. The honey bees have many ways such as waggle dance to determine the best

The contents of the thesis is for internal user only

REFERENCES

Ã–zbakir, L., Baykasoglu, A., & Tapkan, P. I. (2010). Bees algorithm for generalized assignment problem. *Applied Mathematics and Computation, 215*(11), 3782-3795.

Abraham, A., & Jain, L. (2005). Evolutionary multiobjective optimization. *Evolutionary Multiobjective Optimization*, 1-6.

Agarwal, A., & Kubiatowicz, J. D. (1998). Integrated shared-memory and message-passing communication in the Alewife multiprocessor.

Akbari, R., Mohammadi, A., & Ziarati, K. (2009). A powerful bee swarm optimization algorithm. *Multitopic Conference, 2009. INMIC 2009. IEEE 13th International*, 1-6.

Bajpai, P., & Kumar, D. R. M. (2010). Genetic Algorithm–an Approach to Solve Global Optimization Problems. *Indian Journal of Computer Science and Engineering, 1*(3), 199-206.

Buyya, R., & Moura, L. (1999). Parallel Programming models and paradigms. *High Performance Cluster Computing: Architectures and Systems, 2*.

Chou, Y. C., Nestinger, S. S., & Cheng, H. H. (2010). Ch MPI: interpretive parallel computing in C. *Computing in Science & Engineering, 12*(2), 54-67.

Dev – C++ program from http://www.bloodshed.net/devcpp.html

Dorigo, M., Birattari, M., & Stutzle, T. (2006). Ant colony optimization. *Computational Intelligence Magazine, IEEE, 1*(4), 28-39.

Dorigo, M., Caro, G. D., & Gambardella, L. M. (1999). Ant algorithms for discrete optimization. *Artificial life, 5*(2), 137-172.

Gropp, W., Lusk, E., & Skjellum, A. (1999). *Using MPI: portable parallel programming with the message passing interface*.

Hu, X. M., Zhang, J., & Li, Y. (2008). Orthogonal methods based ant colony search for solving continuous optimization problems. *Journal of Computer Science and Technology, 23*(1), 2-18.

Ismail, M. A. (2004). *Parallel genetic algorithms (PGAs): master slave paradigm approach using MPI*.

Judd, K. L. (1998). *Numerical methods in economics*: The MIT press.

Kavousi, A., Vahidi, B., Salehi, R., Bakhshi Zadeh, M., Farokhnia, N., & Fathi, S. (2011). Application of Bee Algorithm for Selective Harmonic Elimination Strategy in Multilevel Inverters. *Power Electronics, IEEE Transactions on*(99), 1-1.

Knop, F., Mascarenhas, E., Rego, V., & Sunderam, V. (1994). *An introduction to fault tolerant parallel simulation with EcliPSe*.

Krishnanand, K., Nayak, S. K., Panigrahi, B., & Rout, P. (2009). *Comparative study of five bio-inspired evolutionary optimization techniques*.

Lin, C., & Snyder, L. (2008). *Principles of parallel programming*: Addison-Wesley Publishing Company.

Mahmuddin, M. (2008). *Optimisation using bees algorithm on unlabelled data problems.*

Mahmuddin, M., & Yusof, Y. (2009). *A Hybrid Simplex Search and Bio-Inspired Algorithm for Faster Convergence.* Paper presented at the 2009 International Conference on Machine Learning and Computing.

Mathew, T. V. (2005). Genetic Algorithm.

Merkle, D., & Middendorf, M. (2000). An ant algorithm with a new pheromone evaluation rule for total tardiness problems. *Real-World Applications of Evolutionary Computing*, 290-299.

Microsoft .NET Framework Version 2.0. from http://www.microsoft.com/download/en/details.aspx?displaylang=en&id=19

Microsoft Visual C++ 2005 SP1. from http://www.microsoft.com/download/en/details.aspx?displaylang=en&id=5638

Mishra, K., Tiwari, S., & Misra, A. (2011). *A bio inspired algorithm for solving optimization problems*.

Molga, M., & Smutnicki, C. (2005a). Test functions for optimization needs. *Test functions for optimization needs*, 1-43.

Molga, M., & Smutnicki, C. (2005b). Test functions for optimization needs. *2007330 httpwww zsd ict pwr wroc plfilesdocsfunctions pdf*(c), 1-43.

MPI Project Template. from http://visualstudiogallery.msdn.microsoft.com/90fb60d4-0b8c-472f-8135-683d3c45f45a

Musunoori, S. B., Horn, G., Eliassen, F., & Mourad, A. (2006). On the Challenge of Allocating Service Based Applications in a Grid Environment. *Autonomic and Autonomous Systems, 2006. ICAS '06. 2006 International Conference*, 43-49.

Neumann, F., & Witt, C. (2010). *Bioinspired Computation in Combinatorial Optimization: Algorithms and Their Computational Complexity*: Springer-Verlag New York Inc.

Pagliari, R., Hong, Y. W., & Scaglione, A. (2010). Bio-inspired algorithms for decentralized round-robin and proportional fair scheduling. *Selected Areas in Communications, IEEE Journal on, 28*(4), 564-575.

Pallottelli, S., Tasso, S., Pannacci, N., Costantini, A., & Lago, N. (2010). Distributed and Collaborative Learning Objects Repositories on Grid Networks. *Computational Science and Its Applications–ICCSA 2010*, 29-40.

Pham, D., & Ghanbarzadeh, A. (2007). *Multi–objective optimisation using the bees algorithm*.

Pham, D., Ghanbarzadeh, A., Koc, E., Otri, S., Rahim, S., & Zaidi, M. (2006). *The bees algorithm a novel tool for complex optimisation problems.* Paper presented at the Proceedings of IPROMS 2006 conference.

Pham, D., & Kalyoncu, M. *Optimisation of a fuzzy logic controller for a flexible single-link robot arm using the Bees Algorithm.* Paper presented at the Industrial Informatics, 2009. INDIN 2009. 7th IEEE International Conference on.

Pham, D., Koç, E., Lee, J., & Phrueksanant, J. (2007). *Using the bees algorithm to schedule jobs for a machine.* Paper presented at the Proceedings of the 8th International Conference on Laser Metrology, CMM and Machine Tool Performance.

Pham, D., Marzi, H., Marzi, A., Marzi, E., Darwish, A. H., & Lee, J. (2010). *Using grid computing to accelerate optimization solution: A system of systems approach*.

Pham, D., Otri, S., Ghanbarzadeh, A., & Koc, E. (2006). Application of the bees algorithm to the training of learning vector quantisation networks for control chart pattern recognition. *Information and Communication Technologies, 2006. ICTTA'06. 2nd, 1*, 1624-1629.

Pham, D., Soroka, A., Koc, E., Ghanbarzadeh, A., & Otri, S. (2007). *Some applications of the bees algorithm in engineering design and manufacture*.

Pham, D. T., Afify, A., & Koc, E. (2007). *Manufacturing cell formation using the bees algorithm.* Paper presented at the Innovative Production Machines and Systems Virtual Conference, Cardiff, UK.

Polratanasuk, P., Mesacharoenwong, P., Anantasate, S., & Leeprechanon, N. (2009). Solving Optimal Power Flow Problem Using Parallel Bee Algorithm. *IEEE*, 60-64.

Ragsdale, S. (1991). *Parallel programming*: McGraw-Hill, Inc.

Ramanatha, R. (2009). *Application Of Parallel Computing In Performing An Unsupervised Fluoroscopic Analysis Of Knee Joint Kinematics.* Unpublished Master's thesis, Boise State University, Idaho , USA.

Regenbrecht, H. T., Schubert, T. W., & Friedmann, F. (1998). Measuring the sense of presence and its relations to fear of heights in virtual environments. *International Journal of Human-Computer Interaction, 10*(3), 233-249.

Rothbaum, B. O., Hodges, L. F., Kooper, R., Opdyke, D., Williford, J. S., & North, M. (1995). Effectiveness of computer-generated (virtual reality) graded exposure in the treatment of acrophobia. *American Journal of Psychiatry, 152*(4), 626.

Rubinstein, A., & Boothroyd, A. (1987). Effect of two approaches to auditory training on speech recognition by hearing-impaired adults. *Journal of speech and hearing research, 30*(2), 153.

Sabielny, M. (2006). Design of frequency-selective radomes using parallel Particle Swarm Optimisation. *Antennas and Propagation, 2006. EuCAP 2006. First European Conference on*, 1-6.

Satav, S. K., Satpathy, S., & Satao, K. (2011). A Comparative Study and Critical Analysis of Various Integrated Development Environments of C, C++, and Java Languages for Optimum Development.

Seol, E. (2003). Running C/C++ Program in parallel using MPI.

Songmuang, P., & Ueno, M. (2010). Bees Algorithm for Construction of Multiple Test Forms in e-Testing. *IEEE Transactions on Learning Technologies*, 209 - 221.

Spitzer, R. L., Gibbon, M. E., Skodol, A. E., & Williams, J. B. W. (1994). *DSM-IV casebook: A learning companion to the Diagnostic and Statistical Manual of Mental Disorders—4th ed.*: American Psychiatric Association.

Srinivasa Prasanna, G. N., & Musicus, B. R. (14, 14-18 Nov 1994). *Generalized multiprocessor scheduling for directed acyclic graphs.* Paper presented at the Supercomputing '94. Proceedings Supercomputing '94. Proceedings VO

Walczak, K., Chmielewski, J., Stawniak, M., & Strykowski, S. (2006). Extensible metadata framework for describing virtual reality and multimedia contents. *Database and Applications*.

Wang, L., Wang, X. P., & Wu, Q. D. (2002). Ant system algorithm based Rosenbrock function optimization in multi-dimension space. *Machine Learning and Cybernetics, 2002. Proceedings. 2002 International Conference on, 2*, 710-714 vol. 712.

Watson, G., Rasmussen, C., & Tibbitts, B. (2006). *Application development using eclipse and the parallel tools platform*.

Watson, G. R., Rasmussen, C. E., & Tibbitts, B. R. (2009). *An integrated approach to improving the parallel application development process*.

Witmer, B. G., & Singer, M. J. (1998). Measuring presence in virtual environments: A presence questionnaire. *Presence, 7*(3), 225-240.

Yang, X. S. (2005). Engineering optimizations via nature-inspired virtual bee algorithms. *Artificial Intelligence and Knowledge Engineering Applications: A Bioinspired Approach*, 317-323.

Zhu, Y., & Tang, X. (2010). *Overview of swarm intelligence.* Paper presented at the Computer Application and System Modeling (ICCASM), 2010 International Conference on.

Zhuge, H. (2008). The knowledge grid environment. *Intelligent Systems, IEEE, 23*(6), \63-71.

Zilles, C. B. (2002). *Master/slave speculative parallelization and approximate code.* UNIVERSITY OF WISCONSIN.