UNIVERSITI TEKNOLOGI MARA

LOW-LEVEL HYBRIDIZATION SCRIPTING LANGUAGE WITH DYNAMIC PARAMETERIZATION IN PSO-GA

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Thesis submitted in fulfillment
of the requirements for the degree of
Doctor of Philosophy

Faculty of Computer and Mathematical Sciences

July 2015

AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This topic has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic rules and regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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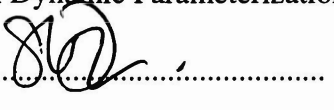
Signature of Student	:	
Date	:	July 2015

ABSTRACT

Surrounded by an assortment of intelligent, adaptive and efficient search entities, the Low-Level Hybridization(LLH) for Particle Swarm Optimization (PSO) and Genetic Algorithm (GA), are proven to be a comprehensive tool for solving different kinds of optimization problems due to their contradictive behaviour. In addition, the two algorithms have achieved a remarkable improvement from the adaptation of dynamic parameterization. However, in many cases, implementing the suitable hybrid algorithms for a given optimization problem is a considerably difficult, which in most cases, is time consuming. In addition, research has identified that the existing tools are not adequately designed to enable users to easily develop the LLH algorithms with the dynamic parameterization. In responding to this problem, this research investigates rapid mechanisms for the LLH design and development with easy, flexible and concise programming. The research has proposed new implementation frameworks and new scripting language with the dynamic parameterization. In addition, the research conducts a comprehensive evaluation for the scripting language that covers the easiness, conciseness and flexibility. Based on the implementation reviews from the existing LLHs that combine PSO with GA, the implementation frameworks with a sequential global (SG) scheme, are found to be widely used in practice. The scheme consists of three implementation frameworks: the SG with mutation (SGMutation), the SG with crossover (SGCrossover) and the SG with both crossover and mutation (SGCrossMutation). The scripting language is designed and developed based on the algorithm structure that is defined in the proposed implementation frameworks with the dynamic parameterization. Evaluations of four different sets of applications that used the proposed implementation frameworks with dynamic parameterization have indicated the effectiveness of each tested algorithm in comparison to the single PSO and constant parameterization. In the scripting language evaluation, nine LLHs and three single PSO algorithms have been successfully created using the scripting languages. The codes of the scripting language are shown to easily use, concisely describe the algorithm in a directly publishable form and flexible for new problem creations. This work is the first exposition of scripting language for the LLH of PSO-GA embedded with dynamic parameterization, which paves the way for further research possibilities in the future.

ACKNOWLEDGMENT

Alhamdulillah, praise be to Allah, the Most Gracious, the Most Merciful.

Many people have contributed their ideas, time, and energy to assist me in the pursuit of this research. A countless thanks to my main supervisor, Associate Professor Dr. Siti Zaleha Zainal Abidin and my co-supervisor, Dr Nasiroh Omar. To work with them has been a real pleasure to me, with heaps of fun and excitement. They have always been patient and encouraging in most of the times and difficulties. Thank you for the trust and understanding.

On a professional note, I must thank Professor John Grundy, Dean of Faculty of Information and Communication Technologies at Swinburne University of Technology, Hawthorn Campus, Victoria, Australia. I am grateful to be allowed for research attachment at the faculty from November 2012 to January 2013. I have been very privileged to collaborate with Dr Irene Moser and Dr James Montgomery. Also, a short discussion with Professor Tim Hendtlass and Dr Clinton Woodward on experimental issues and algorithm design has significantly improved my work.

Furthermore, I would like to express my sincere gratitude to Professor Min Chen from the University of Oxford's e-Research Centre for his insightful comments on my research framework and for many motivating discussions during his short visit to Universiti Teknologi MARA. Also, thank you very much to all JACIE teams of my faculty with the continuous support and ideas.

The financial support of this study was funded by the Kementerian Pendidikan Malaysia in together with Universiti Teknologi MARA. I thank you all the staff.

Last but not least, words cannot express how grateful I am to all friends and members of family, for all the prayers they have made for me. Also, my deepest appreciation goes to my husband who has been supporting and blessing me from the day of registering my study until the day of submitting the final manuscript. Not forgetting my active kids Syazana, Muhammad, Madihah, Adam and Anas (my PhD baby), thank you for all patience and sacrifices.

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND

One promising way to effectively solve optimization problem is by using meta-heuristics algorithms. In this research, the concern is to propose rapid mechanisms for the design and implementation of meta-heuristics hybridizations involving two well-known meta-heuristics namely Particle Swarm Optimization (PSO) (Kennedy and Eberhart, 1995; Clerc, 2006) and Genetic Algorithm (GA) (Holland, 1975; Affenzeller, Winkler, Wagner, and Beham, 2009). These two meta-heuristics have gained widespread appeal amongst researchers to solve optimization problems in a variety of application domains. The algorithms were developed based on nature analogy, but are different in several ways. The search element of PSO has been designed to mimic the social activities of animals such as birds flocking or fish schooling. On the other hand, GA has been designed to simulate the natural evolution of creatures such as genetic reproduction and mutation.

The main motivation of meta-heuristics hybridization is to alleviate the limitations of one algorithm with the strengths of others. PSO is known to be very efficient in providing results quickly, but in some cases, its ability to find optimal solutions, especially for real life problems, is still insufficient (Matthew and Terence, 2005; Gao and Xu, 2011). Most practical problems are multi-modal and due to its fast convergence to a single point, PSO tends to converge to a local optimum. Compared to PSO, GA is generally found to have better exploration properties (Wu and Law, 2011; Kaur, 2011). GA also has several operators that can control exploration and exploitation of the search projection namely: mutation, crossover and selection (Črepinšek, Liu, and Mernik, 2013). Mutation is generally thought to enable exploration, whereas both exploratory and exploitative aspects are ascribed to crossover.

An integration of strengths from PSO and GA can yield a new meta-heuristic with better efficiency than the single algorithm. In other words, GA operators help PSO to have a good balance between the exploitation and exploration search capability (Kaur, 2011; Alireza, 2011). Explorative aspects introduce diversity into the search direction such that vast areas of the search space can be covered, while exploitation provides the necessary search intensity to optimize the discovered solutions locally. Therefore, the results produced by the PSO hybrid have a tendency to be more accurate and faster than the single algorithm.