A HYBRID KIDNEY ALGORITHM STRATEGY FOR COMBINATORIAL INTERACTION TESTING PROBLEM

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DOCTOR OF PHILOSOPHY

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Thesis submitted in fulfilment of the requirements
for the award of the degree of
Doctor of Philosophy

Faculty of Computing

UNIVERSITI MALAYSIA PAHANG

FEBRUARY 2022

ACKNOWLEDGMENTS

Thanks to All Mighty Allah, , the Most Merciful Who always bestows upon me His endless blessings. The completion of this thesis is yet another very special blessing that All Mighty Allah bestowed on me.

I am very thankful to my supervisors, Associate Professor Dr. AbdulRahmand Ahmed AlSewari and Professor Dr. Kamal Zuhairi Zamli, for their trust, patience and professional supervision. Without a doubt, their flexible and results-oriented monitoring aided my independence and productivity as a researcher. Whenever I met them, I was constantly inspired and acquired new research methodologies. This work was only a dream without their novel style of supervision and dedication towards undertaking quality research. Thank you very much Professors! I feel myself extremely fortunate to have you as my supervisors. I will keep our friendship with you (Associate Professor Dr. AbdulRahmand Ahmed AlSewari) forever. I hope to meet again you and your family at our country after this civil war in safe and peace situation. You were truly big brother for me in this journey.

I am very grateful to my respectable parents for their kind prayers, selfless love and continuous support. I can't get my PhD without my father's unlimited support. I never have a hard time in my life because of my father’s lifelong hard work and my mother's prayers. Shekh Ali bin Mohammed, you are my real ideal. I am very thankful to my lovely wife for her unconditional support and company. I always feel blessed to have you in my life. Your presence and help made my Ph.D. journey very comfortable. Thank you very much. My special thanks go to my daughter, sons, brothers and sisters and big family in Yemen. I really love you all.

Many thanks to all of the members of staff in UMP for their kind support during my PhD study. Also, I extend my thanks to all my colleagues at UMP university for their continuous encouragement and support, as well as to all of my friends and colleagues from UMP and outside for their time, advice and moral support. In particular, Dr. Mohammed AbdulGader Al-Aidroos, Mr. Raid Gafer Baraja, Dr. Mohammed Abdullah AlSharafi, Dr. Fakhrud Din, Dr. Amar Kareem, Dr. Yazen Alsaraira, Dr. Hasneeza Lisa Zakaria and Dr. Abdullah

I would like to thank UMP for support my study by several funds: UMP (RDU190334): A Novel Hybrid Harmony Search Algorithm with Nomadic People Optimizer Algorithm for Global Optimization and Feature Selection, and (FRGS/1/2018/ICT05/UMP/02/1) (RDU190102): A Novel Hybrid Kidney-Inspired Algorithm for Global Optimization, Enhance Kidney Algorithm for IoT Combinatorial Testing Problem, and PGRS160396 Hybridize Jaya Algorithm for Harmony Search Algorithm's Parameters Selection, and DSS by IPS.

ABSTRAK

Pengujian Interaksi Kombinatorik (CIT) menjana sampel set kes ujian (Sut Ujian Akhir (FTS)) dan bukannya kesemua kemungkinan kes ujian. Penjanaan FTS dengan saiz optimum adalah masalah pengoptimuman komputasi dan juga masalah Polinomial Tidak Deterministik Keras (NP-hard). Kajian terbaharu telah mengimplementasi algoritma metaheuristik sebagai asas strategi CIT. Walaupun strategi hibrid CIT menjana saiz SUT yang kompetitif, tiada strategi tunggal yang berjaya mengatasi antara satu sama lain dengan jayanya pada keseluruhan kes. Tambahan pula, strategi hibrid memerlukan lebih masa larian daripada strategi algoritma asal. Algoritma Ginjal (KA) adalah satu algoritma metaheuristik terkini yang mempunyai kecekapan dan prestasi tinggi dalam menyelesaikan masalah pengoptimuman yang berbeza serta mengatasi kebanyakan algoritma metaheuristik sedia ada, Namun, KA mempunyai kelemahan dalam proses exploitasi dan explorasi dengan keperluan pengimbangan yang perlu dipertingkatkan. Kekurangan ini menyebabkan KA mudah terjerumus kepada optimum tempatan. Kajian in mencadangkan penghibridan KA tahap rendah dengan pengendali mutasi serta menambahbaik proses penyaringan KA untuk membentuk Algoritma Ginjal (HKA) yang baharu. HKA menangani kelemahan dalam KA dengan meningkatkan proses eksplorasi dan eksploitasi algoritma melalui hibridisasi dengan operator mutasi, dan menambahbaik proses pengimbangan dengan meningkatkan proses penyaringannya. HKA berjaya meningkatkan kecekapan dari segi penghasilan ukuran FTS yang optimum dan meningkatkan prestasi dari segi masa penjanaan. HKA telah diadaptasi dalam strategi CIT sebagai Strategi CIT berasaskan HKA (HKAS) untuk menghasilkan ukuran FTS yang paling optimum. Hasil HKAS menunjukkan bahawa HKAS dapat menghasilkan ukuran FTS optimum di lebih daripada 67% eksperimen penanda aras serta menyumbang sebanyak 34 ukuran FTS optimum baru. HKAS juga mempunyai kecekapan dan prestasi yang lebih baik daripada KAS. HKAS adalah strategi CIT berasaskan metaheuristik hibrid pertama yang menghasilkan ukuran FTS optimum dengan masa penjanaan yang lebih baik daripada strategi CIT berasaskan algoritma asal. Selain daripada menyokong ciri CIT yang berbeza: seragam / VS CIT, IOR CIT serta kekuatan interaksi hingga 6, kajian ini memperkenalkan juga satu lagi varian KA iaitu KA Penambahbaikan (IKA) dan KA Mutasi (MKA) serta tambahan strategi baru CIT yang berasaskan IKA (IKAS) dan MKA (MKAS).

ABSTRACT

Combinatorial Interaction Testing (CIT) generates a sampled test case set (Final Test Suite (FTS)) instead of all possible test cases. Generating the FTS with the optimum size is a computational optimization problem (COP) as well as a Non-deterministic Polynomial hard (NP-hard) problem. Recent studies have implemented hybrid metaheuristic algorithms as the basis for CIT strategy. However, the existing hybrid metaheuristic-based CIT strategies generate a competitive FTS size, there is no single CIT strategy can overcome others existing in all cases. In addition, the hybrid metaheuristic-based CIT strategies require more execution time than their own original algorithm-based strategies. Kidney Algorithm (KA) is a recent metaheuristic algorithm and has high efficiency and performance in solving different optimization problems against most of the state-of-the-art of metaheuristic algorithms. However, KA has limitations in the exploitation and exploration processes as well as the balancing control process is needed to be improved. These shortages cause KA to fail easily into the local optimum. This study proposes a low-level hybridization of KA with the mutation operator and improve the filtration process in KA to form a recently Hybrid Kidney Algorithm (HKA). HKA addresses the limitations in KA by improving the algorithm's exploration and exploitation processes by hybridizing KA with mutation operator, and improve the balancing control process by enhancing the filtration process in KA. HKA improves the efficiency in terms of generating an optimum FTS size and enhances the performance in terms of the execution time. HKA has been adopted into the CIT strategy as HKA based CIT Strategy (HKAS) to generate the most optimum FTS size. The results of HKAS shows that HKAS can generate the optimum FTS size in more than 67% of the benchmarking experiments as well as contributes by 34 new optimum size of FTS. HKAS also has better efficiency and performance than KAS. HKAS is the first hybrid metaheuristic-based CIT strategy that generates an optimum FTS size with less execution time than the original algorithm-based CIT strategy. Apart from supporting different CIT features: uniform/VS CIT, IOR CIT as well as the interaction strength up to 6, this study also introduces another recently variant of KA which are Improved KA (IKA) and Mutation KA (MKA) as well as new CIT strategies which are IKA-based (IKAS) and MKA-based (MKAS).

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