

GLOBAL OPTIMIZATION USING NONPARAMETRIC
FILLED FUNCTION METHOD

GOH KHANG WEN

MASTER OF SCIENCE
UNIVERSITI MALAYSIA TERENGGANU
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A special dedication to my beloved
parents and respected supervisor &

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Abstract of thesis presented to the Faculty of Graduate Studies
in fulfillment of the requirement for the Degree of Master of Science

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GOH KHANG WEN

Chairperson: Professor Ismail Bin Mohd, Ph.D.

Member: Yassin Bin Daud, Ph.D.

Faculty: Science and Technology

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Abstract: This research is on global optimization methods which have been developed in order to solve these non-convex problems. However, they often failed in locating the global optimum of non-convex optimization problems. Hence, the main purpose of this research is to improve the ability of the existing local optimization method in solving unconstrained global optimization global optimization problems.

Several modifications and new methods developed have been done throughout this study. In the local optimization phase, we have introduced an algorithm designed to overcome the problem of the steepest descent method. A comparison with several well-known step size selection procedures have been done in this study. The surprising numerical results have shown that our

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Chairperson: Professor Ismail Bin Mohd, Ph.D.

Member : Yosza bin Dasril, Ph.D.

Faculty : Science and Technology

Mathematicians believe some of the daily problem that we faced can be modeled into mathematical model. There are several unconstrained optimization methods which have been developed in order to solve those mathematical models. However, they often failed in locating the global solution of non-convex optimization problems. Hence, the main purpose of this research is to improve the ability of the existing local deterministic method in solving unconstrained general deterministic global optimization problems.

Several modifications and new methods developed have been done throughout this study. In the local optimization phase, we have proposed an alternative step size selection procedure for the steepest descent method. A comparison with several well-known step size selection procedures have been done in this study, the surprising numerical results have shown that our

alternative method are more effective in solving non-convex optimization problems compared to others. However, in order to maintain the global convergence of the modified steepest descent method, we have fixed a suitable range for step size selection. The numerical results have reflected the success of the modification in maintaining the global convergence ability of the modified steepest descent method in solving non-convex optimization problems.

Furthermore, in the global optimization phase, we have introduced a new method which combines the steepest descent method and the Newton's method in solving general global optimization problems. In addition, we have proposed a new version of filled function which does not required any parameter to be selected as needed in previous classical filled functions. More over, by joining the modified steepest descent method and the non-parameter filled function, we have successfully solving general several single variable multi-modal global optimization problems.

Beside that, we discovered that the original algorithm of filled function may not work effectively, since several region of the domain have been examined more than once. A modification has been done to the original algorithm, the numerical results have showed the modified algorithm has performed better and works more effectively while the whole region only been examined once.

Abstrak tesis yang dikemukakan kepada Senat Universiti Malaysia Terengganu sebagai memenuhi keperluan untuk Ijazah Sarjana Sains

**PENGOPTIMUMAN SEJAGAT MENGGUNAKAN KAEDAH FUNGSI
PENGISIAN TANPA PARAMETER**

GOH KHANG WEN

Pengerusi : Profesor Dr. Ismail Bin Mohd, Ph.D.

Ahli : Yosza Bin Dasril, Ph.D.

Fakulti : Sains dan Teknologi

Ahli matematik yakin bahawa sesetengah masalah yang muncul dalam pelbagai perusahaan manusia, dapat diungkapkan ke dalam bentuk model matematik. Terdapat pelbagai kaedah pengoptimuman tak berkekangan telah diperkenalkan untuk mencari penyelesaian yang optimum bagi model-model matematik tersebut. Akan tetapi, kaedah-kaedah tersebut sering gagal untuk memperoleh penyelesaian optimum sejagat bagi masalah-masalah pengoptimuman tak cembung. Dengan itu, tujuan utama kajian ini adalah untuk mengubahbaikkkan kaedah-kaedah tersebut atau memperkenalkan kaedah baru supaya dapat menyelesaikan masalah pengoptimuman tentu sejagat tak berkekangan umum.

Dalam kajian ini, kami telah melakukan pelbagai pengubahbaikkkan dan pembangunan kaedah baru dalam usaha menyelesaikan masalah pengoptimuman sejagat tak berkekangan umum. Dalam fasa

pengoptimuman setempat, kami telah mencadangkan satu prosedur carian garis tepat yang baru dalam menentukan ukuran langkah bagi kaedah penurunan tercuram. Di samping itu, satu perbandingan telah dilakukan atas prosedur baru yang dicadangkan tersebut dengan beberapa prosedur carian ukuran langkah lain yang terkenal. Keputusan berangka perbandingan tersebut telah menunjukkan satu kejutan bahawa prosedur yang telah kami cadangkan lebih berkesan dalam membantu kaedah penurunan tercuram untuk menentukan penyelesaian setempat bagi masalah-masalah pengoptimuman tak cembung. Selanjutnya, demi mengekalkan ciri-ciri penumpuan sejagat yang dimiliki oleh kaedah penurunan tercuram, dalam menyelesaikan masalah-masalah tak cembung, kami telah menetapkan satu julat untuk pemilihan ukuran langkah bagi kaedah penurunan tercuram.

Manakala dalam fasa pengoptimuman sejagat pula, kami telah memperkenalkan satu kaedah baru yang menggabungkan kaedah penurunan tercuram dan kaedah Newton untuk menyelesaikan masalah pengoptimuman sejagat umum. Selain itu, dalam fasa yang sama kami telah memperkenalkan satu versi baru fungsi pengisian yang tak berparameter. Dengan menggabungkan kaedah penurunan tercuram yang telah diperubahbaikkan dalam fasa pengoptimuman setempat bersama dengan fungsi pengisian tak berparameter, kami telah berjaya menyelesaikan masalah pengoptimuman sejagat berpembolehubah tunggal umum. Akan tetapi, kami mendapati bahawa dengan menggunakan algoritma yang dicadangkan oleh penyelidik-penyelidik yang lain, kaedah gabungan tersebut telah dilaksanakan dengan tidak cukup berkesan. Terdapat beberapa rantau tersaur telah dipantau dan diteliti lebih dari sekali. Dengan itu, kami telah

membuat pengubahsuaian algoritma tersebut sehingga kami dapat memperkenalkan satu kaedah yang bernama Longsor demi Longsor yang hanya memantau dan meneliti rantau tersaur bagi domain kajian masalah pengoptimuman sejagat berpembolehubah tunggal umum tersebut hanya sekali dalam keseluruhan pencarian penyelesaian optimum sejagat.

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