

UNIVERSITI TEKNOLOGI MARA

TECHNICAL REPORT

**COMPARATIVE ANALYSIS OF LINE SEARCH METHODS IN THE
STEEPEST DESCENT ALGORITHM FOR UNCONSTRAINED
OPTIMIZATION PROBLEMS**

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Report submitted in partial fulfillment of the requirement

for the degree of

Bachelor of Science (Hons.) Management Mathematics

College of Computing, Informatics and Mathematics

JANUARY 2024

ACKNOWLEDGEMENTS

IN THE NAME OF ALLAH, THE MOST GRACIOUS AND THE MOST MERCIFUL

First and foremost, we express our profound gratitude to Allah S.W.T. for granting us the strength to complete this project successfully. We would like to convey our heartfelt gratitude to Dr. Siti Farhana Binti Husin for her tremendous support, supervision and invaluable assistance. Her guidance played a pivotal role in steering us towards the successful completion of our project. We extend our heartfelt thanks to all team members for their tireless dedication, teamwork and unwavering support throughout the project. Each member's hard work and support played a crucial role in making this project a success. Special acknowledgment should be attributed to our highly esteemed lecturers, Dr. Nurul Liyana Binti Aziz and Dr. Noorehan Binti Awang, for their invaluable guidance and insightful feedback throughout the project. Their expertise knowledge and experience played a significant role in impacting and shaping the course of our endeavor, thereby contributing to the overarching distinction of our undertaking. To our families and friends, we convey our deepest thanks for unwavering support, patience and encouragement throughout this challenging journey. In closing, we extend our gratitude to any individuals, organizations or entities who directly or indirectly contributed to success of our project.

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ABSTRACT

The Steepest Descent (SD) method, also known as gradient descent, remains a widely utilized optimization technique across various domains. Over time, it has undergone notable refinements compared to its earlier versions. These advancements have addressed several limitations and enhanced its overall effectiveness. Unfortunately, the classical SD method faces challenges especially in handling large-scale unconstrained problems. To address this, we propose a comparative analysis of different line search methods within the SD framework, aimed at enhancing its performance in such settings. This study focuses on "Comparative Analysis of Line Search Methods in SD Algorithm for Unconstrained Optimization Problems". The current SD method tends to progress slowly and shows a zigzag pattern towards solutions because it struggles with functions that have sharp curves or tight valley, often requiring many steps to reach the optimal point. Additionally, it takes small steps in some areas and large steps in others, making it less efficient. Particularly noteworthy is its diminished performance when applied to large-scale problems. The study's trajectory takes a subtle turn as it proposes a modified methodology that includes a detailed comparison investigation of several line search strategies inside the SD algorithm. The study focuses on line search algorithms such as the golden section search, quadratic interpolation, and the Armijo rule, among others—the study aims to decipher their individual and collective efficacy in optimizing unconstrained problems. The investigation, conducted through comprehensive numerical experiments and implementation in MATLAB as our analysis tool, the study aims to not only clarify the subtleties of performance for each line search method but also to assist practitioners and researchers in choosing the best modified SD method of the optimization problem at hand. In summary, this study transcends the scope of mere modification to delve into a thorough comparative analysis, providing insights into the complicated interaction of line search techniques inside the SD algorithm for unconstrained optimization problems. The result from this study is choosing FMRI algorithm using exact line search to get faster convergence rate which means that the algorithm achieves a high level of accuracy in fewer iterations compared to using other algorithms and inexact line search.