

UNIVERSITI TEKNOLOGI MARA

**NUMERICAL METHODS OF
HYBRID ROOT FINDING IN
SOLVING NON-LINEAR EQUATION**

ANIS NURNAFISAH BINTI AZMI

BSc

July 2025

ABSTRACT

This study analyses and compares the performance of traditional, modified and hybrid root-finding methods in solving non-linear equations. The traditional root-finding methods involve Bisection method, False Position method and Secant method, while the modified root-finding method involve Trisection method, Modified False Position method and Modified Secant method. In addition, hybrid root-finding methods which are Hybrid Bisection–False Position, Trisection–False Position, Bisection–Modified False Position, Trisection–Modified False Position and Secant–False Position are implemented to assess whether combining methods improves accuracy, reliability and efficiency. A set of combination of non-linear functions which involve various complexity forms are used to evaluate each method. Each method is tested using the same stopping criteria based on accuracy TOL 10^{-6} , CPU time and number of iterations. Numerical results show that hybrid and modified methods often outperform their traditional counterparts in terms of speed and robustness. This research provides valuable insights into the effectiveness of combining numerical techniques to enhance root-finding performance for non-linear problems.

ACKNOWLEDGEMENT

In the name of Allah, the Most Merciful and Compassionate, all praise is due to Him for granting me the strength, patience and perseverance to complete this Final Year Project (FYP)

I would like to express my sincere gratitude to my supervisor Dr. Nurul Ainina Binti Redwan for her invaluable guidance, encouragement and constructive feedback throughout the research and writing process. Her support has been instrumental in helping me stay focused and motivated. My heartfelt thanks also go to the lecturers and academic staff of the faculty for the knowledge skills imparted during my studies.

I am deeply grateful to my beloved parents and family for their constant prayers, understanding and unwavering support. Their belief in me has been the foundation of my academic journey. Special appreciation goes to my friends and course mates who shared this journey with me for their moral support, insightful discussion and cooperation throughout this project.

Finally, I thank all individuals who contributed directly or indirectly to the successful completion of this research. May Allah bless all of you.

TABLE OF CONTENTS

	Page
ABSTRACT	iv
ACKNOWLEDGEMENT	v
TABLE OF CONTENTS	vi
LIST OF TABLES	viii
LIST OF FIGURES	x
LIST OF ALGORITHMS	xi
CHAPTER 1 INTRODUCTION	12
1.1 Introduction	12
1.2 Research Background	12
1.3 Problem Statement	13
1.4 Research Objectives	14
1.5 Significance of Research	14
1.6 Research Scope	15
1.7 Definition of Terms and Concepts	16
CHAPTER 2 LITERATURE REVIEW	17
2.1 Introduction	17
2.2 Traditional Root Finding Methods	17
2.3 Modified Root Finding Methods	20
2.4 Hybrid Root Finding Methods	22
2.5 Stopping Criterion	23
CHAPTER 3 RESEARCH METHODOLOGY	24
3.1 Introduction	24
3.2 Mathematical Formulation	24
3.2.1 Non-Linear Equation	24
3.2.2 Traditional Root Finding Methods	25
3.2.3 Modified Root Finding Methods	28

3.2.4	Hybrid Root Finding Methods	31
3.3	Research Step	38
CHAPTER 4 IMPLEMENTATION		41
4.1	Introduction	41
4.2	Sample of Functions	41
4.3	Solving Non-Linear Equations	42
4.3.1	Exact Solution	42
4.3.2	Numerical Solution	49
4.4	Error Calculation	75
4.5	Performance Profile	76
CHAPTER 5 RESULT AND DISCUSSION		78
5.1	Introduction	78
5.2	Numerical Analysis Based on Each Categories	78
5.2.1	Results Based on CPU Time	78
5.2.2	Results Based on Number of Iteration	82
5.2.3	Relative Error and Accuracy Results at TOL 10^{-6}	87
CHAPTER 6 CONCLUSION AND RECOMMENDATION		93
6.1	Introduction	93
6.2	Conclusion	93
6.3	Recommendation	93
REFERENCES		95
APPENDICES		97