UNIVERSITI TEKNOLOGI MARA

COMPARATIVE STUDY OF NEWTON'S, MURAKAMI I, MURAKAMI II AND NEWTON-STEFFENSEN METHOD TO SOLVE NONLINEAR EQUATIONS

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ABSTRACT

In numerical analysis and computational engineering, solving nonlinear equations remains a fundamental challenge. Reliable root-finding techniques essential as these equations frequently arise in complex real-world modelling. By comparing four iterative algorithms, this project evaluates the trade-offs between speed, computational complexity, and stability to of the standard Newton's method, the composite third-order Newton-Steffensen method and fourth-order Murakami I and II methods studied. Using ten different nonlinear equations consist of polynomial, trigonometric, exponential, and logarithmic functions, performance of these four methods were assessed. Maple 2016 software was used for implementation and execution of all methods. The stopping criterion for all calculations were set to 10^{-10} and 10^{-15}. To evaluate both convergence speed and overall robustness of these methods, each algorithm were tested with two distinct initial approximations. This research aims to determine whether the Murakami's methods or the Newton-Steffensen method with higher-order of convergence more efficient and robust compared to standard Newton's method with order of convergence of two (2), based on the number of iterations and CPU time. From the result of this study, the best method based on both criteria mentioned is Newton's method as it solves the most nonlinear equations in the study, followed by Murakami I method then Murakami II method, while Newton-Steffensen method solve the least number of nonlinear equations due to the undefined result for majority of time. This research shows that faster convergence is not an assurance for a method to become the most efficient method. Newton's simpler implementation, requiring only one function and one derivative evaluation per iteration is the reason of its efficiency.