

# **A robust algorithm for solving nonlinear system of equations using trust-region and line-search techniques**

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## **ABSTRACT**

Newton's method is an attractive method for solving nonlinear system of equations because of its fast convergence property. However, Newton's method may fail if the Jacobian matrices are singular. Newton's method with trust-region can be used to avoid such problem. In this work, a new trust-region technique for Newton's method was formulated to solve the nonlinear system of equations. The search direction in this method is computed by a sequence of factorisations of the Jacobian matrix with modified structure using a Lagrange multiplier associated with trust-region constraint such that the final modified Jacobian turns out to be well-conditioned (regularised). An optimal Lagrange multiplier was deduced using the same idea of unconstrained optimisation to satisfy the trust-region constraint. Furthermore, Armijo line-search technique is integrated with the method in order to improve the step length. Numerical tests were conducted to investigate the performance of Newton's method integrated with trust-region and line-search techniques.

**KEYWORDS:** unconstrained optimisation; trust-region method; Armijo line search; nonlinear system of equations.

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