Ezquerro, J. A.; Gutiérrez, J. M.; Hernández, M. A.

The authors consider a family of third-order iterative methods for computing solutions of the univariate nonlinear equation \( f(x) = 0 \). One such method is that of Chebyshev

\[
t_{n+1} = G_0(t_n) = t_n - \frac{f(t_n)}{f'(t_n)} \left( 1 + \frac{1}{2} \frac{f(t_n)f''(t_n)}{[f'(t_n)]^2} \right),
\]

and convex acceleration of Newton’s method \( t_{n+1} = G_1(t_n) \) another. A homotopy between \( G_0 \) and \( G_1 \) is defined and leads to a family of iterations which is a convex combination of \( G_0 \) and \( G_1 \), with parameter \( \alpha \), for which convergence analysis is provided. Then it is shown that a method from this family, with suitable values of \( \alpha \), can always be applied to solve \( f(x) = 0 \). Some numerical examples and practical remarks complete the paper.

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MSC:
65H05 Numerical computation of solutions to single equations
65H20 Global methods, including homotopy approaches to the numerical solution of nonlinear equations

Keywords:
Chebyshev method; third-order iterative methods; nonlinear equation; Newton’s method; homotopy; numerical examples

Full Text: DOI

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