



Numerical Methods for Roots of Polynomials - Part II: Chapter 11. Jenkins–Traub, Minimization, and Bairstow Methods (Studies in Computational Mathematics)

By J.M. McNamee, V.Y. Pan



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**Numerical Methods for Roots of Polynomials - Part II: Chapter 11.
Jenkins–Traub, Minimization, and Bairstow Methods (Studies in
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First we consider the Jenkins–Traub 3-stage algorithm. In stage 1 we define $p_1(z)$ in the second stage the factor is replaced by $p_2(z)$ for fixed m , and in the third stage by $p_3(z)$ where m is re-computed at each iteration. Then a root z_1 is found. A slightly different algorithm is given for real polynomials. Another class of methods uses minimization, i.e. we try to find θ such that $|p(e^{i\theta})|$ is a minimum, where $p(z)$ is the polynomial. At this minimum we must have $\operatorname{Im} p(e^{i\theta}) = 0$, i.e. $p(e^{i\theta})$ is real. Several authors search along the coordinate axes or at various angles with them, while others move along the negative gradient, which is probably more efficient. Some use a hybrid of Newton and minimization. Finally we come to Lin and Bairstow's methods, which divide the polynomial by a quadratic and iteratively reduce the remainder to 0. This enables us to find pairs of complex roots using only real arithmetic.



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First we consider the Jenkins–Traub 3-stage algorithm. In stage 1 we define $p_1(z)$. In the second stage the factor is replaced by $p_2(z)$ for fixed α , and in the third stage by $p_3(z)$ where α is re-computed at each iteration. Then a root α is found. A slightly different algorithm is given for real polynomials. Another class of methods uses minimization, i.e. we try to find α such that $|p(\alpha)|$ is a minimum, where $p(z)$ is the polynomial. At this minimum we must have $p'(\alpha) = 0$, i.e. α is a root of $p'(z)$. Several authors search along the coordinate axes or at various angles with them, while others move along the negative gradient, which is probably more efficient. Some use a hybrid of Newton and minimization. Finally we come to Lin and Bairstow's methods, which divide the polynomial by a quadratic and iteratively reduce the remainder to 0. This enables us to find pairs of complex roots using only real arithmetic.

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