Polynomial having large coefficients 1

`large1.1.n`

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Ring: $\mathbb{C}[x], \mathbb{R}[x]$
Equations:

$ax^n + 10^{300}x^{14} + x^5 + 1, \quad n > 14, \ |a| \leq 1 \ \ (n = 20, a = 1, i)$

Polynomial supplied by D. A. Bini (oct. 1996).

1 Characteristics

- The polynomial has a coefficient with modulus close to the largest number representable as double in the IEEE standard. Overflow conditions/failure are likely for programs that do not use extended arithmetic.
- For $n = 20$ the polynomial has some root with very large modulus and some roots with very small modulus.

2 Problem

Newton-isolate all the roots.

2.1 Solution

Algorithm based on simultaneous iterations (Aberth's method) with cluster analysis (see [?]).

Program in Fortran 90 based on the multiprecision package MPFUN, by D. Bailey.

Machine used: IBM Risc 6000.

Time for Newton-isolating all the roots: for $n = 20$, $a = 1$: 0.1 seconds; for $n = 200$, $a = 10^{-300}$: 0.8 seconds; for $n = 500$, $a = 10^{-300}$: 3.8 seconds;

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References

[1] D. Bini. Numerical computation of polynomial zeros by means of aberth's method. *Numerical Algorithms*, 1997. (to appear).

[2] D. Bini and B. Mourrain. Polynomials test suite. 1996.