Reasons for stability in the construction of derivative-free multistep iterative methods

Alicia Cordero[1], B. Neta[2], and Juan Ramon Torregrosa[1]

[1]Universitat Politecnica de Valencia
[2]Naval Postgraduate School

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Abstract

In this paper, a deep dynamical analysis is made using tools from multidimensional real discrete dynamics of some derivative-free iterative methods with memory. They all have good qualitative properties, but one of them (due to Traub) shows the same behavior as Newton's method on quadratic polynomials. Then, the same techniques are employed to analyze the performance of several multipoint schemes with memory, whose first step is Traub's method, but their construction was made using different procedures. Therefore, their stability is analyzed, showing which is the best in terms of the wideness of basins of convergence or the existence of free critical points that would yield convergence towards different elements from the desired zeros of the nonlinear function. Therefore, the best stability properties are linked with the best estimations made in the iterative expressions rather than their simplicity. These results have been checked with a numerical and graphical comparison with many other known methods with and without memory, with different orders of convergence, with excellent performance.

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