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COMPARISON OF SAFEGUARDED SOLUTION ALGORITHMS

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Safeguarding is used to guarantee some aspects of numerical analysis algorithms. Safeguarding has been used to guarantee sufficient decrease linear searches in nonlinear optimization algorithms. This paper uses safeguarding to guarantee bounds on the solution of nonlinear equations for each iteration. The algorithm is safeguarded if given an interval containing a solution to the equation, the algorithm always generates successively smaller intervals that contain solutions. Bisection is the obvious safeguarded solution algorithm.

The nonlinear solution algorithms that were modified to include safeguarding were Secant, Newton's and Muller's. Bisection was used as baseline for comparisons. In case the algorithm extrapolates outside the guaranteed solution interval, the algorithm uses bisection of the bounding values as a safeguarding technique. The bounding values are updated in every iteration and include the two nearest bounding values to the solution.

The function, the two bracketing values of the solution, and the relative error are the standard inputs to these programs for each test.

The performance of each algorithm is measured according to the number of function evaluations required, the total number of iterations performed, and the number of times the safeguarding was used. The derivative in Newton's methods was counted as a single separate function count. Preliminary indications show that Muller's method has an overall better performance than the other three methods. Each method was best for some particular functions and starting values. More experiments are being conducted with additional functions and will be reported on at the conference with the expectation that the preliminary results will be confirmed.