A Global Optimization Algorithm for INTLAB

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This talk considers an algorithm for the bound constrained global optimization problem implemented in Matlab. It is based on the methods investigated in the past ([1] and [4]), which were first developed from the global optimization algorithm of the Numerical Toolbox [3]. The algorithm uses interval arithmetic operations and automatic differentiation offered by the INTLAB [5] package. INTLAB is a Matlab toolbox supporting real and complex interval scalars, vectors and matrices. It is designed to be fast, and every computation is rigourously verified to be correct.

Interval analysis is a powerful tool which allows to implement branch-and-bound algorithms able to solve global optimization problems. Our algorithm is also based on this technique using the most common accelerating devices: the cutoff test, the concavity test, the monotonicity test, and the interval Newton step. Beyond natural interval extension (based on naive interval arithmetic), a simple centered form inclusion function is also applied. Once the inclusion of the gradient is available, the intersection of these inclusion functions proved to be a good quality estimation of the range of the objective function. We use also multisection and advanced subdivision direction selection.

We have completed a numerical test, and compared the efficiency and the results of the INTLAB implementation to that of a C-XSC procedure. For the comparison we used the standard global optimization problems. The main indicators were the number of function, gradient and Hessian evaluations, the number of iterations, and the memory complexity.

Summarizing our numerical results, we can state the new implementation is as efficient as the old one, with the exception of the CPU time. The CPU time needed is as a rule by at least two order of magnitude higher for the INTLAB version (as it can be anticipated regarding the interpreter nature of Matlab). In spite of the lower speed, the new method is easy to use, and suitable for finding verified solutions of bound constrained global optimization problems.

References

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