Region of Attraction for any Dimensional Case

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Introduction

The concept of regions of attraction around the minimum point approached for obtaining the set of global minimum points of a real continuous function defined on a compact set D of R^n have been published since 1970. Several authors have shown the use of clustering procedure means; the stochastic approach to locate such region of attraction. Under the study, we would like to show how interval analysis could be used to locate the region of attraction confidently. It can be seen that the region of attraction approach is not only practicable on functions of two variables but could be extended on functions of three or more variables.

Materials and Methods

In this study, symmetric operator test has been used, which employed the interval analysis, to locate the region of attraction that has been reported in one of our published paper listed at the end of this report. The stochastic approach to be used is contained in the following algorithm: Choose the real numbers N and α. Let S is a set containing the local minimizers found so far and T is a set containing sample points from which the local search procedure have produced a local minimizer x that was already known. Initially, both S and T are empty.

Step 1: Draw N point and add them to the sample. **Step 2**: Construct the transformed sample as mentioned in this Section. **Step 3**: Apply a clustering procedure to the transformed sample beginning with the elements of S and followed by the elements of T. If all points of the transformed sample can be clustered then compute the smallest local minimum value and stop. **Step 4**: Let $x^{(1)}$ be the point with the lowest function value and apply the local search procedure to $x^{(1)}$ for finding the local minimum x. If $x \notin S$, add x to S and apply the next local search procedure to it else add $x^{(1)}$ to T and apply the next local search procedure to it. Repeat Step 4 until all points have been clustered. If a new point has been added to S, go to Step 1.

Results and Discussion

If $\underline{H}(\underline{x}) = \emptyset$ or if $\underline{S}'(\underline{x}) = \emptyset$, there is no zero of f' in $\underline{x}$, so $\underline{x}$ may be deleted from $\underline{x}^{(0)}$. If $\underline{S}(\underline{x}) \subset \underline{x}$ and $w(\underline{S}(\underline{x})) < w(\underline{H}'(\underline{x}))$, then x is replaced with $\underline{S}(\underline{x})$. Furthermore, $\underline{S}(\underline{x})$ and so $\underline{S}'(\underline{x})$ contains the unique zero x^* of f in $\underline{x}$. Also, the sequence $\{\underline{x}^{(k)}\}$ generated by Newton-iteration-like method, with $x^{(0)} = m(\underline{S}'(\underline{x}))$ remains in $\underline{S}'(\underline{x})$ and converges to x^*. If $\underline{S}(\underline{x}) \subseteq \underline{x}$ but $w(\underline{S}(\underline{x})) = w(\underline{H}'(\underline{x}))$, then $\underline{x}$ is replaced with $\underline{S}'(\underline{x})$ because every zero of f in $\underline{x}$ lies in $\underline{S}'(\underline{x})$ and there is at least one zero of f in $\underline{x}$. If $\underline{S}(\underline{x}) \neq \emptyset$, then $\underline{x}$ is replaced with $\underline{S}'(\underline{x})$ because if $x^* \in \underline{x}$ and $f(x^*) = 0$, then $x^* \in \underline{S}'(\underline{x})$.

Conclusions

- The statistical technique based on clustering procedure to perform the region of attraction of a local minimizer is an attractive method for global optimisation problems. Based on the experience on the method which used interval arithmetic, if in any local search procedure, the method which used interval arithmetic is applied for obtaining the region of attraction, then we believe the resulting method more attractive and will produce better result. Clearly, if there exists the minimizer of the function be considered in this paper, then our method never fail in locating the region of attraction and at the same time the difficulties highlighted in other methods can be handled.

Benefits from the study

Benefits from the study indicated that both labour costs and time consumption can be reduced.

The method can provide a satisfactory starting region of attraction to solve the global optimization problem via statistical approach.

Literature cited in the text

None.

Project Publications in Refereed Journals

Ismail, M. 2000. Identification of Region Attraction for Global Optimization Problem Using Interval Symmetric Operator, Applied Mathematics and Computation. 110: 121 - 131.

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Graduate Research

None.

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