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Efficient Unconstrained Optimization Multistart Solvers Using a Self-Clustering Technique

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Abstract

One of the commonly occurring drawbacks in multistart solvers in unconstrained optimization problems is their inability to determine the quality and the quantity of local minima regions of attraction. Thus, when a sample of random points is generated it is not feasible the correspondence of each point to a single region of attraction, and consequently to a single local minimum. This results into a repeated application of a local search method on all sample points, finding, in general, multiple times the same local minima.

In this work, motivated mostly on the above mentioned weakness of multistart algorithms and having in mind the local minimum definition, a new technique is proposed to correspond each sample point to a single candidate region of attraction. Specifically, each point of the sample is moved towards the best nearest neighbor point, which has the best functional value in this neighborhood. Through this process the sample points are concentrated around these best points, creating clusters that constitute candidate region of attractions. Then, it is assumed that each point inside a candidate region of attraction will drive a multistart algorithm to the same local minimum. For this reason, a new set of points is created. The new set will contain the best points inside each candidate region of attraction, namely the center of each self-clustered area, and these points will feed the multistart algorithm.

It is noted that the number of created clusters depends on the sample size and the overall morphology of the objective function, that is the actual number of local minima. Furthermore, the proposed technique is a first-order process, that is, only functional values are necessary to determine the clusters and their corresponding centers.

Finally, the proposed technique is utilized in a classic multistart solver, using a local search algorithm, and is tested on a set of well-known, one-dimensional test function. The results of these experiments show that in most cases the proposed technique makes the classic multistart algorithm efficient in finding uniquely many local minima. In addition, the experimental results showed that in most of the cases the global minimum is also found and as the grid size grows up, the number of clusters tends rapidly to the total number of local and global minima of the objective function.

Key words: multistart algorithm, unconstrained optimization, self-clustered technique.