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Global Optimization Heuristic Based on Novel Heuristics, Low-Discrepancy Sequences and Genetic Algorithms

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Abstract

In this paper a new heuristic hybrid technique for bound-constrained global optimization is proposed. We developed iterative algorithm called $GLP_\tau S$ that uses genetic algorithms, LP_τ low-discrepancy sequences of points and heuristic rules to find regions of attraction when searching a global minimum of an objective function. Subsequently Nelder-Mead Simplex local search technique is used to refine the solution. The combination of the three techniques (Genetic algorithms, $LP_\tau O$ Low-discrepancy search and Simplex search) provides a powerful hybrid heuristic optimization method which is tested on a number of benchmark multimodal functions with 10 to 150 dimensions, and the method properties - applicability, convergence, consistency and stability are discussed in detail.

Key Words: Global optimization, Genetic algorithms, Heuristics, Low-discrepancy sequences, Hybrid methods.

1. Introduction

Multidimensional global optimization is a field with applications in many areas of science, engineering, economics and others where mathematical modelling is used. In general, the goal is to find a global optimum of an objective function defined in a given search space. The vast majority of available deterministic methods, however, consider only local optimization and if the objective function is multimodal, highly non-linear, with steep and flat regions and irregularities, this could be a very challenging task (Horst and Tuy, 1996; Fletcher, 2001). Also, for such complex problems, there are no mathematical conditions that can guarantee a certain point to be a global optimum, unlike a local optimum, for which gradient information (*Jacobian* and *Hessian*) can provide sufficient conditions.

The unconstrained (besides the bound constraints) global optimisation (GO) problem is defined as to find a point $P^* \in \Pi$ from a nonempty, compact feasible interval domain $\Pi \subset \mathbf{R}^n$ that minimizes an objective function F, i.e.:

$$F^* = F(P^*) \leq F(P), \ \ \forall P \in \Pi, \tag{1}$$

where $F : \mathbf{R}^n \rightarrow \mathbf{R}$ is a continuous, real valued objective function.

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