Chapter 18

Hookes–Jeeves–Based Variant of Memetic Algorithm

Dipti Singh
Gautam Buddha University, India

Kusum Deep
Indian Institute of Technology, Roorkee, India

ABSTRACT

Due to their wide applicability and easy implementation, Genetic algorithms (GAs) are preferred to solve many optimization problems over other techniques. When a local search (LS) has been included in Genetic algorithms, it is known as Memetic algorithms. In this chapter, a new variant of single-meme Memetic Algorithm is proposed to improve the efficiency of GA. Though GAs are efficient at finding the global optimum solution of nonlinear optimization problems but usually converge slow and sometimes arrive at premature convergence. On the other hand, LS algorithms are fast but are poor global searchers. To exploit the good qualities of both techniques, they are combined in a way that maximum benefits of both the approaches are reaped. It lets the population of individuals evolve using GA and then applies LS to get the optimal solution. To validate our claims, it is tested on five benchmark problems of dimension 10, 30 and 50 and a comparison between GA and MA has been made.

INTRODUCTION

Optimization is an art of selecting the best alternative amongst a given set of options. The process of finding the largest or the smallest possible value, which a given function can attain in its domain of definition, is known as optimization. The function to be optimized could be linear, non–linear, fractional or geometric. Sometimes even the explicit mathematical formulation of the function may not be available. Often the function has to be optimized in a prescribed domain which is specified by a number of constraints in the form of equalities or inequalities. The process of optimization addresses the problem of determining those values of the independent variables which do not violate the constraints and at the same time give an optimal value of the function being optimized. Thus, the mathematical techniques for finding the optimal value (the greatest possible value or the least possible value) of a function are

DOI: 10.4018/978-1-5225-0788-8.ch018

called ‘Optimization Techniques’. The solution of various real life problems cannot be possible without robust optimization techniques and these robust techniques are designed from the mathematical theory of optimization. Several books based on mathematical concepts of optimization are available in literature. For example: (Bector et al, 2005), (Joshi and Moudgalya, 2004) etc.

Optimization problems arise in various fields of science, engineering and industry like electrical engineering, mechanical engineering, computer science, economics, manufacturing system, physical sciences etc. In view of their practical utility there is a need to develop efficient and robust computational algorithms, which can numerically solve problems in different fields irrespective of their size.

A non-linear optimization problem may have one or more local optimal solution, whereas every local optimal solution of a linear programming problem is also its global optimal solution. The problem of determining global optimal solution of a non-linear problem is even more difficult as compared to determining one of its local optimal solutions. It is not possible to find the point of global minima (or maxima) without searching in the neighborhood of every feasible point. As a consequence no computational algorithm can guarantee to locate the global solution in a finite number of steps. Thus a soft computing techniques based on random search method have been developed for solving realistic global optimization problems. Among these algorithms Genetic Algorithms, Particle Swarm optimization, Ant Colony optimization and Differential Evolution are most popular. Some of the common features of these algorithms are: working with the population of solutions, use of probabilistic transition rules, inspired by the natural phenomenon etc. Based on the working principles of these algorithms, they are also known as population based techniques, random search techniques, probabilistic techniques, Soft computing techniques etc. In this chapter we are focusing to improve the efficiency of GA by the process of hybridization. Working on population of solutions, GAs are capable of exploring the promising regions in the search space by searching in parallel at multiple locations rather than at just one location. Though GAs are very efficient at finding the global optimal solution of nonlinear optimization problems, they take relatively longer time to converge to a global optimum and sometimes end up in premature convergence. To avoid this, some information has to be provided to the search domain. This is done by incorporating the local search method in it. Such hybridized algorithms are known as Memetic Algorithms (MAs) or hybridized GAs. In this chapter, an attempt has been made to improve the efficiency of GA by hybridizing it with a local search method. This approach is based on the fact that GA converges very fast when the search domain is large, so at that time there is no need to apply local search but when search domain narrows down, GA converges slowly, at this moment convergence can be speed up by merging it with local search. The main advantage of using local search after narrowing down the search space is that the cost of the algorithms will not increase significantly. To validate our claims, it is tested on five well known benchmark problems of dimension 10, 30 and 50 and results are compared with the results obtained by GA. Based on the results it is concluded that this is improved variant of GA and converges very fast as compared to GA.

MATHEMATICAL FORM OF OPTIMIZATION PROBLEMS

Different types of practical problems lead to different types of mathematical models for which optimal solutions have to be obtained. The general mathematical formulation of single objective optimization problem is:

Related Content