International Journal on Applications in Basic and Applied Sciences
Volume 3: Issue 1: september 2017, pp 7-9 . www.aetsjournal.com ISSN (Online) : 2455 - 1007

OPTIMIZATION TECHNIQUES USED IN VARIOUS FIELD –A STUDY

M.Priya , Dr.M.Muthulakshmi

Abstract— Optimization means maximization or minimization of one or more functions with any possible constraints. Different teams had to do research on military operations in order to invent optimization techniques to manage with available resources so as to obtain the desired objective. It is an undeniable fact that all of us are optimizers as we all make decisions for the sole purpose of maximizing our quality of life, productivity in time, as well as our welfare in some way or another. The efforts and lives behind this aim dedicated by many brilliant philosophers, mathematicians, scientists, and engineers have brought the high level of civilization we enjoy today. Therefore, we find it imperative to get to know first those major optimization techniques along with the philosophy and long history behind them before going into the details of the method detailed in this book. This chapter begins with a detailed history of optimization, covering the major achievements in time along with the people behind them.

I. INTRODUCTION

The origin of optimization methods can be traced from 300 BC when Euclid identified the minimal distance between two points to be length of straight line joining the two. He also proved that a square has the greatest area among the rectangles with given total length of edges. Heron proved in 100 BC that light travels between two points through the path with shortest length when reflecting from a mirror. Before the invention of calculus of variations, the optimization problems like, determining optimal dimensions of wine barrel in 1615 by J. Kepler, a proof that light travels between two points in minimal time in 1657 by P. De Fermat were solved. I. Newton (1660s) and G.W. von Leibniz (1670s) created mathematical analysis that forms the basis of calculus of variation. L. Euler's publication in 1740 began the research on general theory of calculus of variations.

M.Priya , Assistant Professor , Department of Maths , Jayshriram Group of Institutions, Tirupur .

Dr.M.Muthulakshmi , Assistant Professor , Department of Maths , Jayshriram Group of Institutions, Tirupur .

The method of optimization for constrained problems, which involve the addition of unknown multipliers, became known by the name of its inventor, J. L. Lagrange. Cauchy made the first application of the gradient method to solve unconstrained optimization problems in 1847. G. Dantzig presented Simplex method in 1947. N. Karmarkar's polynomial time algorithm in 1984 begins a boom of interior point optimization methods. The advancement in solution techniques resulted several well defined new areas in optimization methods.

The linear and non-linear constraints arising in optimization problem can be easily handled by penalty method. In this method few or more expressions are added to make objective function less optimal as the solution approaches a constraint.

II. CLASSICAL OPTIMIZATION TECHNIQUES:

The classical methods of optimization are useful in finding the optimum solution of continuous and differentiable functions. These methods are analytical and make use of the techniques of differential calculus in locating the optimum points .

These methods assume that the function is differentiable twice with respect to the design variables and the derivatives are continuous.

Three main types of problems can be handled by the classical optimization techniques:

– Single variable functions
– Multivariable functions with no constraints,
– Multivariable functions with both equality and inequality constraints. In problems with equality constraints the Lagrange multiplier method can be used. If the problem has inequality constraints, the Kuhn-Tucker conditions can be used to identify the optimum solution. These methods lead to a set of nonlinear simultaneous equations that may be difficult to solve.

III. NUMERICAL METHODS OF OPTIMIZATION:

1) Linear programming:

studies the case in which the objective function *f* is linear and the set A is specified using only linear equalities and inequalities. (A is the design variable space)

2) Integer programming:

studies linear programs in which some or all variables are constrained to take on integer values.

3) Quadratic programming :

Allows the objective function to have quadratic terms, while the set A must be specified with linear equalities and inequalities

4) Nonlinear programming :

studies the general case in which the objective function or the constraints or both contain nonlinear parts.

IV. ADVANCED OPTIMIZATION TECHNIQUES

A. Hill climbing:

It is a graph search algorithm where the current path is extended with a successor node which is closer to the solution than the end of the current path.In simple hill climbing, the first closer node is chosen whereas in steepest ascent hill climbing all successors are compared and the closest to the solution is chosen. Both forms fail if there is no closer node. This may happen if there are local maxima in the search space which are not solutions.Hill climbing is used widely in artificial intelligence fields, for reaching a goal state from a starting node. Choice of next node/ starting node can be varied to give a number of related algorithms.

B. Simulated annealing:

The name and inspiration come from annealing process in metallurgy, a technique involving heating and controlled cooling of a material to increase the size of its crystals and reduce their defects. The heat causes the atoms to become unstuck from their initial positions (a local minimum of the internal energy) and wander randomly through states of higher energy;

the slow cooling gives them more chances of finding configurations with lower internal energy than the initial one. In the simulated annealing method, each point of the search space is compared to a state of some physical system, and the function to be minimized is interpreted as the internal energy of the system in that state. Therefore the goal is to bring the system, from an arbitrary initial state, to a state with the minimum possible energy.

C. PSO Optimization Technique:

PSO is one of the optimization techniques belonging to EAs. The method has been developed through a simulation of simplified social models.PSO combines social psychology principles in socio-cognition human agents and evolutionary computations and has been motivated by the behavior of organisms such as fish schooling and bird flocking. According to the research results for a flock of birds, birds find food by flocking (not by each individual).

The observation leads to the assumption that the information is shared inside flocking. Moreover, according to observation of behavior of human groups, behavior of each individual (agent) is also based on the behavior patterns authorized by the groups such as customs and other behavior patterns according to the experiences by each individual. This assumption is the basic concept of PSO. PSO is basically developed through simulation of a flock of birds in two dimensional space. The position of each agent is represented as (x, y) in the XY plane and the velocity (displacement vector) is expressed by yx (the velocity along X-axis) and vy (the velocity along Y-axis).

The features of PSO are given below:

- Generally, PSO is characterized as simple in concept, easy to implement, and computationally efficient. Unlike the other heuristic techniques, PSO has a flexible and well-balanced mechanism to enhance the global and local exploration abilities.
- It is based on a simple concept. Therefore, the computation time is short and it requires few memories.
- The global and local best positions are computed at each instant of time (iteration), and the output is the new direction of search. Once this direction is computed, it is followed by the cluster of birds.
- It could differ from the ordinary genetic algorithm, since the crossover and mutation operators are not considered.
- All particles in PSO are kept as members of the population throughout the course of the run.
- PSO algorithm that does not implement concept "the survival of the fittest".

V. GENETIC ALGORITHM

Genetic algorithm (GA) is an optimization algorithm based on the mechanics of natural selection and genetics. In GA, candidate solutions to the given problem are analogous to individuals in a population. Each individual is encoded as a string, called chromosome. New candidate solutions are produced from parent chromosomes by the crossover operator. The mutation operator is then applied to the population. The quality of each individual is 27 evaluated and rated by the so-called fitness function. Similar to the natural selection mechanism in the biological system, the fitter individuals have more chance to pass on information to the next generation. When a chromosome with the desired fitness is obtained, it will be taken as the optimal solution, and the optimization process is terminated.

Otherwise, the process is repeated until the maximum number of generations is reached and the fittest chromosome so far obtained is taken to be the optimal solution. Diversity is important in genetic algorithms (and genetic programming) because crossing over a homogeneous population does not yield new solutions. In evolution strategies and evolutionary programming, diversity is not essential because of a greater reliance on mutation.

GA has the following features:

- GA searches from a population of points, not based on single point. GA does not require linearity, continuity, or differentiability of the objective function, nor do they need continuous variables.
- Treats integer and discrete variables naturally.
- GA has inherent parallel computation ability (Ma and Lai 1995).

VI. NT COLONY OPTIMIZATION:

In the real world, ants (initially) wander randomly, and upon finding food return to their colony while laying down pheromone trails. If other ants find such a path, they are likely not to keep traveling at random, but instead follow the trail laid by earlier ants, returning and reinforcing it if they eventually find food. Over time, however, the pheromone trail starts to evaporate, thus reducing its attractive strength. The more time it takes for an ant to travel down the path and back again, the more time the pheromones have to evaporate. A short path, by comparison, gets marched over faster, and thus the pheromone density remains high. Pheromone evaporation has also the advantage of avoiding the convergence to a locally optimal solution.

If there were no evaporation at all, the paths chosen by the first ants would tend to be excessively attractive to the following ones. In that case, the exploration of the solution space would be constrained. Thus, when one ant finds a good (short) path from the colony to a food source, other ants are more likely to follow that path, and such positive feedback eventually leaves all the ants following a single path. The idea of the ant colony algorithm is to mimic this behavior with "simulated ants" walking around the search space representing the problem to be solved. Ant colony optimization algorithms have been used to produce near-optimal solutions to the traveling salesman problem.

They have an advantage over simulated annealing and genetic algorithm approaches when the graph may change dynamically. The ant colony algorithm can be run continuously and can adapt to changes in real time.This is of interest in network routing and urban transportation

VII. CONCLUSION

We can include many more new optimization techniques in succeeding papers. Optimization technique is a practical resource for the very many researches and practitioners in optimization who wish to learn about and experiment with the latest ideas in the field. As a conclusion we want to emphasize the researchers that the above discussed optimization techniques can help them to find the result in easiest way which had been proved by many who had already done in their works.

REFERENCES

[1] J.-H. Chang and L. Tassiulas. Fast approximation algorithms for maximum lifetime routing in wireless ad-hoc networks. In Networking, LNCS 1815, pages 702–713, 2000.
[2] J. Gao, L. J. Guibas, J. Hershberger, L. Zhang, and A. Zhu. Discrete mobile centers. Discrete and Computational Geometry, 30(1):45–65, 2003
[3] J.C. Spall, Multivariate stochastic approximation using a simultaneous perturbation gradient approximation.
[4] R. Storn, ‘‘On the usage of differential evolution for function optimization’’. Biennial Conference of the North American Fuzzy Information Processing Society (NAFIPS). pp. 519–523, (1996)
[5] G. V. Reklaitis, A. Ravindran, K. M. Ragsdell, “Engineering Optimization: Methods and Applications”, Wiley (2006).
[6] Michael C. Bartholomew-Biggs, “Nonlinear optimization with engineering applications”, Springer (2008).
[7] Kwang Y. Lee, Mohamed A. El-Sharkawi, “Modern heuristic optimization techniques: theory and applications”, Kluwer (2008).