



Memetic Algorithm: Introduction

Shalini Yadav

Assistant Professor

University College, Kurukshetra
India

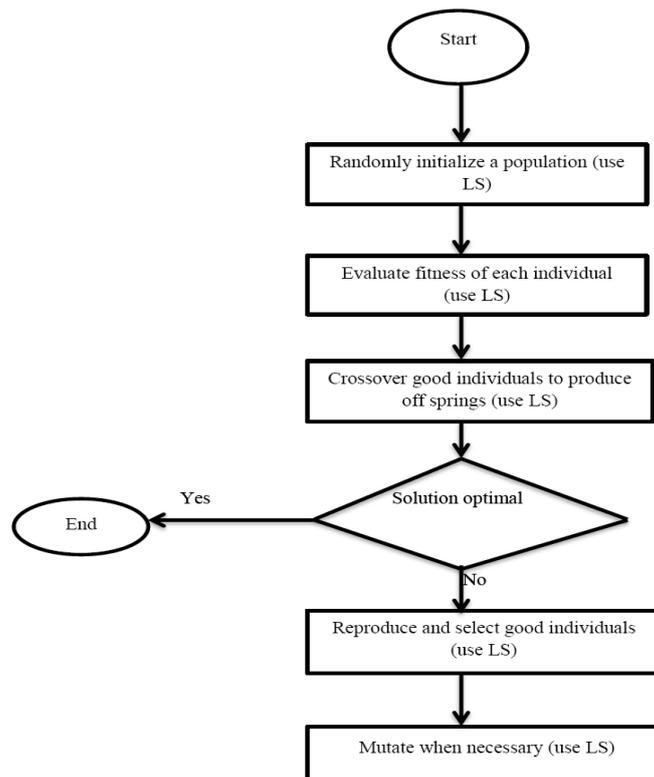
Abstract— Computational drawbacks of existing derivative-based numerical methods have forced researchers all over the world to look towards metaheuristic algorithms founded on simulations of nature to solve computationally intractable engineering optimization problems since the past two decades. Within this growing trend, the methodology, known as Memetic algorithm, is one of the most recent technique which mimicks the nature and culture. The biological-cultural selection has indeed transcended the field of combinatorial and continuous optimization. Recent literature is continually indicating that the concept of "meme" dispersal and selection can be exploited in, for example, robotics engineering, multi-agent systems, robotics, optimization, software engineering, computational biology, business intelligence, and the social sciences. This paper gives a basic introduction to memetic algorithm.

Keywords— Evolutionary Algorithm, Genetic Algorithm, Local search, Local optima and Diversity.

I. INTRODUCTION

There are two kind of optimization problem: Deterministic and Non-Deterministic. The deterministic can be easily solved as the solution nature is known. While in case of Non deterministic there is no information about the solution domain. A number of techniques have been developed for these. Evolutionary computation is one such technique. Genetic Algorithm is a branch of Evolutionary computation. In this technique a population of candidate solutions is produced. It is inspired by both genetics and evolution strategies of nature. When Genetic algorithm is incorporated with local search techniques, a new algorithm called Memetic algorithm is developed. Memetic algorithm comprises of memes. This term was coined by Dawkins in his book: The Selfish Gene. A meme is a unit of cultural evolution. In this the information is not just simply transmitted but processed and incremented at each step. It represents a learning and development strategy.

II. MEMETIC ALGORITHM FLOWCHART



III. MEMETIC ALGORITHM PSUEDO-CODE

1. Start by initializing a population randomly using a LS.
2. Use LS to evaluate fitness of each individual.
3. Crossover to produce off springs use LS.
4. If optimal solution found
Then Exit.
Else Reproduce to find next generation use a LS.
5. Mutate (use LS) when struck at local optima found.

Methods in MA:

Genetic operators + local search.

Genetic operators:

- Selection: The first step consists in selecting individuals for reproduction. This selection is done randomly with a probability depending on the relative fitness of the individuals so that best ones are often chosen for reproduction than poor ones.
- Reproduction: In the second step, offspring are bred by the selected individuals. For generating new chromosomes, the algorithm can use both recombination and mutation.
- Evaluation: Then the fitness of the new chromosomes is evaluated.
- Replacement: During the last step, individuals from the old population are killed and replaced by the new ones.[1]

Local Search Techniques:

Local search is a heuristic for solving optimization problems. They have the ability that when provided with knowledge, they exploit the entire search space to find the best solution. There are two forms of genetic local search. One is based on Lamarckian algorithm and the other one is Baldwin effect. In both cases LS operators are used to improve the fitness of candidate solution and hence change its selection probability.

Lamarckianism vs. Baldwinian Effect:

The dilemma is what to do with the new improved solution. Lamarckianism method says that on getting the better solution replace old with new. In this case the genetic information contained in old individual is lost. Whereas the Baldwinian method says that on getting the improved solution replace old fitness with new but keep its genetic information. It is a priori difficult to decide what method is best, and probably no one is better in all cases. Lamarckianism tends to substantially accelerated the evolutionary process with the caveat that it often results in premature convergence. On the other hand, Baldwinian learning is more unlikely to bring a diversity crisis within the population but it tends to be much slower than Lamarckianism.[3]

Preservation of Diversity:

When using a very aggressive local search in MA, the difficulty arises in the need to preserve the diversity. Diversity is lost when all same kind of off springs are produced by strong local search techniques. In such a situation one gets stuck at the local optimal solution. In this case one relies on mutation to come out of the local optima.[3]

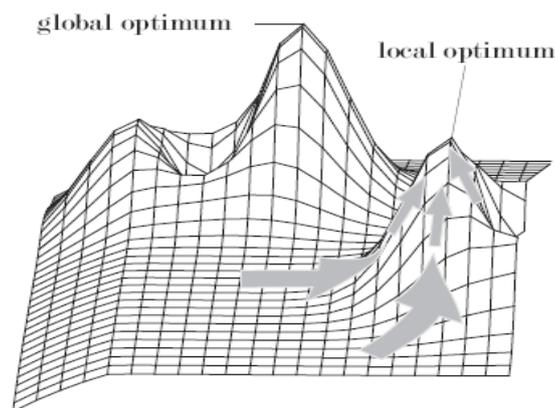


Fig : Premature convergence in Objective space.

Src: Global Optimization Algorithm- Theory and Application by Thomas Weise .[2]

IV. APPLICATIONS

1. To solve NP Hard optimization problems.
2. For combinatorial, multi objective, dynamic, large scale optimization problems.
3. They are good at solving scheduling problems.
4. In robotics and machine learning.

5. In Engineering, electronics and electromagnetics.
6. For molecular optimization problems.
7. Other application includes speech processing, imaging science, oceanography, medicine, mathematics, etc.[4]

V. CONCLUSIONS

Genetic algorithm is the most widely used branch of evolutionary algorithm. GA alone is not sufficient in fine tuning searches in complex combinatorial problems. Local search however have knowledge and exploit the area but lead to being trapped at local optima. So we hybridize the two. Memetic algorithm is mixture of the two techniques. They have been studied and researched by researchers across the globe. It has shown to be very effective and better to GA. It has a wide variety of application and used in diverse fields. Its applicability is increasing day by day and provides a huge future scope.

REFERENCES

- [1] S.N. Sivanandam and S.N. Deepa, "Introduction to Genetic Algorithms" Springer-Verlag 2008.
- [2] Thomas Weise, "Global Optimization Algorithm- Theory and Application" 2007.
- [3] Natalio Krasnogor, Alberto Aragón and Joaquín Pacheco, "Memetic Algorithms".
- [4] Pablo Moscato and Carlos Cotta, "A Gentle Introduction to Memetic algorithms".