TEST Engineering & Management

May-June 2020
ISSN: 0193-4120 Page No. 3601-3604

A Comparative Study of Nature Stimulated Optimization Algorithm

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Article Info
Volume 83
Page Number: 3601-3604
Publication Issue:
May-June 2020

Article History
Article Received: *19 August2019*
Revised: *27 November 2019*
Accepted: *29 January 2019*
Publication: *12 May 2020*

Abstract

Optimization is a collection of mathematical principles and methods used in many disciplines to solve quantitative problems. In the field of Computer Science optimization is the method of changing a system to make some of its features work more efficiently or to use fewer resources. The need for optimization is to achieve the finest strategy in relation to a set of criteria or constraints prioritized. There are some optimization techniques which are used to solve complex problems in real time and to take decisions which is based on the behavior of insects and animals who work together to complete their task. This paper compares the concepts, working model, usage, advantages and disadvantages of few of the nature living algorithms such as bat algorithm, ant colony algorithm, firefly algorithm, artificial bee algorithm and cuckoo search algorithm. [1]

Keywords: *Optimization, algorithm, decision making*

1. Introduction

An algorithm is a method or formula for solving a pro blem, based on a series of actions specified. The optimization algorithm is a procedure that is done iteratively by comparing different solutions until an optimal or acceptable solution has been found. Metaheuristic optimization uses metaheuristic algorithms to solve optimization issues. Essentially, optimization is everywhere, from engineering design to finance, and from holiday planning to Internet routing. Given that money, energy and time are increasingly scarce, the optimum use of these available resources is crucial.

Nature Inspired Algorithms speaks to an extremely dynamic region of research. Swarm knowledge and bio-propelled calculations are a hotly debated issue in the improvement of new calculations which are motivated commonly. Such Nature-propelled metaheuristic calculations can be founded on swarm knowledge, organic frameworks, physical and compound frameworks

This is on the grounds that the issues we are typically acquainted with are getting progressively unpredictable because of size and different measurements, but likewise in view of new issues that emerge when existing strategies don't work.

Nature-Inspired Optimization Algorithms give an extensive manual for the entirety of the fundamental nature-roused enhancement calculations. Despite the fact that not every one of them are viable, a couple of calculations have demonstrated to be extremely effective and have become normal devices for taking care of true issues. Most calculations are not appropriately learned. The point of this article is to give a genuinely thorough rundown of all calculations in the writing, so as to energize further research. It could likewise go about as a motivation outlet for new applications. It's likewise a helpful guide for understudies and designers, just as prepared specialists. [2]

Firefly Algorithm

Firefly algorithm developed in 2007 based on the behavior of fireflies by Xin-She-Yang at Cambridge University. The insect firefly lives in temperate and tropical environment produces yellow, green, pale red cool light from its abdomen. The wavelength of that light is 510 to 670 nanometers. Fireflies' flashing pattern and behavior is based on such functions as attracting and communicating with the mating partners, attracting potential prey, and protective warning mechanism. As the gap went up, light became weaker and weaker due to air absorption. In

some species female mimic the other species being hunted.

The rules governing firefly algorithms are to:

1. Both flies are unisex, allowing one to draw others regardless of sex
2. Attractiveness is equal to the visibility and both reduce with increasing distance.
3. A firefly's brightness defined by objective function

Firefly algorithm solves non-linear, multi-model optimization problems, does not use velocity, this algorithm's convergence speed is very fast to find a solution, and it combines flexibly with other algorithms. The iteration process does not require a good initial solution.

The working process of firefly algorithm is given as flowchart:

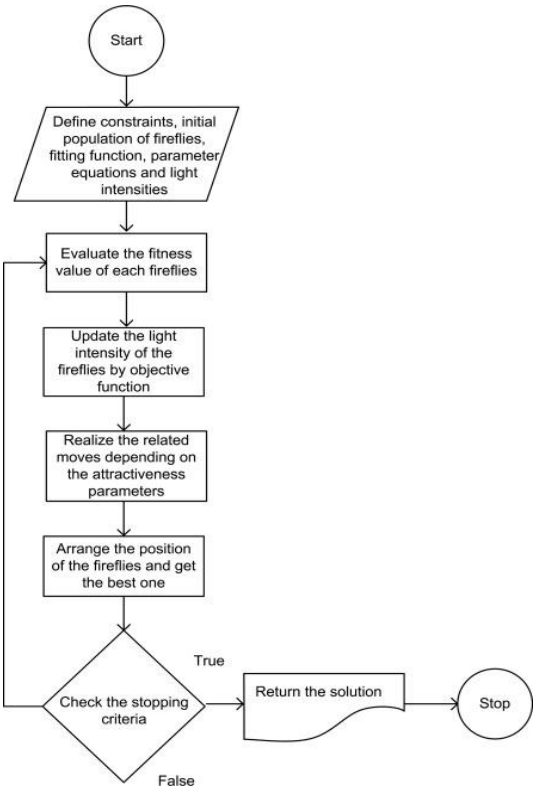

Figure 1: Fire Fly Algorithm Flow Chart

The areas where firefly algorithm is used are digital image processing, digital image compression, features selection and fault detection, structural design, scheduling and dynamic problems. [9]

2. Ant Colony Optimization

This algorithm for oprimization was found in 1992 by Marco Dorigo. It is a optimization technique which uses multi-agent approach. Ant colony is a unit which organizes the life cycle of ants. Ants are basically blind, deaf and dumb, then how ants find their path to food? They deposit pheromones on ground that form a trail, this trail attracts other ants. In longer paths, pheromones evaporate faster; the ants get food as they follow the shortest path of pheromones. They use stigmergic communication over pheromone trails to communicate with other ants. Of high probability, they follow the trail of current pheromones. This is an autocatalytic activity in which more ants follow a path, the path that is more in use becomes the final path to the food source. Therefore, this mechanism is characterized by a positive feedback loop, where the likelihood of a single choice of path decreases with the number of times the same path was chosen previously. It is a autocatalytic positive feedback algorithm. This is used to solve problems with minimum cost. The working modes of ants are either forwards or backwards. The ant memorizes the path through which it reached its destination, when it moves backward, to eliminate the loops formed during forward travel, it leaves more pheromones on the arcs. [6]

The working process of ant colony algorithm is given as flowchart:

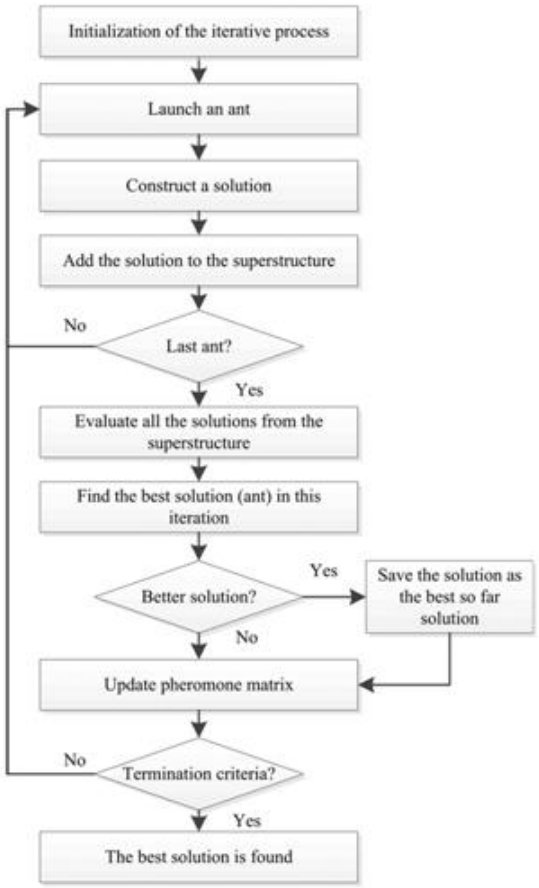

Figure 2: Ant Colony Algorithm Flow Chart

Ant colony optimization algorithm finds the solution very fast, it adapts the changes during the problem solving, so convergence is guaranteed. But probability distribution can change for each iteration and cannot be used for theoretical analysis, the time taken for convergence is uncertain. [10]

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Bats Algorithm

Bats algorithm developed in 2010, by Xin-She yang. The Bat algorithm is based on the BATS echolocation behavior. By using the echolocation method, bats determine the size of an object, distance, and how easily such objects move. Bats uses echolocation to detect space to figure out whether it is obstacles to food / predators and context.

Ats fly randomly, its velocity can be V_i at position X_i with fixed frequency of "f' min, and wavelength lambda(Y) and loudness A_o to search for prey. Depending on the proximity of their target they automatically regulate the wavelength of their emitted pulses and change the rate of pulse emission r in the range of [0,1]

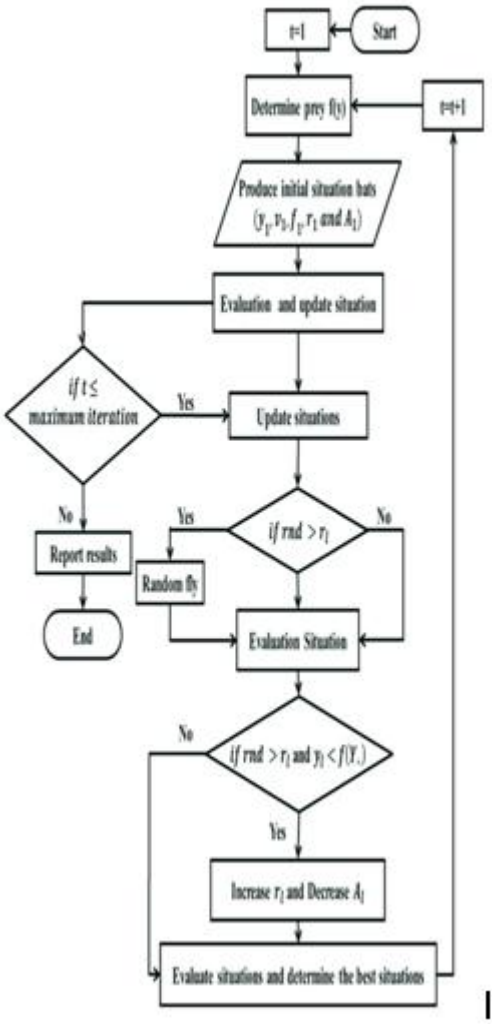

Figure 3: Bats Algorithm Flow chart

Bat algorithm is simple, flexible and easy to implement. it solves non linear problems. The convergence of solution is quick in this algorithm and it promises optimal solution. It works very well in complicated problems. But it leads to stagnation.

Artificial Bee Colony Algorithm

[7]This algorithm is defined by dervis karaboga in 2005; it is a swarm algorithm based on the meta-heuristics. It works on the foraging behavior of honey bee colonies. Waggle dance of the scout bee will inform foragers the direction and distance about the nectar site. The number of runs made by the scout represents the distance and the angle of run indicates the direction of the nectar site.

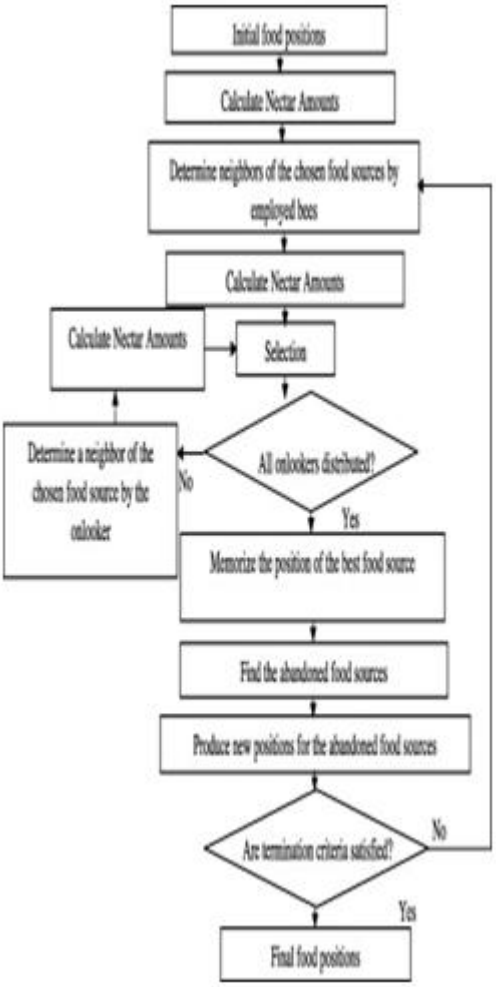

Figure 4: Artificial Bee Colony Algorithm Flow chart

This algorithm is simple, flexible and works fast, it has ability to explore local solutions and handle objective cost. it slowdowns the process when used in sequential processing .the computational cost increases when the solution populates.

Cuckoo Search Algorithm

[11]This calculation is a streamlining calculation that was created in 2009 by xin-she-yang and swash deb. The necessary brood parasitism of certain cuckoo species initiates this calculation. The cuckoo's lay eggs in the home of other host flying creatures of different species. This impersonates have species

shading and shape. Each cuckoo lays each egg in turn and dumps into a home that is picked arbitrarily.

The best nests which have high quality of egg will pass the eggs to the next generation. The numbers of host nests are fixed set. Host bird finds with possibility (0, 1) an alien egg; the host bird detects the egg and kills or hatches.

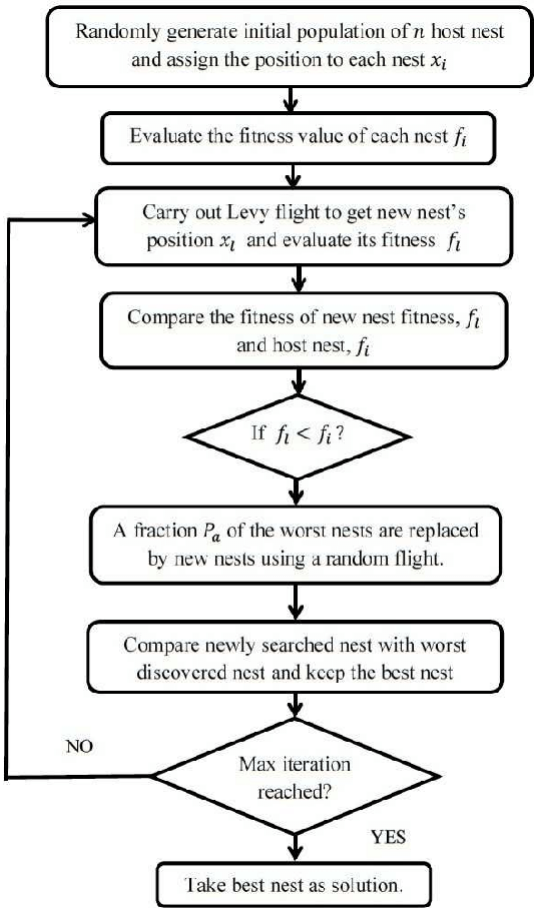

Figure 5: Cockoo search Algorithm Flow Chart

This algorithm is simple and easy to implement. It deals with multi criterion optimization problems. This can be hybridized with other algorithms.

3. Conclusion

This paper discusses the nature-
inspired comparative study of algorithms such as Ant Colony algorithm, Cuckoo search algorithm, Bats alg orithm, Artificial Honey Bee algorithm and Fire fly algorithm. It is mainly focused on the working procedure and its pros and cons. Considering this paper has a base it possible to do further studies on these algorithms.

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