Literature Review on Animal Migration Optimization

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Abstract— This is literature review paper on a new swarm intelligent algorithm, called as Animal Migration Optimization (AMO). This paper is inspired by the animal's migration nature that can be found in all major animal groups, like mammals, fish, reptiles, amphibians, insects, birds, and crustaceans. In this algorithm, there are mainly two processes. In the first process, animals move from the current position to the new position. During this movement, each individual should obey three main rules. In the latter process, some animals leave the group and some join the group during the migration. In previous research, different techniques are used to find the optimal solution. In this paper we will discuss about few algorithms and their simulated results after apply on the benchmark functions. Benchmark functions are employed to find performance of our approach. This technique has been compared with different popular search methods.

Key words: Animal Migration Optimization (AMO)

I. INTRODUCTION

The kingdom of animals is very fascinating phenomena. The animals give us a good teaching experience on, how can we survive? Every year many groups of animals move from one place to another and some of them migrate thousands of miles in different seasons like in the spring, winter and summer. Animals need to migrate for survival or more livable conditions for themselves due to the change in the weather, the seasons, lack of food and water. They move to get better food and water or to provide a safe place for their young ones. Different signals like a modification in weather, the number of days or the provision of food might signal to the animals that it's time to migrate. Scientists say that they learn this "genetically" from their folks. It's traditionally known as instinct.

Animals have no idea about the web, GPS or perhaps maps to seek out their destination, however annually they manage to search out their way across thousands of miles of land and sea. Different animals have custom-made ways of navigating the planet. Some animals use the Sun and also the Stars to work out the proper direction. Others use wind patterns or landmarks like mountains, rivers, and lakes. Still others might be using an additional sense that permits them to use the force field of the planet to grasp that direction to travel. It's wonderful what animals will do? There are different examples of how most of the animals migrate from one place to other as land, air and sea.

It is a nature inspired algorithms. Nature-inspired computing (NIC) is the collection of computing method that is inspired by nature or the progressions that happens in nature. Natural systems are different from classical computing systems so we can understand it by following 3 points-

1) Basic components of natural systems.
2) The self-assembly of a natural system
3) The operation of natural systems.

Nature inspired algorithms are encouraged by some natural happening, that can be divided according to their source of encouragement. Different algorithms related to NIA are: Immune Algorithms, Physical Algorithms, Evolutionary Algorithms, Probabilistic Algorithms, Stochastic Algorithms, Neural Algorithms and Swarm Algorithms [1].Using AMO good experimental result on many optimizing difficulty has been obtain.

II. OPTIMIZATION TECHNIQUE

A. Artificial Bee Colony Algorithm (ABC)

It is a natured inspired [2]. Swarms are the main resources provided for nature inspired optimization algorithms, honey bee is one of them. Honey bee swarms have many features while choosing food sources. It actually works on foraging behaviour, where honey bees look for the food sources. And at the same time they also share information regarding food amount (nectar) and the direction in which it can be found. Collectively honey bees have several features like information gathering, information sharing and environment memorizing. On the basis of these information it also takes decisions whether to proceed or not for the same source and in the same direction. According to the decision take it also updates the information for other bees. This behaviour of honey bees termed as intelligent behaviour. D. Karaboga is also known as father of artificial bee colony algorithm, who has invented this concept for the optimization of complex problems, where swarms such as honey bees and their intelligent thinking provides basis [2].

The honey bees can be one of the following:

1) Employed Bee
2) Unemployed Bee (Onlooker and Scout Bee)

B. Bat Algorithms

bat algorithm (BA) was based on the echolocation features of micro bats (Yang, 2010), and BA uses a frequency-tuning technique to increase the diversity of the solutions in the population, while at the same, it uses the automatic zooming to try to balance exploration and exploitation during the search process by mimicking the variations of pulse emission rates and loudness of bats when searching for prey. As a result, it proves to be very efficient with a typical quick start. Obviously, there is room for improvement. Therefore, this paper intends to review the latest developments of the bat algorithm [3].

C. Cuckoo Search Algorithm

The cuckoo search algorithm (CS) is a simple and effective global optimization algorithm that is presented by Minghao Yin et al. [4]. It has been applied to solve a wide range of real-world optimization problem. In this paper, the proposed method uses two new mutation rules based on the random and best on through whole population. New rules are used to balance the survey and exploration of the algorithm. These

rules are based on a linear decreasing probability. Then, self-adaptive parameter setting is introduced as a uniform random value to enhance the diversity of the population based on the relative success number of the proposed two new parameters in the previous period. To verify the performance of SACS, 16 benchmark functions selected from literature. The results indicate that the proposed method performs better as compare to other from literature when considering the quality of the solutions find. In the last part, experiments are used to find the parameter of Lorenz system and Chen system. The proposed method is very effective by showing the simulation result.

1) Literature Survey

Optimization is the process of estimating good results with some conditions. In almost each and every field of engineering, an engineer needs to take a decision by considering technical and management side issues at different stages. The reason behind these types of decisions is to optimize the utilization of available resources, to maximize the profit of organization or to minimize efforts. In general, optimization is a task of finding the best feasible solution to a prearranged problem, which is the area under discussion to certain constraints. Up-to-the-minute industry and science both have a great collection of optimization problems [5].

Most popular NIA algorithms are Artificial Bee Colony Algorithm [6] that is related to forging behaviour of honey bee and there are many modification or hybridization done in Artificial Bee Colony Algorithm, Cuckoo Search Algorithm [7] is related to behaviour of cuckoo and island species [8], Bat Algorithm which was given by X.Li and J.Zhang in 2013[9] and also use clustering techniques [10], Ant Colony Optimization Algorithm [11], Particle Swarm Optimization algorithm [12] and many more. Nature inspired algorithm has a long list of applications area of optimization, engineering, management and science. Some recent modifications in these algorithms are discussed here.

AMO is proposed by Mingzhi Ma et al. [13]. In this process solution is searched by modify and migrate process. In this paper, a novel migration process has been presented to improve the survey and exploitation ability of the animal migration optimization. Twenty-three benchmark functions are used to verify the effects of these improvements. The results of this algorithms show faster speed and greater convergence precision than the original animal migration optimization and other some other intelligent optimization algorithms such as cuckoo search (CS), artificial bee colony (ABC), and particle swarm optimization (PSO), bat-inspired algorithm (BA) and firefly algorithm (FA).

The behaviour of animal swarm migration is presented by Yangquan Zhou et al. [14]. That is known as Animal Migration Optimization (AMO).It presents an improved AMO algorithm (IAMO). This algorithm helps to find out complex optimization of the original AMO. Data mining technique and clustering is a popular data analysis that is used in different fields. It -means clustering algorithm is used to solve complex problems. This algorithm focuses on the first solution and is easy to fall into local optimum. This paper used IAMO for the clustering problems to improve defect of –means for the clusters. The comparable results create the better performance as compare to the PSO, CPSO, ABC, CABC, and AMO algorithm for solving the clustering problem.

Jie Zhang et al. [15] developed a new heuristic optimization method, called animal migration optimization algorithm. This algorithm is inspired by the animal migration nature that is a universal phenomenon that can be found in all major animal groups such as birds, mammals, fish, amphibians, insects, reptiles and crustaceans. In our algorithm, there are mainly two processes. In this process, the algorithm finds how the groups of animals move from the current position to the other position. Each individual should obey three main rules. In the other process, it find how animals leave the group and some join the group during the migration. In order to verify the result of our approach, some benchmark functions are employed. The proposed method has been compared with different heuristic search methods. Results indicate that the proposed algorithm performs better than the other different approaches from literature when considering the quality of the solution obtained [1].

III. ANIMAL MIGRATION MODEL

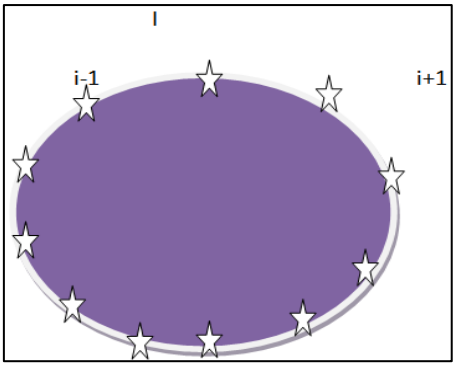
Animal migration algorithm can be divided into animal migration process and animal updating process. In the migration process the algorithm simulates how the groups of animals move from current position to a new position. During this process, each individual should obey three main rules:

1) Move in the same direction as its neighbours
2) Remain close to its neighbours
3) Avoid collisions with its neighbours.

During the population updating process, the algorithm simulates how animals update by the probabilistic method.

A. Animal Migration Process

During the animal migration process, an animal should obey three rules: (1) avoid collisions with your neighbours (2) move in the same direction as your neighbours and (3) remain close to your neighbours. In order to define concept of the local neighbourhood of an individual, we use a topological ring, as has been illustrated in fig. 3.1. For the sake of simplicity, we set the length of the neighbourhood to be five for each dimension of the individual. Note that in our algorithm, the neighbourhood topology is static and is defined on the set of indices of vectors. If the index of animal is i, then its neighbourhood consists of animal having indices i-1, i-2,i,i+1,i+2 , if the index of animal is 1, the neighbourhood consists of animal having indices NP-1,NP, 1, 2, 3, etc.



Once the neighbourhood topology has been constructed, we select one neighbour randomly and update the position of the individual according to this neighbour, as can be seen in the following formula:

$$X_{i,\,G+1}=X_{i,\,G}+\$.\,(N_{eighborhood,\,G}-X_{i,\,G})$$

Where $X_{Neighborhood,\,G}$ is the current position of the neighborhood, $ is produced by using a random number generator controlled by a Gaussian distribution. $X_{i,\,G}$ is the current position of i^{th} individual, and $X_{i,\,G+1}$ is the new position of i^{th} individual.

During the population updating process, the algorithm simulates how some animals leave the group and some join in the new population. Individuals will be replaced by some new animals with a probability Pa. The probability is used according to the quality of the fitness. We sort fitness in descending order, so the probability of the individual with best fitness is 1/NP, the individual with worst fitness, by contrast, the probability is 1, and this process can be shown in Algorithm

1) Algorithm 1: Animal Migration Optimization Algorithm [1]

For i=1 to NP
For j=1 to D
If rand>Pa
$X_{i,g+1}=X_{r1,G}+rand.(X_{best,G}-X_{i,G})+rand.(X_{r2,G},-X_{i,G})$
End If
End For
End For

IV. CONCLUSION

Animal Migration Optimization is a nature inspired algorithm based on the behavior of animal migration found in different groups of animal and it's a ubiquitous behavior, for example mammals, fish, reptiles, amphibians, insects, crustaceans and birds. Animal Migration Optimization algorithm with modifications in position update equation and an additional step applied to some benchmark functions for whether it gives better result or not. Benchmark functions taken in this paper are of different characteristics like uni-model or multi-model and separable or non-separable and of different dimensions.

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