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# Comparative Analysis of Artificial Bee Colony Based Swarm Intelligence Algorithms

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**Abstract**

Swarm intelligence is an important aspect of the artificial intelligence based algorithms as they help in evolving algorithms and also, they play major role in optimizing the data either to the maxima, minima or to any value suggested by the user or the parameters associated. Swarm intelligence (SI) is basically the total direct of decentralized, facilitated systems, customary or counterfeit. The thought is used in work on man-made thinking. The explanation was introduced by Gerardo Beni and Jing Wang in 1989, with respect to cell computerized structures.

Keywords: — Swarm Intelligence, Artificial Intelligence, Bio-Inspired Algorithms, Artificial Bee Colony

## 1 INTRODUCTION

THEartificial bee colony optimization (ABC) is a population-based algorithm for function optimization that is inspired by the foraging behavior of bees. The population consists of two types of artificial bees: employed bees (EBs) which scout for new good solution in the search space and onlooker bees (OBs) that search in the neighborhood of solutions found by the EBs. Artificial Bee Colony (ABC) is conceivably the most actually portrayed figuring by DervisKaraboga in 2005, enlivened by the wise lead of honey bees. It is basically pretty much as fundamental as Particle Swarm Optimization (PSO) and Differential Evolution (DE) figuring, and uses simply ordinary control limits, for instance, settlement size and most limit cycle number. ABC as a progression mechanical assembly, gives a general population-based request strategy in which individuals called sustenance positions are changed by the phony bumble bees with time and the bumble bee's point is to discover the spots of food sources with high nectar aggregate ultimately the one with the most critical nectar. In ABC system, counterfeit bumble bees fly around in a multidimensional request space and a couple (used and bystander bumble bees) pick food sources depending upon the experience of themselves and their home mates, and change their positions. A couple (scouts) flies and pick the food sources indiscriminately without using experience. If the nectar proportion of another source is higher than that of the previous one in their memory, they hold the new position and neglect to recollect the previous one. In this way, ABC system merges close by pursuit procedures, done by used and bystander bumble bees, with overall chase methods, managed by observers and scouts, trying to change examination and abuse measure. Since 2005, a few individuals from the savvy frameworks research gathering, the top of the gathering is Karaboga, have concentrated on ABC calculation and its applications to genuine world-issues. Karaboga and Basturk have concentrated on the rendition of ABC calculation for unconstrained mathematical enhancement issues and its all-encompassing form for the obliged advancement issues.

Artificial Swarm Intelligence (ASI) is modeled after natural systems such as schools of fish, flocks of birds, and swarms of bees. But unlike birds, bees and fish, humans have not evolved the natural ability to form real-time closed-loop swarms, as they lack the subtle connections that other organisms use to establish feedback-loops among members. Schooling fish detect subtle vibrations in the water around them. Flocking birds detect highspeed motions propagating through the formation. Swarming bees generate complex body vibrations called a “waggle dance” that encodes information. To enable networked human groups to form similar real-time systems, a software platform called swarm.ai was developed by Unanimous AI, Inc. It enables distributed

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groups, connected from remote locations around the world, to answer questions, make predictions, and reach decisions by working together as closed-loop swarms.

Optimization is the process of finding the best way to use available resources without violating any of the constraints. Numerous optimization algorithms have been proposed which can be classified into two major categories, deterministic and stochastic. Hybrid algorithms which combine deterministic and stochastic features are stochastic in essence and regarded so. Deterministic and stochastic algorithms have some advantages and disadvantages rather to each other. One of the disadvantages of most deterministic optimization algorithms is dependency of these algorithms on starting-points, such that good starting-points are critical for the success and poor starting-points may have a significant adverse effect on them, while most stochastic optimization algorithms generate their initial solution through an inherent initialization process, and thus avoid being troubled by choosing a poor starting-point. In other hand no stochastic optimization algorithm guarantees absolute success and optimal solution, although the failure percentage might be very small in this algorithm.

To overcome these disadvantages, we propose a new algorithm based on combination of ideas from deterministic and stochastic optimization to define efficient hybrid algorithm that will incorporate both algorithm advantages. We select pattern search for deterministic approach, and Artificial Bee Colony (ABC), as a swarm intelligence algorithm, for the stochastic method.

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## 2 LITERATURE REVIEW

Najimi joined the Artificial Bee Colony calculation with a feed forward fake neural organization (FF-ABC) in the expectation of chloride entrance in self-solidifying cements [1]. Yue proposed a novel Pareto based guided Artificial Bee Colony algorithm (PGABC) for solving the problem of flexible production lines. The algorithm can obtain near optimal Pareto solutions with three different guided mechanisms [2]. Xing proposed a novel multiobjective Artificial Bee Colony algorithm with two performance enhancing schemes integrated for solving problems with network coding for the first time, namely the load balancing and the transmission delay. The algorithm introduced the pareto local search operator with the concept of path relinking integrated[3]. In Khan's research paper, Artificial Bee Colony algorithm is modified with multiple update rules and K-opt operation to solve the Traveling Salesman Problem[4]. Choong applied a hyper-heuristic method, namely a Modified Choice Function (MCF), for the Artificial Bee Colony algorithm. The algorithm can regulate the selection of the neighborhood search heuristics adopted by the employed and onlooker bees automatically[5]. In Ni's paper, to address the advancement of infusion plan of steam flooding, an infusion enhancement strategy for steam flooding dependent on improved Artificial Bee Colony (IABC) calculation is proposed[6]. Xie, in light of improved subspace disintegration (ISD) and the fake Artificial Bee Colony (ABC) calculation, proposed a band choice strategy known as ISD-ABC to resolve the issue of dimensionality decrease in HSI grouping [7]. In Sun's study, an intelligent technique was proposed for predicting the UCS of the calcrete by combining back propagation neural network (BPNN) and beetle antennae search (BAS)[8]. 1 Lin, in order to improve the optimization ability of BAS, has combined particle swarm optimization (PSO) algorithm and proposed a new hybrid BAS and PSO algorithm (BAS-PSO)[9].

In the novel ABC algorithm, 3sorts of bees are there[11]. They are employed, onlooker & scout bees. The number of employed bees and onlooker bees are the same, which separately consists half of the colony size. Single employed bee in one food cause, that is to say, an employed bee talks to a food source. The whole process of original ABC is that employed bees search space and record the location of food sources, then transfer information to onlooker bees. According to the datacarried by the working bees, the onlooker bees choose food sources. If a food source is exhausted, the employed bee becomes a scout bee, and begins to discover a new food source. In this algorithm, each food resourcelocation represents a practicable solution. The number of feasible solutions is defined as Food number[12]. In each cycle, employed bees search for each food source, and calculate the value of objective function of the corresponding food source. Then the employed bee do a comparison to select the new or old food source to locate the location. The selection is based on the size of the objective function value corresponding to different food source. If the new objective function value is better than the old(we call this situation is 'a food source is improved'), the employed bee chooses the new food source and abandons the old one, else the employed bee keeps the old food source. According to the information (the objective function value of each food source) transferred by the employed bees, the onlookers choose food sources proportionally, and search for new food sources around the chosen food sources and calculate the corresponding objective function value. Then do the alikechoice as engaged bees[13].

Optimization algorithms based on swarm intelligence, known as meta-heuristic algorithms, gained popularity in solving complex and high dimensional optimization problems' years ago. Since most of the meta-heuristic methods are independent of the initial solutions and are derivative-free, they overcome the main limitations of deterministic or conventional optimization methods, i.e., getting trapped in local extrema and divergence situations, respectively. The inspiration of most meta-heuristic techniques is natural phenomena, e.g., genetic algorithm (GA) [14], ant colony optimization (ACO) [15], particle swarm optimization (PSO) [16], artificial bee colony (ABC) [17], and firefly algorithm (FA) [18]. In addition, meta-heuristic methods are easy to implement and can be combined with other algorithms. The characteristics of the objective function and/or constraints are inconsequential for the success of those methods. However, meta-heuristic algorithms have parameters to be tuned, an adjustment that is commonly accomplished by trial-and-error as well as the skill of the user. Consequently, an efficient algorithm with fewer parameters to be adjusted is always more favorable.

Optimization problems can be classified into constrained and unconstrained types. The former includes most of the practical and real-world applications. Thus, the constraints of an optimization problem are commonly solved via independent (constraint-handling) techniques [19, 20]. The effectiveness varies from one technique to another and, also, with different algorithms. Moreover, the superiority of current and future meta-heuristic algorithms can be determined through solving benchmark optimization functions where statistical records emphasize their effectiveness.

Inspired by the intelligent foraging behaviour of honey bee swarms, the ABC algorithm was introduced to handle unconstrained benchmark optimization functions [17, 21], similar to other well-known meta-heuristic algorithms. An extended version of the ABC algorithm was then offered to handle constrained optimization problems [22].

The employed bees erratically search for food-source situations (solutions). Then, by dancing, they share information (communicate) about that food source, such as nectar amounts (solutions qualities), with the onlooker bees waiting in the dance area at the hive. The duration of a dance is proportional to the nectar's content (fitness value) of the food source being exploited by the employed bee. Onlooker bees watch various dances before choosing a food-source position, according to the probability proportional to the quality of that food source. Consequently, a good food-source position attracts more bees than a bad one. Onlookers and scout bees, once they discover a new foodsource position, may change their status to become employed bees. When the food-source position has been visited (tested) fully, the employed bee associated with it abandons it, and may once more become a scout or onlooker bee. In a robust search process, exploration and exploitation processes must be carried out simultaneously [17, 23]. In the ABC algorithm, onlookers and employed bees perform the exploration process in the search space, while, on the other hand, scouts control the exploration process.

## 3 CONCLUSION

There have been many attempts made by the researchers to improve the Artificial Bee Colony algorithm, by making various changes, as it was evident from the above study. By accelerating the process or by increasing the food source elements. The results have improved over the time but the scope is huge, there have been many problems where the ABC algorithm can help, specially in optimizing huge datasets.

ABC is well suited for general assignment problem, cluster analysis, constrained problem optimization, structural optimization, and advisory system. It has also been applied to software engineering for software testing and parameter estimation in software reliability growth models. ABC also plays an important role in medical, as used in MR brain image classification, face pose estimation, bioinformatics etc. The successful applications of ABC and its rapid growth suggest that its impact will be felt increasingly in coming years. It persuades the use of ABC and its tools into different advanced applications. It is hoped that this paper will benefit computer scientist who are keen to contribute their works to the field of artificial bee colony.

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