Enhancing the Efficiency of Artificial Bee Colony (ABC) Algorithm Using Genetic Operations

S. Artheeswari [1]

Dr.RM. Chandrasekaran [2]

Research Scholar, Department of Computer Science, Annamalai University, Annamalainagar, Chidambaram
[2] Professor (CSE) / Controller of Examinations, Annamalai University, Annamalainagar, Chidambaram

ABSTRACT

Artificial Bee Colony Algorithm (ABC) simulates the behavior of real bees for solving multidimensional and multimodal optimization problems and numeric problems. It is a population based stochastic algorithm which has good searching capability in most optimization problems. In this paper, we enhance the performance of Artificial Bee Colony (ABC) algorithm to Genetic Artificial Bee Colony (ABC) algorithm by performing genetic operation such as mutation, crossover and selection. This is applied in allocating the data in secure way in cloud application.

1. INTRODUCTION

ABC- Artificial Bee Colony (ABC) algorithm was developed by the person named Dervis Karboga in 2008. He was motivated by the intelligent behavior of honey bees.

ABC is developed based on inspecting the behavior of real bees on finding nectar and sharing the information of food source to the bees in the hive. A set of honey bees is called swarm which is used for social cooperation. The exchange of information among bees is the most important occurrence in the formation of collective knowledge. The most important part of the hive with respect to exchanging information is the dancing area. Communication among bees related to the quality of food source take place in the dancing area. This dance is called Waggle dance.

The colony of artificial bees has three groups of bees.

1. Employed bees
2. Onlooker bees
3. Scout bees

1.1 Employed Bees

The bees that are employed are called as employed bees. They have the information about the sources of the food chain. They know the exact distance and the direction of the nest. They also maintain exact profits.

Probability of selecting nectar source:

$$P_i = \frac{F(\theta_I)}{\sum_{K=1}^{S} F(\theta_K)}$$

where

P_i - probability of selecting i^{th} employed bee

S - number of employed bees

θ_i - position of i^{th} employed bee

F(θ_i) – the fitness value

1.2 Onlooker Bees

The employed bees share the information about the food source to the onlooker bees through waggle dances. It gets the information from food sources and selects one of the food sources to gather the nectar.

Movement of the onlooker:

Calculation of the new position :

$$x_{ij}(t+1) = \theta_{ij}(t) + \varphi(\theta_{ij}(t) - \theta_{kj}(t))$$

where

x_i- position of onlooker bee

t - iteration number

θ_k - randomly chose employed bee

j - dimension of the solution

φ(.) - A series of random variable in the range (-1,1)

If the position cannot be found, then that food source is abandoned.

1.3 Scout bees:

If the food sources position cannot be identified by the onlooker bees, then the scout bees discovers a new food sources.

Movement of the scout bees

$$\theta_{ij} = \theta_{jmin} + r\,(\theta_{jmax} - \theta_{jmin})$$

Where

r = A random number and r [0,1]

2. ALGORITHM

The main steps of the ABC algorithm are:

1. Initialize
2. Repeat

a) Place the employed bees on the food sources in the memory.

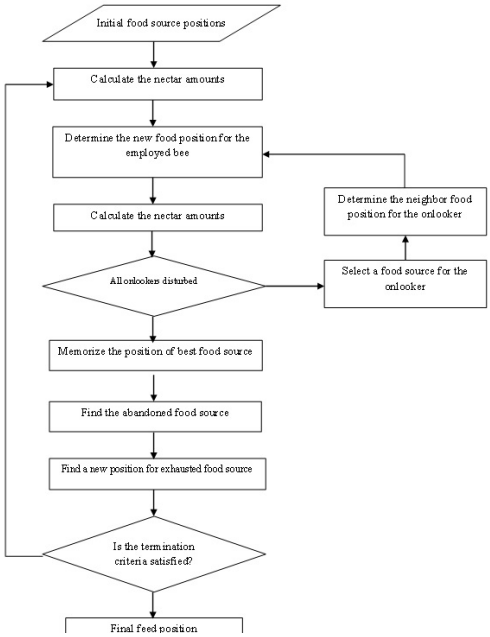
b) Place the onlooker bees on the food sources in the memory.

c) Send the scouts to search area for discovering new food sources.

3. Until(requirements are met)Three control parameters are used in basic ABC
1. The number of food sources which is equal to the number of employed bees or onlooker bees.
2. The value of limit and maximum cycle number (MCN).

The recruitment rate is measured by how quickly the bee colony finds and exploits a newly discovered food source. The survival and progress ofthe bee colony depend upon the rapid discovery and efficient utilization of best food resources.

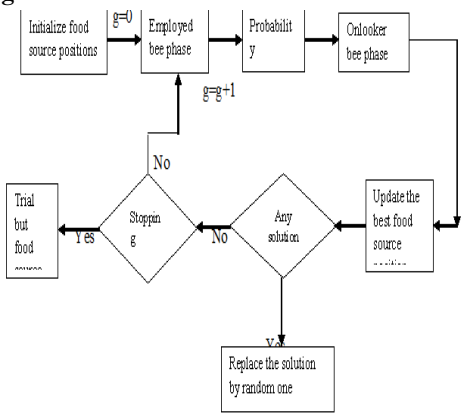
2.1 Flowchart of ABC Algorithm



2.2 Pseudo code of ABC algorithm:

1. Initialize population with random solutions.
2. Evaluate the fitness of the population.
3. While (stopping criteria not met).
4. Select sites for neighborhood search.
5. Recruit bees for selected sites and evaluate fitness.
6. Select the fittest bee from each patch.
7. Assign remaining bees to search randomly and evaluate their fitness.
8. End while.

2.3 Architecture of ABC Algorithm



2.4 ABC Algorithm:

- Send the scouts on to the initial food sources. Repeat
- Send the employed bees onto the food sources and determine their nectar amounts.
- Calculate the probability value of the sources of which they are preferred by the onlooker bees.
- Send the onlooker bees onto the food sources and determine their nectar amounts.
- Stop the exploitation process of the sources exhausted by the bees.
- Send the scouts into the search area for discovery new food sources randomly
- Memorize the best food sources found so far. Until (requirements are met)

2. GENETIC ALGORITHM

A genetic algorithm may offer significant benefits over more typical search of optimization techniques.Genetic algorithms are heuristic search algorithm based on the evolutionary ideas of natural selection and genetics.It is used to solve the optimization problem.

2.1 Based on natural selection:

After an initial populated is randomly generated,the algorithm evolves three operators

1. The selection which equates to the survival of fittest.
2. Crossover which represents waiting between individuals.
3. A mutation which introduces random modification.

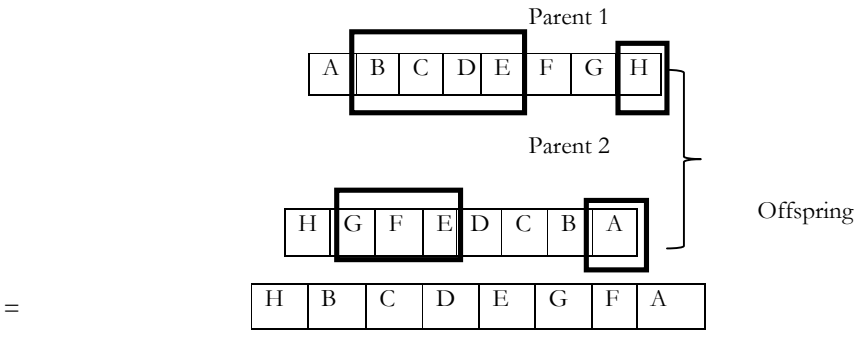
2.2 Genetic operators:

2.2.1 Selection operator

It gives preferences to better individuals, allowing to pass on their genes to the next generation.Fitness proportionate selection(SCX). The individual is selected on the basis of fitness. The probability of an individual to be selected increases with the fitness of the individual greater or less than its competitor's fitness.

2.2.2 Crossover operator:

The prime distinguished factor of CA from other optimization techniques. Two individuals are chosen from the population using selection operatorCrossover site along the bit strings is randomly chosen.The values of two strings are chosen up to this point. If S1=000000 and S2=111111 and the crossover point is 2, then S1'=110000 and S2'=001111. The two offspring created from this mating are put into the next generation of the population.By recombining portions of good individuals, this process is likely to create even better individuals.



2.2.3 Mutation operator:

With some low probability,a portion of new individual will have some of their bits flipped.Its purpose is to maintain diversity within the population and inhibit premature convergence.

Before mutation

A	B	C	D	E	F	G	H

After mutation

A	D	E	C	B	F	G	H

3 PROPOSED WORK

In our proposed work, we enhance the performance of Artificial Bee Colony(ABC) algorithm by including genetic operations like the cross over, mutation and selection. This operation enhances ABC to Genetic Artificial Colony Algorithm GABC algorithm.

Genetic Algorithm is one of the techniques which uses the natural selection mechanism.

3.1 Genetic Artificial Bee Colony Algorithm:

Initialize the food source position.

Compute the nectar amount fitness value.

- For each and every employed bee

1. Yield new source position.
2. Compute the fitness value.
3. Employ GA selection process.

- End for
- Compute the probability value. Onlooker bees
- For each and every onlooker bee

1. Choose a food source depending on probability.
2. Identify new food source position.
3. Compute the fitness value.
4. Employ GA selection process.

- End for Scout bees
- If employed bee becomes the scout, interchange it with a new random source position.

Repeat

Employed bees

4. CONCLUSION

This paper, Enhancing the Efficiency Of Artificial Bee Colony (ABC) Algorithm Using Genetic Operations improves the efficiency of searching and retrieving of data in data mining by combining genetic operations such as mutation, crossover, and selection over Artificial Bee Colony Algorithm called as Genetic Artificial Bee Colony Algorithm. In future, my proposed work can be used to retrieve the data from the cloud with high speed.

REFERENCES

[1]Tereshko, V., Lee, T.: How information mapping patterns determine foraging behavior of a honey bee colony. Open Syst. Inf. Dyn. 9, 181–193 (2002)

[2]Tereshko, V., Loengarov, A.: Collective Decision-Making in Honey Bee Foraging Dynamics. Comput. Inf. Sys. J., 9(3), 1–7 (2005)

[3]Teodorovic, D.: Transport Modeling By Multi-Agent Systems: A Swarm Intelligence Approach, Transport. Plan. Technol. 26(4), 289–312 (2003)

[4]Benatchba, K., Admane, L., Koudil, M.: Using bees to solve a data-mining problem expressed as a max-sat one, artificial intelligence, and knowledge engineering applications: a bioinspired approach. In: Proceedings of the First International Work-Conference on the Interplay Between Natural and Artificial Computation, IWINAC 2005, Las Palmas, Canary Islands, Spain, 15–18 June 2005

[5] Wedde, H.F., Farooq, M., Zhang, Y.: BeeHive: an efficient fault-tolerant routing algorithm inspired by honey bee behavior, ant colony, optimization and swarm intelligence. In: Proceedings of the 4th International Workshop, ANTS 2004, Brussels, Belgium, 5–8 September 2004

[6]Karaboga, D.: An idea based on honey bee swarm for numerical optimization. Technical ReportTR06, Erciyes University, Engineering Faculty, Computer Engineering Department, 2005

[7]D. Karaboga and B. Akay, "A survey: algorithms simulating bee swarm intelligence," Artificial Intelligence Review, 2009, pp. 61–85.

[8] D. Karaboga and B. Basturk, "A powerful and efficient algorithm for numerical function optimization: artificial bee colony (ABC) algorithm," Journal of Global Optimization, pp. 459–471, 2007.

[9]D. Karaboga, and B. Basturk, "On the performance of artificial bee colony (ABC) algorithm," Applied Soft Computing, 2008, pp. 687–697.

Author Profile

Mrs. S. Artheeswari is working as Assistant Professor in Mailam Engineering College, Mailam, Tamilnadu. She has 8 years of experience in the academic field. She completed her Bachelor of Technology(IT) in Madras University and Master of Engineering(CSE) in Anna University. Now, doing as a Research Scholar in Annamalai University in the field of Computer Science. Her area of Interest includes Cloud computing, Data Structures, Security and Database Management System. She also has life member for several association and society. She published 3 papers in in International Journals. She also published many papers in national and international conferences.

Dr. RM. Chandrasekaran is currently working as Professor, Department of Computer Science & Engineering and also jointly as Controller of Examinations for Annamalai University, Chidambaram. He obtained his Bachelor of Engineering in Computer Science and Master of Engineering from Anna University and Master of Business Administration from Annamalai University. Completed his Ph.D. in Computer Science from Annamalai University, Annamalainagar, India. He has 23 years of teaching experience and 5 years of experience in Research & Development. He also worked as a Registrar in Anna University, Trichy for 3 Years. He worked as a software consultant in the USA. He was also a Director, Directorate of Distance Education. Annamalai University. Also, he has co-organized two Workshops and two conferences. His area of interest includes Computer Algorithms, Text Data Mining, and Software Metrics. He published 10 papers in National Journal and 13 papers in International Journals. He also published many papers in national and international conferences.