Enhancing ABC with Dynamic Techniques to Optimize the Execution Time

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Abstract. This paper deals with the dynamic technique which is used in Artificial Bee Colony Algorithm to give better results. This technique is used in data optimization, so far whatever artificial Bee colony has been used in the field technology, takes more time in data optimization. Whereas when dynamic techniques are used in Artificial Bee Colony Algorithm, it takes less time for data optimization. Here using this technique to reduce the time and give a better result for optimization. This is the comparison done in this paper. In this paper, the technique is a comparison with a PSO and GA algorithm. This algorithm is best for all of them.

Keywords: Artificial Bee Colony (ABC), Particle Swarm Optimization (PSO), Genetic Algorithm (GA), Wireless Sensor Network (WSN), Glowworm Swarm Optimization (GSO), Improved Artificial Bee colony optimization-based Clustering (IABCOCT).

1. Introduction

In different mobile wireless sensor networks, data collecting is a basic process. Because they must transfer massive volumes of data, nodes near the Sink may get exhausted prematurely. In effect, the suggested data gathering technique for mobile Sinks is based on a simulated bee colony. [1]. A Wireless Sensor Network (WSN) is made up of a large number of sensor nodes that are spread out across a big region. Each sensor node has a limited amount of battery power. WSN efficiency is extended using a variety of energy-efficient Clustering techniques. The basic goal of WSN design is to have the network last as long as possible [2]. Video streaming communication networks will be a significant means of transmitting multimedia data at any time and from any location. The power consumption of LoRa nodes and the mesh

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network's real-time responsiveness are incompatible. This article uses an updated artificial bee colony method [3] to resolve this inconsistency. A multi-hop routing mechanism is utilized to transfer data in most wireless sensor networks. In large-scale WSNs, multi-hop forwarding causes energy waste and excessive transmission overhead. The suggested technique significantly reduces data transmission, saves energy, and improves the efficiency of network data collecting [4]. An improved deployment algorithm based on Artificial Bee Colonies is proposed in a publication (ABC). The ABC-based deployment ensures that a network's lifespan is extended. It operates by reducing the overall number of deployed relays and improving network characteristics. Simulations have been used to verify the efficiency of the suggested technique in various scenarios [5]. One of the key difficulties that directly affects the effectiveness of wireless sensor networks is dynamic deployment. To improve performance, an artificial bee colony algorithm is used for the dynamic deployment of mobile sensor networks. The algorithm's high performance indicates that it may be used to solve dynamic problems in such networks [6]. The major goal of this research is to keep the network's lifetime as long as possible while transmitting data efficiently. For the optimistic path, we suggested a novel swarm intelligence technology named ABC (Artificial Bee Colony). It is put to the test on five multimodal high-dimensional numerical benchmark functions [7]. Software testing is a method of assessing a software system's quality. An artificial bee colony (ABC) approach was employed to solve the problem of test data production in this article. Our technique surpasses simulated annealing, genetic algorithms, particle swarm optimization, and ant colony optimization, according to the results [8]. In a wireless sensor network, dynamic approaches can be utilized to optimize data. The dynamic approach using an artificial bee colony (ABC) algorithm can be used to optimize data [9]. Big data is a vast volume of data that is difficult for on-hand systems to process. Swarm Intelligence includes the Artificial Bee Colony algorithm. It's based on how honey bees locate food sources and may be used for Big Data analysis [10]. In this study, an Artificial Bee Colony (IABC) model is used to solve the MEP issue of finding the best shortest path. The link-level congestions scenario was proposed by Prim's algorithm. The IABC model uses a lot of energy, and there will be data congestion [11]. The primary goal of dynamic deployment in Wireless Sensor Networks is to take advantage of sensor node mobility. In this research, we include a distance factor and change the scout bee's operating mode to enhance the basic artificial bee colony method. The upgraded AI has a quicker convergence speed and a larger coverage rate, according to the results [12]. The artificial Bee Colony (ABC) algorithm is a prominent swarm-based algorithm that is based on honeybees' clever foraging activity. This work does a literature review on ABC, its variations, and data clustering applications [13]. Artificial Bee Colony (ABC) is a quick and reliable approach for solving complicated nonlinear optimization problems. When compared to other metaheuristic algorithms, ABC is more successful for high-dimensional issues. The suggested approach may be used to find quick solutions to a variety of dynamic optimization issues [14]. One of the key difficulties that directly affect the effectiveness of wireless sensor networks is dynamic deployment. To improve performance, an artificial bee colony algorithm is used for the dynamic deployment of mobile sensor networks. The algorithm's high performance indicates that it may be used to solve dynamic issues in such networks [15].

The contribution of this paper is as follows,

- ABC (Artificial Bee Colony) algorithm using the dynamic technique.
- To pick a food source, follow the general scheme of the ABC algorithm (i.e., employee bees, onlooker bees, and Scout bee’s phase).
- For searching data, implement the employee and onlooker phase in the dynamic technique.

2. Review of Literature

Khan et al [16] developed a self-organization-based clustering technique for cluster formation and maintenance based on glowworm swarm optimization (GSO). Cluster head selection and cluster formation are based on the UAVs' luciferin value and residual energy, as well as their connectivity with the ground control station.

Yan Yang et al [17] proposed a novel technique for solving numerical integration based on an artificial glowworm swarm optimization algorithm. The approach may compute the standard definite integral as well as singular and oscillatory integrals for any function. The suggested approach has a greater precision based on simulation findings.

Zainal et al [18] Glowworm Swarm Optimization (GSO) is a meta-heuristic method with no derivatives. It imitates the glowworm's behavior, which can efficiently capture all of the multimodal functionalities. There are several flaws in locating the global optimal solution.

Yu Xiuwu et al [19] To handle the Wireless sensor network (WSN) energy balancing problem, an uneven clustering routing technique based on glowworm swarm optimization for wireless sensor networks (UCRA-GSO) is developed. The simulation results demonstrate that this method efficiently extends the life cycle of the network while managing energy dissipation.

Reddy et al [20] Clustering is a good approach to provide a better route that doesn't cause any problems when transmitting data. The network will suffer from network failures and energy depletion if suitable clustering is not done. The goal of this study is to determine the best cluster head for an energy-efficient routing protocol in a WSN.

Ehsan et al [21] suggested data clustering as a means of dividing data into groups based on some measure of similarity or dissimilarity. When dealing with multi-dimensional data, many clustering techniques fail. For data clustering, researchers have presented a new fuzzy approach with enhanced discrete artificial bee colony (ID is ABC).

Farzaneh Zabihi et al [22] described clustering as a branch of unsupervised learning in which data is separated into clusters of comparable individuals. Many swarm intelligence-based algorithms have been used to effectively tackle this challenge. On nine UCI datasets and two fake datasets, the suggested approach has been tested.

Hui Wang et al [23] suggested artificial bee colony (ABC) algorithms that identify appropriate food sources using a probability strategy. This research presents a novel ABC that use a neighborhood radius-based selection mechanism. When compared to 22 benchmark issues used in trials, NSABC outperforms five other ABC algorithms.

Ke CK et al [24] Wireless sensors, as proposed, have several limits and constraints, including limited power and computer capability. The question of how to program more flexibly and quickly in response to the status of each sensor node in the network becomes critical. Wireless sensor networks are optimized using artificial bee colony methods.

Cui et al [25] presented the artificial bee colony (ABC) method for optimization issues as an efficient swarm-based meta-heuristic algorithm. However, its competitiveness has been harmed by its poor convergence pace. To make it more competitive an enhanced ABC with dynamic composition (ABCDC) has been proposed.

Famila et al [26] Clustering is an energy-efficient method of structuring a network methodically to ensure optimum load distribution and enhance network longevity. Using the Grenade Explosion Method (GEM) and the Cauchy Operator, we present an Improved Artificial Bee colony optimization based ClusTering (IABCOCT) approach in this study.

Habila Basumatary et al [27] Many IoT devices are now powered by batteries that have a limited lifespan and are installed in distant regions. A hybrid artificial bee colony method with an efficient schedule transformation is proposed in this work. The quick rise in fitness function due to the complete exploitation of superfluous information is a distinctive feature of HABCA-EST.

Lu et al [28] An enhanced artificial bee colony (ABC) algorithm with a teaching strategy is provided as a WSN coverage optimization technique. ABC excels in exploration but struggles at exploitation. In comparison to existing state-of-the-art algorithms, the suggested method achieves a better balance between global and local search.

Xingbin Zhan et al [29] presented Customers are grouped to use the same vehicle to lower overall travel costs. The dynamic problem is broken down into several tiny and continuous static sub-problems to be solved. The suggested solution method's problem characteristics and performance are illustrated utilizing large-scale real-time data from Didi.

Ren et al [30] How to maximize data, the shortest mobile path, and the network's dependability is an optimization challenge in proposed mobile wireless sensor networks (MWSNs). Based on enhanced artificial bee colony optimization, this research provides a method for accurate data gathering for mobile Sinks. It can minimize network energy consumption and boost energy consumption balance and network dependability when compared to other ways.

Dr. I. Jeena Jacob et al [31] An artificial intelligence method is used to improve the throughput of wireless multi-channel networks. This method entails three steps: creating a wireless environment-specific model, optimizing performance with the correct tools, and improving routing. When compared to existing state-of-the-art models, the nature-inspired routing method outperforms them.

Famila et al [32] By combining the benefits of Grenade Explosion with the Cauchy operator, an Improved Artificial Bee Colony Optimization-based Clustering Technique (IABCOCT) is proposed. Simulation experiments are used to investigate IABCOCT's potential. Meta-heuristic optimization techniques are found to be the most effective in aiding the selection and clustering of cluster heads.

Mann et al [33] based on an artificial bee colony metaheuristic, proposed an improved technique for optimization challenges. The suggested clustering technique has an enhanced cluster head selection criterion and an efficient cluster creation process. The suggested approach's superiority is demonstrated by a thorough study and comparison with current well-known Si-based algorithms.

Ilango et al [34] The suggested Artificial Bee Colony (ABC) technique aim to reduce execution time and choose the optimum cluster for different dataset sizes. The suggested ABC Algorithm is implemented utilizing mapper and reducer programming in the Hadoop environment. The suggested ABC scheme outperforms PSO and DE in terms of time efficiency, according to the results.

Karaboga et al [35] Clustering was mentioned as one of the most prominent approaches for routing activities. To extend the network lifetime, a novel energy-efficient clustering technique based on an artificial bee colony algorithm is given. The suggested approach's performance is compared to LEACH and particle swarm optimization algorithms.

J. Jayanth et al [36] Traditional statistical classifiers simply look at spectral variance, neglecting the spatial distribution of pixels corresponding to land cover classifications and the association between different bands, as proposed. Swarm intelligence underpins the Artificial Bee Colony (ABC) algorithm. Object identification and classification are based on the ability to define spatial differences within pictures as a way of obtaining information.

3. Algorithm for Artificial Bee Colony using Dynamic Technique:

ABC Algorithm was inspired by honey bee foraging behavior. The Honey bee swarm is one of nature's multitudes, searching for nourishment in a collective intellectual manner. The honey bee swarm possesses several characteristics, including the ability to transmit data, recall the weather, store and offer data, and make decisions based on that data. As a result, the Artificial Bee Colony calculation is often sensitive to the initial population growth, and it has a limited inquiry range. One of the key reasons for the number of occupants in various solutions for relocating the hunt space to a more fitting section is for this reason. WSN's principal concern is the organization's longevity. As a result, centers are as frequent as possible to facilitate flexibility. As much as possible gathered in bunches driven by a pioneer, sometimes known as a bundle head To address the aforementioned challenges, this study proposes a sophisticated ABC computation with a dynamic approach for transmitting information to the base station and assisting general centers in delivering detected information to target centers. With improved organization execution, the use of energy by group heads (CH) will become more visible than that of general center points.

This algorithm uses the following collection of algorithms -

1. Population Initialization of data optimization using ABC Algorithm
2. Employee Bees phase of ABC algorithm
3. Onlooker Bees phase of ABC algorithm
4. Scout Bees phase of ABC algorithm

4. Simulation Outputs and Performance Evaluation:

Figure 1 depicts the execution time, or simulation time, of the implemented suggested framework. The ABC method and a dynamic approach with varying numbers of nodes linked were used to compute the execution time. The 10th node's lowest execution time is 8.2 seconds, while the 50th node's maximum execution time is 10.2 seconds.

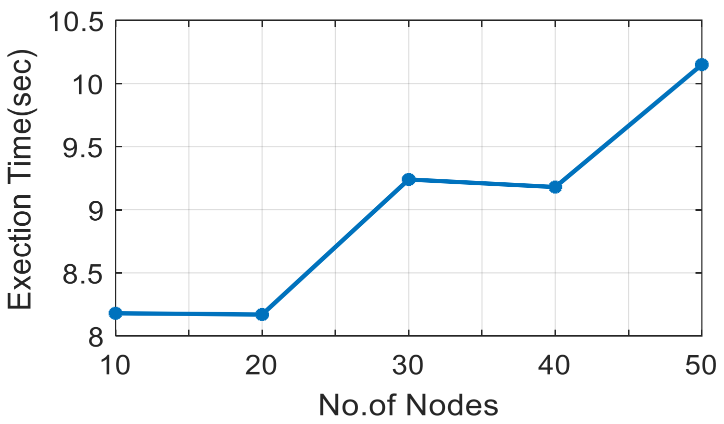

Fig.1. Execution Time (sec)

Execution Time (sec) Comparison

According to Figure 2, the simulation time of the developed suggested framework is the execution time. With a different number of nodes, the execution time was calculated. The execution time was a minimum of 10 seconds, 30 seconds less than PSO, and 29 seconds less than GA.

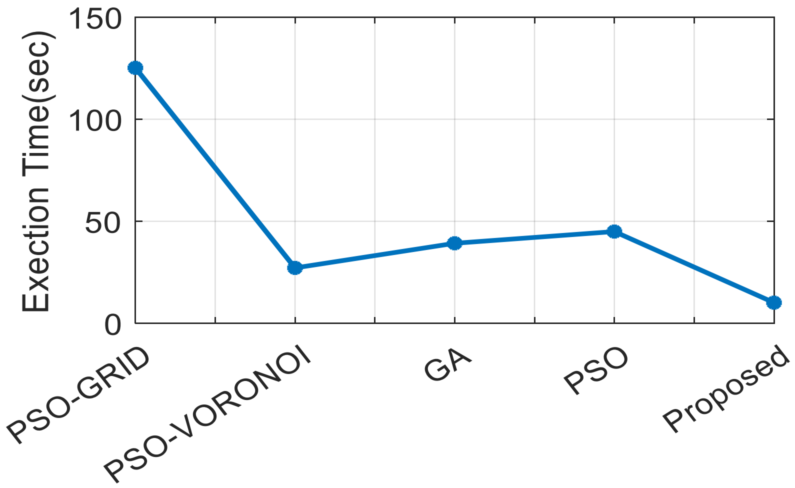

Fig.2. Execution time (sec) comparison.

5. Conclusion

The execution time is compared with a different number of nodes in this study. The suggested approach takes 10 seconds, while other algorithms such as PSO and GA take 30 and 29 seconds, respectively, which is longer than the proposed algorithm. As a result, the proposed algorithm is the best.

References

[1]. Yue,Y., Li, J., Fan, H.,Qin, Q.: Optimization-Based Artificial Bee Colony Algorithm for Data Collection in Large-Scale Mobile Wireless Sensor Networks. Journal of Sensors, vol. 2016, Article ID 7057490, 12 pages, 2016. DOI: 10.1155/2016/7057490

[2]. Shinge S.R., Sambare S.S.: Survey of different Clustering Algorithms used to Increase the Lifetime of Wireless Sensor Networks. December 2014, International Journal of Computer

[3]. Yue, Y.,Li, J.,Fan, H., Qin, Q.: Optimization-Based Artificial Bee Colony Algorithm for Data Collection in Large-Scale Mobile Wireless Sensor Networks. Journal of Sensors, vol. 2016, Article ID 7057490, 12 pages, 2016. DOI: 10.1155/2016/7057490Applications 108(10):15-18. DOI: 10.5120/18947-0031

[4]. Song, Y., Huang, L., Xu, P., Li, L.,Song, M., Long, Y.: An Improved Artificial Bee Colony Algorithm in LoRa Wireless Communication System for Efficient Multimedia Transmission. International Journal of Digital Multimedia Broadcasting, vol. 2018, Article ID 9678694, 9 pages, 2018. DOI: 10.1155/2018/9678694.

[5]. Vijayashree, R., Dhas, C. S. G.: Energy-efficient data collection with multiple mobile sinks using artificial bee colony algorithm in large-scale WSN. Automatika, 60:5, 555-563, DOI: 10.1080/00051144.2019.1666548

[6]. Hashim, H.A., Ayinde, B. O., Abido, M. A.: Optimal Placement of Relay Nodes in Wireless Sensor Network Using Artificial Bee Colony Algorithm. Volume 64, April 2016, Pages 239-248. DOI: 10.1016/j.jnca.2015.09.013

[7]. Öztürk, C., Karaboğa, D., Görkemli, B.: Artificial bee colony algorithm for dynamic deployment of wireless sensor networks. Turk J Elec Eng& Comp Sci, Vol.20, No.2, 2012, c TUB¨ ˙ ITAK, DOI: 10.3906/elk-1101-1030

[8]. Karaboga, D., Okdem, S., Ozturk C.: Cluster-based wireless sensor network routing using artificial bee colony algorithm. Wireless Netw 18, 847–860 (2012). DOI: 10.1007/s11276-012-0438-z

[9]. Dangi, M., Arora, K.: Optimistic Path using Artificial Bee Colony Approach. International Journal of Information & Computation Technology. ISSN 0974-2239 Volume 4, Number 13 (2014), pp. 1255-1261 © International Research Publications House http://www. irphouse.com

[10]. Aghdam, Z. K., Arasteh, B.: An Efficient Method to Generate Test Data for Software Structural Testing Using Artificial Bee Colony Optimization Algorithm. International Journal of Software Engineering and Knowledge Engineering Vol. 27, No. 06, pp. 951-966 (2017). DOI: 10.1142/S0218194017500358

[11]. Yang, Y., Fu, G.: Clustering Routing Algorithm in Wireless Sensor Networks Based on artificial Bee Colony and Assistant Cluster Heads. MATEC Web of Conferences Volume 22, 2015.International Conference on Engineering Technology and Application (ICETA 2015). DOI: 10.1051/matecconf/20152201021.

[12]. Shukla, S., Fadia, P.: Artificial Bee Colony Algorithm for Optimization in Data Science. © IJEDR 2018 | Volume 6, Issue 2| ISSN: 2321-9939. ww.ijedr.org.

[13]. Aravinth, S. S., Senthilkumar, J., Mohanraj, V., Suresh, Y.: An Improved Artificial Bees Colony Algorithm to Solve Minimal Exposure Problem in Wireless Sensor Networks. International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-9 Issue-1, November 2019. DOI: 10.35940/ijitee.L3552.119119.

[14]. He, P. Y., Jiang, M.Y.: Dynamic Deployment of Wireless Sensor Networks by an Improved Artificial Bee Colony Algorithm. Applied Mechanics and Materials DOI: https://doi.org/10.4028/www.scientific.net/AMM.511-512.862, (Volumes 511-512).

[15]. Kojima, M., Nakano, H., Miyauchi, A.: An Artificial Bee Colony Algorithm for solving dynamic optimization problems. 2013 IEEE Congress on Evolutionary Computation. DOI: 10.1109/CEC.2013.6557856.

[16]. Öztürk, C., Karaboğa, D., Görkemli, B.: Artificial bee colony algorithm for dynamic deployment of wireless sensor networks. Turk J Elec Eng& Comp Sci, Vol.20, No.2, 2012, c TUB¨ ˙ ITAK, DOI: 10.3906/elk-1101-1030.

[17]. Khan, A., Farooq, A., Zhongshan, Z.: Self-organization-based clustering scheme for FANETs using Glowworm Swarm Optimization. (2019). Physical Communication. 36. 100769. 10.1016/j.phycom.2019.100769.

[18]. Yang, Y, Zhou, Y.: Glowworm Swarm Optimization Algorithm for Solving Numerical Integral, Intelligent Computing and Information Science, 2011, Volume 134, ISBN: 978-3-642-18128-3.

[19]. Nurezayana, Z., Azlan, Z., Radzi, N., Udin, A.: Glowworm Swarm Optimization (GSO) Algorithm for Optimization Problems: A State-of-the-Art Review. Applied Mechanics and Materials. 421. 507-511. 10.4028/www.scientific.net/AMM.421.507. (2013).

[20]. Xiuwu, Y., Qin, Z. L., Yong, L., Mufang, H., Ke Z., Renrong, X.: Uneven clustering routing algorithm based on glowworm swarm optimization, Ad Hoc Networks, Volume 93,2019,101923, ISSN 1570-8705, https://doi.org/10.1016/j.adhoc.2019.101923.

[21]. Reddy, D., Puttamadappa, C., Suresh, H. N.: Merged glowworm swarm with ant colony optimization for energy efficient clustering and routing in Wireless Sensor Network. Pervasive and Mobile Computing. 71. 101338. 10.1016/j.pmcj.2021.101338. (2021).

[22]. Amiri, E., Dehkordi, M.N.: Dynamic data clustering by combining improved discrete artificial bee colony algorithm with fuzzy logic, International Journal of Bio-Inspired Computation 2018 12:3, 164-172.

[23]. Zabihi,F., Nasiri, B.: A Novel History-driven Artificial Bee Colony Algorithm for Data Clustering, Applied Soft Computing, Volume 71, 2018, Pages 226-241, ISSN 1568-4946, https://doi.org/10.1016/j.asoc.2018.06.013.

[24]. Wang, H., Wang, W., Xiao, S., Cui, Z., Xu, M., Zhou, X.: Improving artificial Bee colony algorithm using a new neighborhood selection mechanism, Information Sciences, Volume 527,2020, Pages 227-240, ISSN 0020-0255, https://doi.org/10.1016/j.ins.2020.03.064.

[25]. Ke, C.K.., Wu, M.Y., Hsu, W.H., Chen C.Y.: Discover the Optimal IoT Packets Routing Path of Software-Defined Network via Artificial Bee Colony Algorithm. vol 317. Springer, Cham. https://doi.org/10.1007/978-3-030-52988-8_13. (2020).

[26]. Cui, Y., Hu, W., Rahmani, A.: Improved artificial bee colony algorithm with dynamic population composition for optimization problems. Nonlinear Dyn (2021). https://doi.org/10.1007/s11071-021-06983-2

[27]. Famila, S., Jawahar, A., Sariga, A.: Improved artificial bee colony optimization-based clustering algorithm for SMART sensor environments. Peer-to-Peer Netw. Appl. 13, 1071–1079 (2020). https://doi.org/10.1007/s12083-019-00805-4

[28]. Basumatary, H., Debbarma, M.K.: Comparative Study on Different Parameters Used for Energy Conservation in Wireless Sensor Networks. IETE Technical Review 0:0 pages 1-13. (2021).

[29]. Lu, C., Li, X., Yu, W.: Sensor network sensing coverage optimization with improved artificial bee colony algorithm using teaching strategy. Computing 103, 1439–1460 (2021). https://doi.org/10.1007/s00607-021-00906-0.

[30]. Zhan, X., Szeto, W.Y., Shui, C.S., Chen, X.: A modified artificial bee colony algorithm for the dynamic ride-hailing sharing problem, Transportation Research Part E: Logistics and Transportation Review, Volume 150,2021,102124, ISSN 1366-5545, https://doi.org/10.1016/j.tre.2020.102124.

[31]. Ren, G., Wu, J., Versonnen, F.: Bee-based reliable data collection for mobile wireless sensor network. Cluster Comput 22, 9251–9260 (2019). https://doi.org/10.1007/s10586-018-2116-0.

[32]. Jacob, I. J., Darney, P.E.: Artificial Bee Colony Optimization Algorithm for Enhancing Routing in Wireless Networks, Journal of Artificial Intelligence and Capsule Networks (2021), Vol.03/ No.01, https://doi.org/10.36548/jaicn.2021.1.006.

[33]. Famila, S., Jawahar, A.: Improved Artificial Bee Colony Optimization-Based Clustering Technique for WSNs. Wireless Pers Commun 110, 2195–2212 (2020). https://doi.org/10.1007/s11277-019-06837-6.

[34]. Mann, P.S., Singh, S.: Artificial bee colony metaheuristic for energy-efficient clustering and routing in wireless sensor networks. Soft Comput 21, 6699–6712 (2017). https://doi.org/10.1007/s00500-016-2220-0.

[35]. Ilango, S.S., Vimal, S., Kaliappan, M.: Optimization using Artificial Bee Colony based clustering approach for big data. Cluster Comput 22, 12169–12177 (2019). https://doi.org/10.1007/s10586-017-1571-3.

[36]. Karaboga, D., Okdem, S., Ozturk C.: Cluster based wireless sensor network routing using artificial bee colony algorithm. Wireless Netw 18, 847–860 (2012). https://doi.org/10.1007/s11276-012-0438-z.

[37]. Jayanth, J., Koliwad, S., Kumar, T.S.: Classification of remote sensed data using Artificial Bee Colony algorithm, The Egyptian Journal of Remote Sensing and Space Science, Volume 18, Issue 1,2015, Pages 119-126, ISSN 1110-9823, https://doi.org/10.1016/j.ejrs.2015.03.001.