ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 2.114

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

A HONEY BEE SWARM INTELLIGENCE ALGORITHM FOR COMMUNICATION NETWORKS

Prof. Amol V. Zade*, Dr. R. M. Tugnayat
Head, Department of CSE, DESCOET Amravati, India
Principal, Shankarprasad Agnihotri College of Engineering, Wardha, India

ABSTRACT

A particular intelligent behavior of a honey bee swarm, foraging behavior, is considered and a new artificial bee colony algorithm simulating this behavior of real honey bees for solving multidimensional and multimodal optimization problems. A new optimization algorithm based on the intelligent behavior of honey bee swarm has been described. The proposed algorithm can be used for solving Traveling salesman problem and other applications. The proposed research work combines the energy awareness and efficiency with the Swarm Intelligence (SI) optimization to determine on-demand optimal path between a certain source-destination pair. Bee Colony Optimization (BCO) model is a new general purpose Swarm Intelligence optimization technique based on efficient labor employment and efficient energy consumption through a multi-agent distributed model. BCO model has adopted mainly two natural behaviors from the social bees' life: The mating process behavior and the foraging process behavior.

KEYWORDS: Swarm Intelligence; Foraging; Bees; TSP.

INTRODUCTION

Swarm intelligence has become a research interest to many research scientists of related fields in recent years. The swarm intelligence as "any attempt to design algorithms or distributed problem-solving devices inspired by the collective behavior of social insect colonies and other animal societies" [1]. Bonabeau et al. focused their viewpoint on social insects alone such as termites, bees, wasps as well as other different ant species. However, the term swarm is used in a general manner to refer to any restrained collection of interacting agents or individuals.

Behavior of Honey Bee Swarm:

The minimal model of forage selection that leads to the emergence of collective intelligence of honey bee swarms consists of three essential components: food sources, employed foragers and unemployed foragers and the model defines two leading modes of the behavior: the recruitment to a nectar source and the abandonment of a source. **i) Food Sources:** The value of a food source depends on many factors such as its proximity to the nest, its richness or concentration of its energy, and the ease of extracting this energy. For the sake of simplicity, the "profitability" of a food source can be represented with a single quantity [8].

ii) Employed foragers: They are associated with a particular food source which they are currently exploiting or are "employed" at. They carry with them information about this particular source, its distance and direction from the nest, the profitability of the source and share this information with a certain probability.

iii) Unemployed foragers: They are continually at look out for a food source to exploit. There are two types of unemployed foragers: scouts, searching the environment surrounding the nest for new food sources and onlookers waiting in the nest and establishing a food source through the information shared by employed foragers. 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 sources takes place in the dancing area. This dance is called a waggle dance.

There is a greater probability of onlookers choosing more profitable sources since more information is circulated about the more profitable sources. Employed foragers share their information with a probability proportional to the profitability of the food source, and the sharing of this information through waggle dancing is longer in duration. After locating the food source, the bee utilizes its own

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 2.114

capability to memorize the location and then immediately starts exploiting it. Hence, the bee will become an “employed forager”. The foraging bee takes a load of nectar from the source and returns to the hive and unloads the nectar to a food store. After unloading the food, the bee has the following three options:

i) It becomes an uncommitted follower after abandoning the food source.
ii) It dances and then recruits nest mates before returning to the same food source.
iii) It continues to forage at the food source without recruiting other bees.

The experiments confirmed that new bees begin foraging at a rate proportional to the difference between the eventual total number of bees and the number of present foraging.

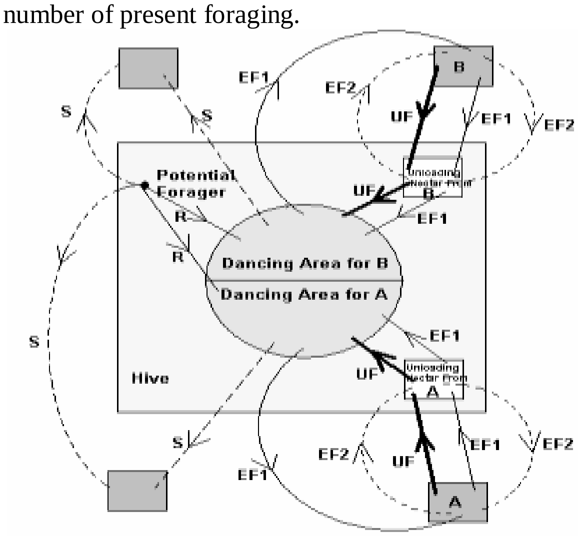

Fig. 1: Behavior of honey bee foraging near nectar.

The basic properties on which self organization relies are as follows:

i) **Positive feedback:** As the nectar amount of food sources increases, the number of onlookers visiting them increases, too.

ii) **Negative feedback:** The exploration process of a food source abandoned by bees is stopped.

iii) **Fluctuations:** The scouts carry out a random search process for discovering new food sources.

iv) **Multiple interactions:** Bees share their information about food source positions with their nest mates on the dance area.

LITERATURE REVIEW

Ahmet Karaarslan [1] explained experimental studies shows that the Bee Colony Optimization control method is a robust technique and is compatible with the standards. Described optimization algorithm depends on modeling the natural behavior of real honey bees. Shyh-Jier Huang et al. [2] proposed an enhanced honey-bee mating optimization algorithm to solve the fault section estimation problems. This proposed method outperforms other methods by avoiding premature convergence and, hence, is considered very effective for fault section estimation applications and is suitable for real-world applications.

Nikola Todorovic and Sanja Petrovic [3] introduced a novel bee colony optimization algorithm for nurse rostering problems. Proposed algorithm provides intelligent reduction of the search neighborhood in which the moves that are not expected to improve the current solution are discarded. Zulfiqar Ali et al. [4] analyzed the Swarm Intelligence based paradigms, PSO, ACO and Honeybees, nature inspired routing algorithms in MANETs and WSNs. SI based routing algorithms are more promising for specific nature of Ad hoc & Sensor Networks due to the freely mobility and frequent topology changes, also Swarm Intelligence based routing protocols are more promising for Ad hoc & Sensor networks. Kit Yan Chan et al. [5] presents an innovative algorithm integrated with particle swarm optimization and artificial neural networks to develop short-term traffic flow predictors, which are intended to provide traffic flow forecasting information for traffic management in order to reduce traffic congestion and improve mobility of transportation.

Roy Friedman and Anna Shulman [6] presented a couple of novel protocols for pub/sub in mobile ad hoc networks, namely LCDD-Pub/Sub and LDDD-Pub/Sub. The proposed protocols are built on top of the density-driven virtual topography substrate. P. visu et al. [7] proposed the CSI-RP protocol which utilizes both ABC and ACO and reduces time in UDP. In CSI-RP throughput increased around 3% and hence it’s an efficient routing protocol. Luca Caputo et al. [8] proposed a auto-configuration algorithm for wireless ad-hoc networks, *AutoBeeConf* inspired from natural systems provide a sufficient motivation for designing and developing algorithms for scheduling and routing problems as well as for auto-configuration. Francesco Sambo et al. [9] proposed a Mixed Optimization for Reverse Engineering (MORE), a mixed discrete and continuous optimization algorithm for the problem of fitting a sparse system of nonlinear differential equations to biological time series. MORE significantly outperforms a state-of-the-art continuous optimization algorithm in terms of

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 2.114

accuracy of the results. Moreover, the designed feedback strategies between the two optimization layers are proven effective in significantly reducing the computation time. Adamu Murtala Zungeru et al. [10] proposed a protocol which is promising in terms of energy efficiency. Surveys the state-of-the-art routing protocols in WSNs from classical routing protocols to swarm intelligence based protocols.

PROPOSED METHODOLOGY

In this work, a particular intelligent behaviour of a honey bee swarm, foraging behaviour, is considered and a new artificial bee colony (ABC) algorithm simulating this behaviour of real honey bees is described for solving multidimensional and multimodal optimisation problems.

In the model, the colony of artificial bees consists of three groups of bees: employed bees, onlookers and scouts. The first half of the colony consists of the employed artificial bees and the second half includes the onlookers. For every food source, there is only one employed bee. In other words, the number of employed bees is equal to the number of food sources around the hive. The employed bee whose food source has been exhausted by the bees becomes a scout.

Send the scouts onto 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 with which they are preferred by the
onlooker bees
Stop the exploitation process of the sources abandoned by the bees
Send the scouts into the search area for discovering new food sources, randomly
Memorize the best food source found so far
UNTIL (requirements are met)

A honeybee colony has many features that are desirable in networks:

• *E*fficient allocation of foraging force to multiple food sources;
• *D*ifferent types of foragers for each commodity;
• *F*oragers evaluate the quality of food sources visited and then recruit the optimum number of foragers for their food source by dancing on a dance floor inside the hive;
• *N*o central control;
• *F*oragers try to optimize the energetic efficiency of nectar collection and make decisions without any global knowledge of the environment.

THE BEE'S ALGORITHM

The Bees Algorithm models the foraging behavior of honey bees. A bee colony uses a small part of its population continually to scout the environment for new food sources.

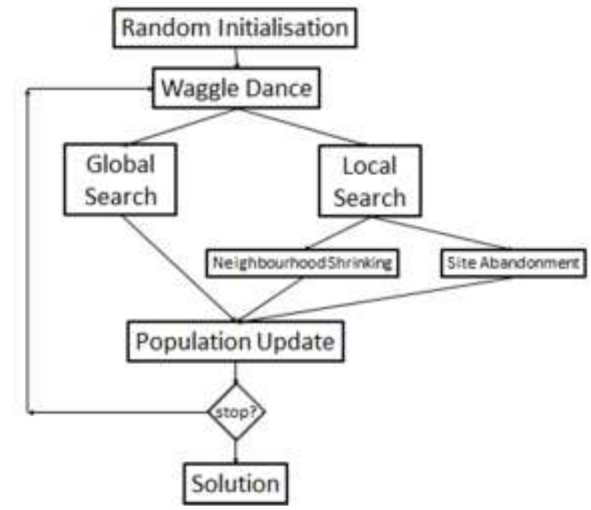

Fig. 2: Flowchart of Bee's Algorithm

In the Bees Algorithm the agent population is divided into a small number of 'scouts' and a larger set of 'foragers'. The scouts randomly sample the solution space, and evaluate the fitness of the visited flower patches (i.e. locations). The foragers sample the neighborhood of known good sites (fit solutions) looking for further fitness improvement.

The Travelling Salesman Problem (TSP):

The TSP is considered a standard test-bed for evaluation of new algorithmic ideas for discrete optimization; indeed, good performance for TSP is considered reasonable proof of an algorithm's usefulness. The TSP is the problem of a salesman who wants to find the shortest possible trip through a set of cities on his tour of duty, visiting each and every city exactly once.

CONCLUSION

The major focus of research is to design and develop cost-efficient bio/nature inspired business solutions for highly competitive markets. Therefore, the development of a nature-inspired routing algorithm must follow a feedback-oriented engineering approach. The most important challenge, therefore, is to identify a natural system of which the working principles could be appropriately abstracted for deriving suitable principles to work in a given technical system. Instead of adding numerous non-biological features to a natural system, we believe that it is more advisable to look to other natural systems for inspiration. In our case we chose honeybee colonies because the foraging behavior of bees could be transformed into different types of agents performing different routing tasks in telecommunication networks.

REFERENCES

[1] Ahmet Karaarslan, "The Implementation of Bee Colony Optimization Algorithm to Sheppard-Taylor PFC Converter", IEEE TRANSACTIONS ON INDUSTRIAL ELECTRONICS, VOL. 60, NO. 9, ISSN: 0278-0046, pp. 3711-3719, SEPTEMBER 2013.

[2] Shyh-Jier Huang, Xian-Zong Liu, Wei-Fu Su, Ting-Chia Ou, "Application of Enhanced Honey-Bee Mating Optimization Algorithm to Fault Section Estimation in Power Systems", IEEE TRANSACTIONS ON POWER DELIVERY, VOL. 28, NO. 3, ISSN: 0885-8977, pp.1944-1951, JULY 2013.

[3] Nikola Todorovic and Sanja Petrovic, "Bee Colony Optimization Algorithm for Nurse Rostering", IEEE TRANSACTIONS ON SYSTEMS, MAN, AND CYBERNETICS: SYSTEMS, VOL. 43, NO. 2, ISSN: 2168-2216, pp. 467-473, MARCH 2013.

[4] Zulfiqar Ali, Waseem Shahzad, "Analysis of Routing Protocols in AD HOC and Sensor Wireless Networks Based on Swarm Intelligence", International Journal of Networks and Communications, 3(1): pp 1-11, March 2013.

[5] Kit Yan Chan, Tharam Dillon, Elizabeth Chang, Jaipal Singh, "Prediction of Short-Term Traffic Variables Using Intelligent Swarm-Based Neural Networks", IEEE TRANSACTIONS ON CONTROL SYSTEMS TECHNOLOGY, VOL. 21, NO. 1, ISSN: 1063-6536, pp. 263-274, JANUARY 2013.

[6] P.Visu, E. Kannan, "Combined Swarm Intelligence Routing Protocol for MANET", International Journal of Information Technology, 12(4): pp. 791-797, ISSN 1812-5638, 2013.

[7] Luca Caputo, Cristiano Davino, Filomena de Santis,Vincenzo Ferri, "A swarm intelligence algorithm for MANET administration", International Journal of Advanced Research in Artificial Intelligence, Vol. 2, No. 2,pp. 53-60, 2013.

[8] Roy Friedman, Anna Kaplun Shulman, "A density-driven publish subscribe service for mobile ad-hoc networks", ELSEVIER: AD HOC NETWORKS 11 (2013), pp. 522–540, ISSN: 1570-8705, September 2012

[9] Francesco Sambo, Marco A. Montes de Oca, Barbara Di Camillo, Gianna Toffolo, and Thomas Stutzle, "MORE: Mixed Optimization for Reverse Engineering—An Application to Modeling Biological Networks Response via Sparse Systems of Nonlinear Differential Equations", IEEE/ACM TRANSACTIONS ON COMPUTATIONAL BIOLOGY AND BIOINFORMATICS, Issue: 5, pp. 1459 – 1471, ISSN :1545-5963, Volume:9,April 2012.

[10] Adamu Murtala Zungeru, Li-Minn Ang, Kah Phooi Seng, "Classical and swarm intelligence based routing protocols for wireless sensor networks: A survey and comparison", ELSEVIER JOURNAL OF NETWORK AND COMPUTER APPLICATIONS, ISSN: 1084-8045, pp.1508-1536, March 2012.

[11] Dervis KARABOGA, "AN IDEA BASED ON HONEY BEE SWARM FOR NUMERICAL OPTIMIZATION", TECHNICAL REPORT-TR06, Erciyes University, Engineering, Kayseri, OCTOBER, 2005.

[12] Farook M., "Bee-inspired protocol engineering from Nature to Networks", Springer, pp. 1-18, ISBN: 978-3-540-85953-6, 2009.

[13] V. Tereshko and A. Loengarov, "Collective Decision-Making in Honey Bee Foraging Dynamics," Journal of Computing and Information Systems, vol. 9, no. 3, pp. 1-7, 2005.