Journal of Advanced Research in Microelectronics and VLSI
Volume 7, Issue 1 - 2024, Pg. No. 1-4
Peer Reviewed Journal

Research Article

A Hybrid Metaheuristic Based Approach for Solving Optimization Problem

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How to cite this article:
Kaur A. Ahybrid Metaheuristic Based Approach for Solving Optimization Problem. J Adv Res Microelec VLSI 2024; 7(1): 1-4.

Date of Submission: 2024-02-17
Date of Acceptance: 2024-03-23

A B S T R A C T

The ant colony optimization is a technique which is used in order to find path from the graph with optimality. The ant colony optimization (ACO) found its application in the area of operation research. In addition, there also exists honey bee optimization algorithm. Travelling Salesman Problem (TSP) is about finding a Hamiltonian path with minimum cost. The problem with ACO is that the shortest path is located by moving through region of other paths. Also, they move in shorter distances only. The Honey bee on the other hand can move in any direction and cover more distances also. In the proposed technique collaboration of Honey bee and ACO techniques are made to form hybrid approach to improve the effectiveness of load balancing and cloud scheduling to solve the problem of travelling salesman problem. The proposed technique will take into consideration advantages of both the techniques to form hybrid approach. The simulation is conducted in MATLAB and it suggests optimal result as comparison to individual ant colony and honey bee algorithm.

Keywords: Ant Colony · Honey Bee · Optimization Problem · Shortest Distance · Hybrid · Mat Lab

Introduction

The ant colony optimization strategy is used in order to locate path from within the graph which is optimal in nature. The optimal path is located by moving through the number of other paths. The Travelling salesman problem is a NP (non-deterministic polynomial time) hard problem because any algorithm for solving it can be translated into one to solve NP problem. a salesman is given a graph of set of cities along with travelling distances (or costs) from one city to another city. The ant colony optimization algorithm (ACO) is a probabilistic technique for solving computational problems which can be reduced to finding good paths through graphs. The overall process become slow as path consideration could be the problem when number of edges within the graph is more. (Xhafa et al. 2011) The overall process is slower as compared to the Honey bee optimization approach. The ant colony optimization will be represented through the fig 1 (Blum 2012) The ant colony optimization is based on genetic approach. The steps utilized in the ant colony optimization will be listed as follows

Generate solution

The initial solution is given in order to start the simulation. The solution generation process is iteratively generated for further simulation.

Updating solution

Series of calculations are performed as the new edge between the nodes within the graph is detected. This is accomplished with the help of daemon processed in simulation.

Trail Update

$$T_{XY} = (1-p) * T_{xy} + \sum \Delta T_{xy}^{k}$$

(Abdulal et al. 2012) When all the ants update the solutions then trail updates are made. These updates are made by considering the following equation

$$T_{xy} = (1-p) * T_{xy} + \sum \Delta T_{xy}^{k}$$

The solution within the simulation will be generated by the use of edge selection equation. The equation will be listed as follows

$$p_{xy} = \frac{(T_{xy})^{\alpha}(n_{xy})^{\beta}}{\Sigma(T_{xz})^{\alpha} * (n_{xy})^{\beta}}$$

The ant colony optimization is not optimal algorithm if the distance is large. In order to resolve the problem honey bee optimization algorithm comes into existence.

(Bandyopadhyay and Bhattacharya 2013) The honey bee algorithm is the extension of the ant colony optimization problem in which ants are allowed to move in any direction and larger distances can be covered. The honey bee optimization is shown through the fig 2. The honey bee approach is used in order to speed up the process of path determination from within the graph. The precision is however lost when honey bee algorithm is used.

(Jourdan, Basseur, and Talbi 2009) The simulation starts from the single queen with no family to the development of colonies having queen with families. The selection and generation process has certain fitness function associated with it. The generation in this case is fast since honey bees can move in any direction and at any distance. Maximum of 14 Km will be covered by the use of Honey Bee Algorithm.

The proposed technique utilizes the advantages offered by both the algorithms and form hybrid approach.

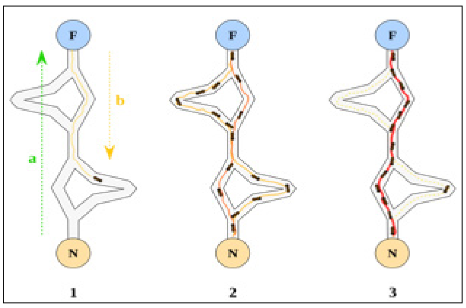


Figure 1.Showing the ant colony optimization process

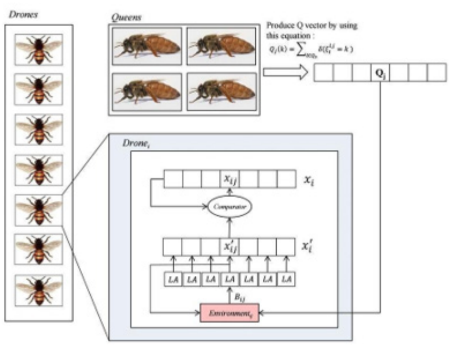


Figure 2.Showing the Honey Bee optimization

Related Work

The work has been done toward the ant colony and Honey bee algorithms. (Umale and Mahajan 2010) Both of these algorithms are used as a optimization approach in the process of job scheduling and operation research. (Maruthanayagam and UmaRani 2010) The enhanced ant colony optimization in case of grid computing is proposed in this case. The grid computing contains number of machines of different structures and configurations. With the help of ant colony optimal path from source to destination is going to be detected. (Alobaedy and Ku-Mahamud 2014) Metaheuristics algorithms

explain very fine performance in solving different job scheduling problems in computational grid system. However, due to the difficulty and diverse nature of resources in grid computing, stand- alone algorithm is not able to discover a high- quality solution in realistic time. This study propose a hybrid algorithm, specially ant colony and genetic algorithm to resolve the job scheduling problem. The high level hybridization algorithm will maintain the individuality of each algorithm in performing the scheduling job. The study focus on static grid computing environment and the metrics for optimization are the make span and flow time. Testing results illustrate that the proposed algorithm outperforms other stand-alone algorithms such as ant system, genetic algorithms and ant colony system for make span. However, for flowtime, ant system and genetic algorithm perform better. (Wang and Zeng 2010) The computational surroundings are very suit to assemble the computational demands of large various groups of tasks and the task scheduling difficulty in it has been a research hotspot in recent years. (Sharma, Chhabra, and Sharma 2015) Some heuristic methods have been used to optimize it and have got good results. However, select the best one to use in a given environment leftovers a complex problem, because comparison is frequently clouded by dissimilar underlying assumption in the unique study of each algorithm. A few comparisons have been made to them, but a few new algorithms are not integrated in the comparisons. So, four popular research algorithms recently are chosen, implemented, and analyzed. The four heuristics are Genetic Algorithm, Ant Colony Optimization Algorithm, Particle Swarm Optimization Algorithm and Simulated Annealing Algorithm. The evaluations consist of the schedule creating time, the make span and the mean response time. It shows that on behalf of the cases studied here, the PSO heuristic perform improved in contrast to the other technique.

Proposed System

(Kaur 2015; Qureshi et al. 2014) The proposed system utilizes the advantages of both theant colony and honey bee approach to form a hybrid approach. (Sonawane and Ragha 2014; Suguna and Sharmila 2013) The proposed algorithm utilizes the precision of ant colony and speed of honey bee to enhance the existing approach. The task of honey bee is to find the maximum possible resources and ant colony optimization will be used to find the path towards the searched resources. The algorithm describing the proposed technique wills e as follows

Algorithm Hybrid

Generate the initial population size to n, denote the patch size to m, set the prescribed tolerance to e, select the ants who are going to operate on the selected re-sources,

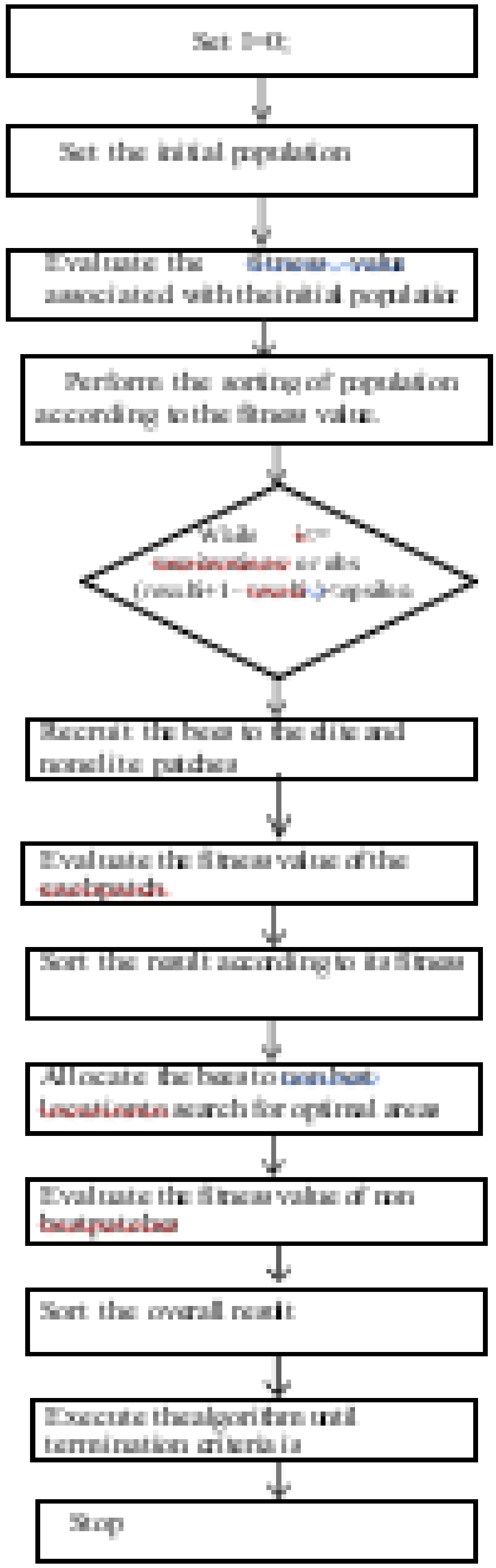
Specifythe size of the neighborhood, Specify the maximum number of iterations

1. Set i=0
2. Set the initial population
3. Evaluate the fitness value related with the initial population
4. Perform the sorting of population according to the fitness value.
5. While i<=maxiterations or abs(result$_{i+1}$-result$_i$) <epsilonI=i+1 Select the elite and non elite patches for neighborhood selection Recruit the bees to the elite and non-elite patches Evaluate the fitness value of each patch Sort the result according to its fitness Allocate the bees to non-best location to search for optimal areas Evaluate the fitness value of non-best patches Sort the overall result Execute the algorithm until termination criteria is satisfied
6. Stop

Table 1.Showing the parameter list to be utilized in the proposed work

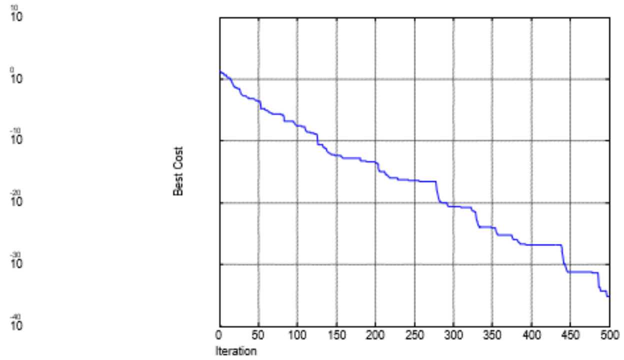
Parameter	Symbols
Number of scout bees in the selected patches	*n*
Number of best patches in the selected patches	*m*
Number of elite patches in the selected best patches	*e*
Number of recruited bees in the elite patches	*nep*
Number of recruited bees in the non-elite best patches	*nsp*
The size of neighborhood for each patch	*ngh*
Number of iterations	*Maxiter*
Difference between value of the first and last iterations	*diff*

Flow Chart



Result and Simulation

The simulation is conducted in the MATLAB and results are observed. The results of hybrid approach is considered to be better as compared to the existing approach. The result is as listed below



Conclusion and Future Work

The hybrid approach utilizes the precision value of the ant colony optimization and honey bee approach. The ant colony optimization locates the path from within the multipath availability within the graph. The process is slow in nature. The honey bee on the other hand will utilize the longer distances to locate the optimal patches. The speed of operation is also faster. The proposed technique utilizes the precision of Ant colony algorithm and speed of Honey bee algorithm. The approach formed is optimal in nature. The precision of the algorithm can be further enhanced by the use of GAwith minimum population towards the non best patches.

References

1. Abdulal, Wael, Ahmad Jabas, S. Ramachandram, and Omar Al Jadaan.: Task Scheduling in Grid Environment Using Simulated Annealing and Genetic Algorithm, pp. 1-10. Springer (2012)
2. Alobaedy, Mustafa Muwafak and Ku Ruhana Ku-Mahamud.: Scheduling Jobs in Computational Grid Using Hybrid ACS and GA Approach, Proceesings - 2014 IEEE
3. Computers, Communications and IT Apllications Conference, ComComAp 2014 223- 28.
4. Bandyopadhyay, Susmita and Ranjan Bhattacharya.: On Some Aspects of Nature- Based Algorithms to Solve Multi-Objective Problems, Studies in Computational Intelligence 2013 427:477–524.
5. Blum, Christian.: Hybrid Metaheuristics in Combinatorial Optimization: A Tutorial, Lecture Notes in Computer Science 2012(including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics) 7505 LNCS(6):1–10. Retrieved (http://dx.doi.org/10.1016/j.asoc.2011.02.032).
6. Jourdan, L., M. Basseur, and E. G. Talbi.: Hybridizing Exact Methods and Metaheuristics: A Taxonomy, 2009 European Journal of Operational Research 199(3):620–29. Retrieved (http://dx.doi.org/10.1016/j.ejor.2007.07.035).
7. Kaur, Japinder.:Evolutionary Heuristic for Job Scheduling Using Grid Computing, 2015, 120(15):22–24.
8. Maruthanayagam, D. and R. UmaRani.: Enhanced Ant Colony Algorithm for Grid Scheduling, International Journal of Computer Technology and Applications 20101(1):43–53.
9. Qureshi, Muhammad Bilal.: Survey on Grid Resource Allocation Mechanisms,Journal of Grid Computing 2014 ,12(2):399–441.
10. Sharma, Shyna, Amit Chhabra, and Sandeep Sharma.: Comparative Analysis of Scheduling Algorithms for Grid Computing, 2015, 349–54.
11. Sonawane, P. A. and L. Ragha.:Hybrid Genetic Algorithm and TABU Search Algorithm to Solve Class Time Table Scheduling Problem, International Journal of Research Studies in Computer Science and Engineering (IJRSCSE) 2014, 1(4):19–26.
12. uguna, R. and D. Sharmila.:An Efficient Web Recommendation System Using Collaborative Filtering and Pattern Discovery Algorithms, International Journal of Computer Applications2013(http://research.ijcaonline.org/volume70/number3/pxc3887755.pdf).
13. Umale, Jayant and Sunita Mahajan.:Optimized Grid Scheduling Using Two Level Decision Algorithm (TLDA),2010 First International Conference On Parallel, Distributed and Grid Computing (PDGC 2010) 78–82. Retrieved (http://ieeexplore.ieee.org/lpdocs/epic03/wrapper.htm?arnumber=5679602).
14. Wang, Meihong and Wenhua Zeng.:A Comparison of Four Popular Heuristics for Task Scheduling Problem in Computational Grid, 2010 6th International Conference on Wireless Communications, Networking and Mobile Computing, WiCOM 2010 3–6.
15. Xhafa, Fatos.:Evaluation of Hybridization of GA and TS Algorithms for Independent Batch Scheduling in Computational Grids, Proceedings - 2011 International Conference on P2P, Parallel, Grid, Cloud and Internet Computing, 3PGCIC 2011 148–55.