ENHANCED BEE COLONY ALGORITHM FOR SOLVING TRAVELLING SALESPERSON PROBLEM

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ABSTRACT

Bee colony optimization is newly emerged Swarm intelligence technique. Bee colony algorithm is based on the foraging behaviour of natural bees to solve complex problems. In this paper we introduce enhanced bee algorithm for TSP which is non-deterministic polynomial-time (NP)-hard combinatorial optimization problem. Proposed enhanced bee colony algorithm uses Self Organizing Map as initialization technique and performs K-Means, than enhanced bee algorithm is implemented to obtain the final global tour.

KEYWORDS

Travelling Salesperson Problem, Combinatorial Optimization, Bee Colony Algorithm, K-Means Clustering, Self Organizing Map.

1. INTRODUCTION

Swarm based metaheuristic has become motivation to many research scientists in recent years. Bonabeau has defined the swarm intelligence as "any attempt to design algorithms or distributed problem-solving devices inspired by the collective behaviour of social insect colonies and other animal societies" [1]. Swarm algorithm mimics the social, self-organizing behaviour of species such as ant, bees, termites etc. Bee algorithm is a swarm intelligence technique which is based on foraging behaviour of honey bees. The foraging behaviour in a bee colony remains mysterious for many years until von Frisch translated the language embedded in bee waggle dances [2]. Bee colony algorithm tries to adapt food foraging behaviour of real bees. Bees use several mode of communication like waggle dance to optimally locate food sources and to search new food sources. Various metaheuristic algorithms have been used to solve the combinatorial problem. These combinatorial problems are difficult to solve because of their large dimension and difficulty of decomposing them into small sub problems. The Travelling salesman problem (TSP) [3] is a well-known non-deterministic polynomial-time (NP)-hard problem in combinatorial optimization. In TSP a salesman find the minimum cost to traverse all cities in a way that it visits every city exactly once and at end returns back to the starting city. Cost of traversing is directly proportional to the distance between two cities. Various metaheuristic such as Genetic Algorithm (GA) [4], Ant Colony Optimization (ACO) [5], Particle Swarm Optimization (PSO) [6] or Bee Colony Optimization (BCO)[7] were applied to solve TSP. In this paper we propose enhanced Bee Algorithm for TSP, using self organizing map as initialization technique with K-means to cluster cities than applying Bee Algorithm.

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2. REVIEW OF EXISTING WORK

Bee colony algorithm is influenced by the foraging behaviour of bees as they possess good capability for searching and exploring food sources. Foraging behaviour of bee is the based on the way of their communication, which is known as waggle dance. Dance performance conveys the information about food source to other bees on the hive. Bee algorithm has been used in many fields. Lucic and Teodorovic (2001) [8], proposed the bee system based on the collective intelligence of bee for finding the food source. This aims to solve various combinatorial problems and was tested for travelling sales person problem. Lucic and Teodorovic in [9] (2003) proposed the model the bee system and Fuzzy Logic which was applied on vehicle routing problem. Chin Soon Chong[10](2006)proposed bee colony optimization algorithm to job shop scheduling the experimental results show Bee algorithm achieves better mean and maximum percentages as well higher number of best solutions. Li-Pie Wong[7](2008) presented solution for travelling salesman problem using bee colony optimization involving evaluation of probability using arc fitness and the distance between the cities i and j respectively as the parameters. Waggle dance is used as the communication tool among bees. The dance duration of the bee is evaluated on the scaling factor, profitability score of a bee and average profitability bee colony.

3. PROPOSED METHODOLOGY

In our proposed approach we are clustering data into different cluster to reduce the number of computational complexities, using self organizing map as an initialization technique with K-means. Bee colony algorithm is applied on individual cluster. We reinforce the best tour on the basis of duration of waggle dance performed by the bees. Local routing tables are maintained to store the optimum sequence generated in each cluster. In the global tour the all cities are traversed on the basis of the local bee routing table, then using the proposed connection method to combine all clusters to form global tour.

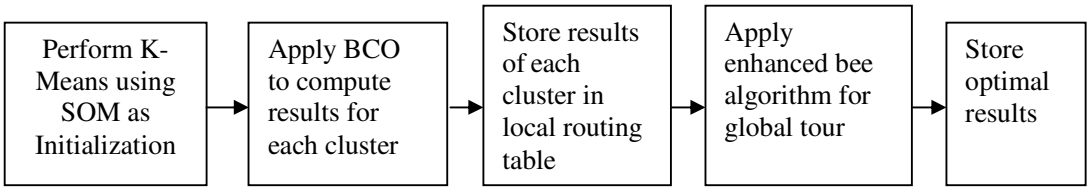

Figure 1. Block diagram of proposed methodology

3.1. Proposed Algorithm

SOM as initialization perform K-means

```
for (c=1;c<=n;c++)//n is the maximum number of clusters
{
        for(i=1;i<=m;i++)// m is the number of scout  bees
        {
        Observe Waggle dance

        Compute the transition probability for moving to next city on the basis of observed
        dance;
```

```
                For each bee perform waggle dance;
                }
}
```

Reinforce the best tour on the basis of duration of waggle dance.

Best tour for each cluster is stored in the local routing table.

```
//Global tour
Initialize Bee
Update the bee memory.

for(c=1;c<=n-1;c++)
{
                if(current city!=(p-1)th city // p is maximum number of cities in a cluster
                {
                Bee moves according to bee local routing table.
                }
                else
                {
                Bee moves to next cluster on the basis of minimum distance
                }
}
for (cluster number = n)
                {
                Reserve city=min (distance to initial node)
                Traverses cities by reading bee local routing table
                }
Visit initial city

Print the shortest path.
```

4. RESULT

Proposed enhanced bee algorithm has been analyzed by applying them of the benchmark problem taken from TSP library. The numbers of bee equal to number of cities. The parameter setting used in the experiment are $\alpha = 1$, $\beta = 10$, $\lambda = .096$, K=0.1*BC max, BCmax =10000.

Table1: Table showing the comparison of TSP path length

Problem Instances	Optimal	BeeColony Optimization[7] Best	Average	Bee System[2]	Proposed Algorithm Best	Average
EIL51	426	428	429.62	431.121	426	426.59
EIL76	538	539	548.81	n/a	538	539.62
KROA100	21282	21762	22011.97	21441	21282	21307

Enhanced Bee colony when applied to 57 cities gives the following results

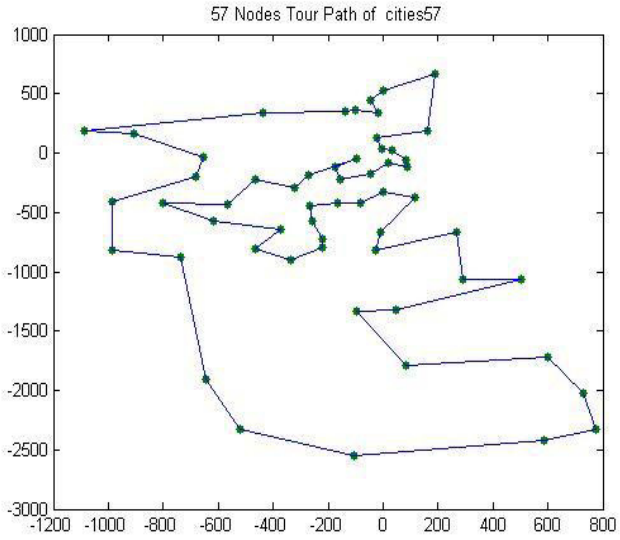

Figure 2.Plot showing Traditional Bee Colony

Path length of Traditional Bee Colony 14042.

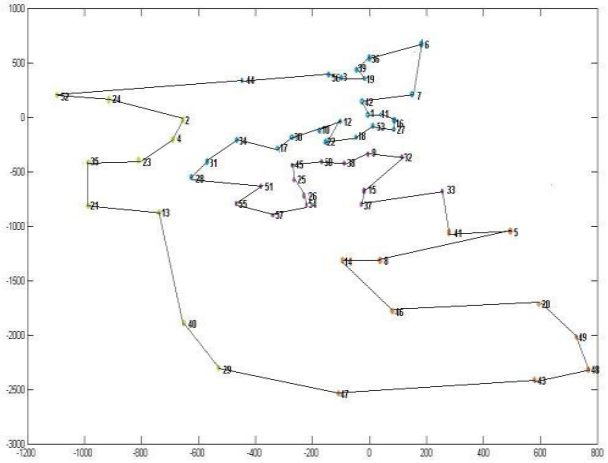

Figure 3. Plot showing Enhanced Bee Colony

Path length of Enhanced Bee Colony 13762

5. CONCLUSION

Results shown above concludes that enhance bee colony optimization has reduced cost and enhanced performance for solving TSP problem. We can use different clustering technique to find better solution and enhance the efficiency.

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