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Optimized Geographic Routing in Mobile Ad Hoc Network using Bees Swarm Optimization

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Higher mobility, dynamic topology and scalability are considered as major challenges while performing routing in Mobile ad hoc network (MANET). These challenges remain true if the techniques works on increasing the lifetime of the network. In addition, geographic routing fails to perform an effective routing procedure between the sources and sink nodes with network lifetime as its constraints. The methods on optimal coverage and resource optimization fail to perform in proving its effective routing procedures. Hence, in order to improve the network lifetime with proper resource optimization, the study uses Bees Swarm Optimization (BSO) with Geographic Routing Procedure (GRP). The optimized GRP is generated by the BSO that helps the entire network to perform effective routing that suitably optimizes the resources. The simulation is conducted to check the efficiency of the proposed work, where the network metrics like energy consumption and delay is measured between the proposed and other works.

Keywords: BSO, MANET, Network Lifetime, Routing

Introduction

Today, new trend lies in the MANET research is to conserve the energy with improved routing quality.[1–3] Various geographical protocols are designed[4–8] in sensor network, however most of the system fails in providing effective routing due to its reduced network lifetime with increased energy consumption during the design of geographic routing. The major contribution of the study is to find the routes in MANET effectively using geographic routing with reduced delay. To improve the process of geographic routing, the proposed system uses BSO algorithm.

Experimental Details

Proposed Method

The proposed method uses three different kinds of bees for finding the effective routing based on the available resource in MANET. The main process of the proposed system is dealt below:

1. Once the fitness function is estimated for all the bees, the proposed method uses experienced forager bee for identification of neighbourhood nodes using distance metric.
2. Scout bee is used for the selection of energy efficient route using fitness function estimated on a sensor node.
3. Onlookers bee is used to increase the resource based optimised routing.

Bees Swarm Optimization

Bee Swarm Optimization (BSO) is a novel method based on foraging behaviours of honey bee swarms. The BSO uses different bee types to optimize the numerical formulations. Each bee type has its own mobilization pattern. For instance, scout bees move in nearby range in random motion. The onlooker bees move towards the elite bee, which is the experienced employed bee. The onlooker bees finds the optimal experienced employed bee and move towards it for finding the optimal solution[9] and adjust its position.

Algorithm of BSO for Geographical Routing

The challenges that the geographic routing undergoing in the MANET is explained below:

1 The major concern in geographic routing is the improvement over the network lifetime.

2 The geographic routing using sensor nodes requires essential positional update at regular instance with its adjacent neighbour to acquire efficient routing.

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3 The position update strategy is required to be implemented in geographic routing for regulating the position updates in a dynamic manner that achieves the node mobility in a dynamic manner.

In this study, we use BSO algorithm (Fig. 1) to improve the GRP that provides effective routing path. The BSO finds the highly efficient nodes in an optimal manner. The nodes are identified initially by GRP and BSO checks whether the node is fit for carrying out the packets in long run.

The process of BSO with GRP is explained in the following algorithm.

Step 1: Initially, the parameters are initialized and then the bees are initialized.

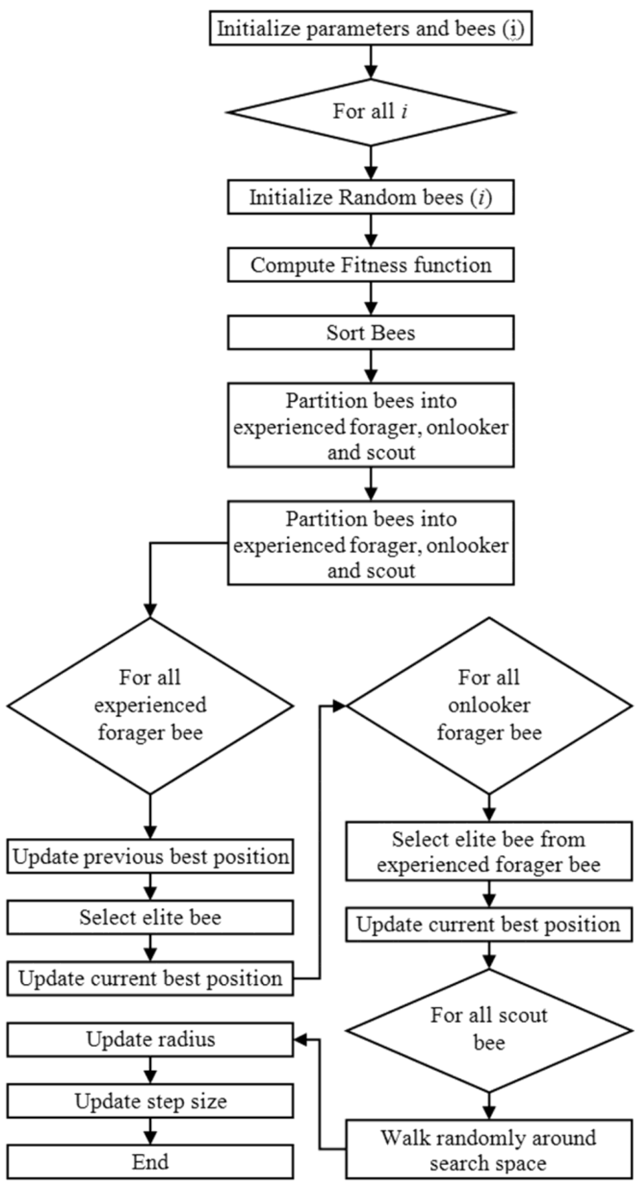

Fig. 1 — Proposed BSO for routing

Step 2: After initialization, the bees are randomly deployed over the search space.

Step 3: The fitness function is then estimated for finding the optimal route where distance between the nodes is taken as the metric.

Step 4: After the estimation of fitness values, the bees are sorted based on the results and then the bees are partitioned into forager bee, scout bee and onlooker bee.

Step 5: The forager bee finds the neighborhood optimal node for routing using distance metric and updates the location of node.

Step 6: Then the scout bee is iterated to find the efficient path based on the optimal node selection by the forager bee.

Step 7: Finally, the onlooker checks for the available resource in the optimal path and if the resource is available then the path is established and made available for packet transmission.

On other hand, if the resources like node energy and node transmission range is not matching the optimal values, then forager bee is initiated in finding the other sensor node for route establishment.

Initialize experienced foragers, scouts bee, onlookers bee, dimension of search space, number of bees, radius

While *i* = 1: *N*
For all the bees
Initialize the bees randomly **Do**
Compute fitness function
Sort bees using fitness function
Partition the swarm into experienced forager, onlooker and scout
End
For all the experienced forager bees
For D-dimensional space
Update the previous best position
Select elite bee for experienced forager bees
For D-dimensional space
Update the onlooker bee position
End
Update the experienced forager bee position
End
End
For each onlooker bee
Select an elite bee from experienced forager bee
For D-dimensional space
Update the onlooker bee position
End
End
For each scout bee

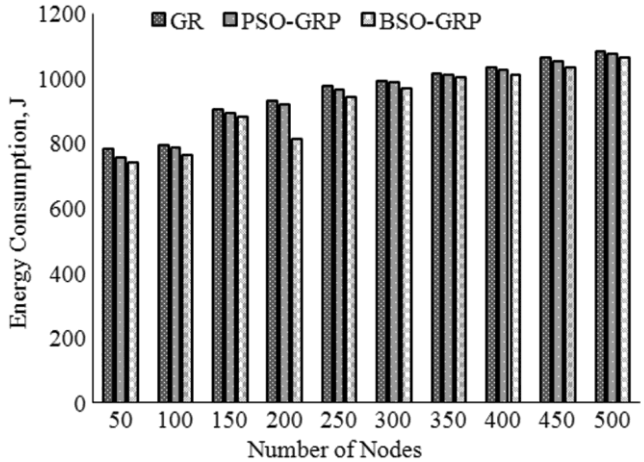

Fig. 2 — Energy consumption

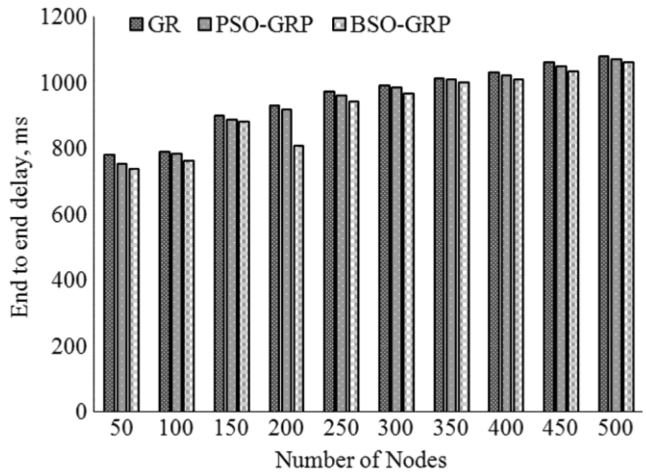

Fig. 3 — End-to-end delay

For D-dimensional space
Walk randomly on search space
End
End
Adjust radius and step size for scout bees
End until termination is met

Results and Discussion

The proposed method is tested against existing methods in terms of energy consumption, delay and network lifetime. The results are shown in Figs 2, 3 and Table 1, respectively for Energy consumption, End-to-end delay and Network Lifetime. The proposed method is compared with existing methods like a benchmark Geographical Routing (GR) method and Particle Swarm Optimization (PSO-GRP).

The result of Figs 2, 3 and Table 1 shows that the proposed method attains reduced energy consumption, reduced delay and increased network lifetime marginally than the existing methods.

Table 1 — Network Lifetime

Number of nodes	GR	PSO-GRP	BSO-GRP
50	65.31	68.34	71.22
100	68.28	70.75	73.54
150	69.55	72.34	75.55
200	72.14	75.35	79.65
250	75.41	79.67	82.14
300	79.24	82.34	84.66
350	81.66	85.78	87.95
400	85.00	90.56	89.21
450	89.33	93.34	91.22
500	91.02	95.65	95.44

Conclusions

In this paper, the GRP in MANET is improved using the optimization carried out by BSO algorithm. The bees swarm effectively finds the optimal nodes that were selected previously by GRP for routing. BSO uses experienced forager, onlooker and scout bees to find the nodes based on its location, energy and transmission range. The nodes selected by the BSO among the GRP selected nodes are used for routing. The results show that the proposed method attains improved network lifetime, increased scalability to prove its efficiency than existing methods. The result shows that the proposed method achieves reduced energy consumption, minimum delay and increased packet delivery ratio.

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