

Bees' approach simulation for the topology management in the mobile ad hoc network using the NetLogo Simulator

Salim Bitam

DASCoNet Research Team,
Mohamed Khider University of Biskra, Algeria

Mohamed Chawki Batouche

Lire Laboratory,
Mentouri Brothers University of Constantine, Algeria

Yacine Bouslimani

Engineering Faculty, University of Moncton, Canada
bousliy@umoncton.ca

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Presentation plan

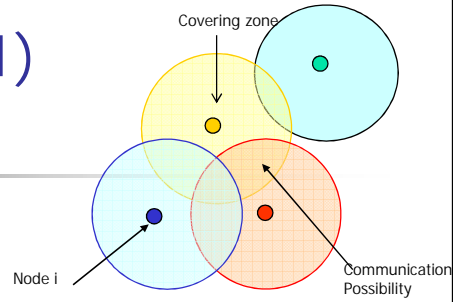
1. Introduction
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3. Bees' approach: our contribution
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Introduction (1)




- (MANETS): Mobile Ad Hoc Networks.
- Design on self organization and adaptive techniques of the MANETS problems.
-  The importance of the MANETS: to communicate in delicate situations.

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Introduction (2)

- Problematic: Topology management in MANETS. (manage other nodes, links and their organization) 

How each node can manage the topology of the whole network starting from local information?

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Overview of topology management problem in the MANETs (1)

- A network topology is a definition of the network architecture. It gives certain provisions of the various nodes (components) of the network and an organization of these nodes.
- Moreover, the mobile ad-hoc network topology is as different and more dynamic than that in mode infrastructure. This is due to the **mobility** and the **capacity** of the network components and the **connectivity nature**. In ad-hoc mode, the components are wireless connected the ones to the others, in order to constitute a peer-to-peer network.

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Overview of topology management problem in the MANETs (2)

- However, the topology of mobile ad-hoc networks can possibly have a very sparse connectivity, and is subject to continuous changes due to node mobility. In such environment, it can be very difficult to perform functions like routing or search, and therefore some algorithms try to perform *topology management*.
- The goal of topology management is to coordinate the sleep transitions of all the nodes, while ensuring that data can be forwarded efficiently to the data sink.

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Bees' approach: our contribution



- Objective: Our approach has as an objective the definition, for each node, the MANET architecture. We obtain at the end and for each node, a **better collection of information** concerned the architecture of the whole MANET which might be useful for other functions such as the routing, search, discovery, monitoring, collective computation...etc.

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Description of « Bees' approach » (1)




- We inspire this approach from a natural and biological phenomenon; it is the: **"bees' communication"**.
- Karl Von Frisch, an Austrian scientist (1886-1982) had discovered in 1919 the bees' communication in dances format. There are two types of dances : **Round dance** and **Wagging dance**.

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Description of « Bees' approach » (2)


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- **Round dance** (the source is in a radius of 100 meters):
 - The bee describes a circle, finds itself with its starting point, makes half-turn and takes again the same movement in the opposite direction. The other bees observe the dance and find that food is located at less than 100 meters (distance). They do not have any indication on its direction.

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Description of « Bees' approach » (3)

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- **Wagging dance** (the source is beyond 100 meters):
 - The bee is directed in comparing to the sun direction. It describes thus an eight scheme. When it traverses the straight line it agitates its abdomen to the right and to the left, it wags.
 - The distance which separates the source of food from the hive is calculated and transmitted including the speed of the bee dance; the more food is near the more movements are fast and light. The bee carries out on average 40 turns per minute if the indicate distance 100 meters, 24 turns if they are 500 meters. For the long distances (being able to go up to 11 km approximately), the dance becomes very slow and the oscillations of the abdomen are more prolonged.

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Description of « Bees' approach » (5)



- For the others: To find the food direction, the bee achieves its dance in comparing to the vertical ray so that the angle of its axis with the vertical ray is the same one as the angle of food relating to the sun in the plane horizon. The direction of the sun is thus represented by the vertical, sight upwards; and the angle formed between the direction of the food with that of the sun is compared to this ascending vertical.

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Projection in the topology management for the MANETs (1)



- ***If the discovery is close (lower than a definite threshold):***
- The transmitter diffuses the *distance* which separates it from the discovery, but no information concerning the *direction* is transmitted. In this case, we mention the profit of energy because there is no operation of direction calculating. Moreover, if it is necessary to apply a function such as the routing, the node must disseminate information. Thus, as the discovery is close, then there is not great energy consumption.

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Projection in the topology management for the MANETs (2)

- ***If the discovery is beyond the definite threshold:***
- The transmitting node diffuses the *distance* which separates it from the discovery. For the *direction*, we propose that each node has a ***compass***, which replaces the sun in the bees phenomenon. The transmitter diffuses the angle between the north (find by the compass) and the direction of the discovery. The receiving nodes calculate –in their own positions - the angle between the north and the direction of the discovery.

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Simulation and results (1)

- We have implemented Bees' approach in NetLogo simulator version 3.1.3 (Wilensky, 1999).
- For the simulation, we have used a simulation area of 1200×1200 units. 🐝
- We choose the threshold equal to 10 units.
- We employed 100 mobile nodes (1 hundred bees). We let the mobile nodes moved in random direction.
- In each movement, the node makes one step (one unit) during 100 iterations (the number maximum of steps carried out by mobile node).

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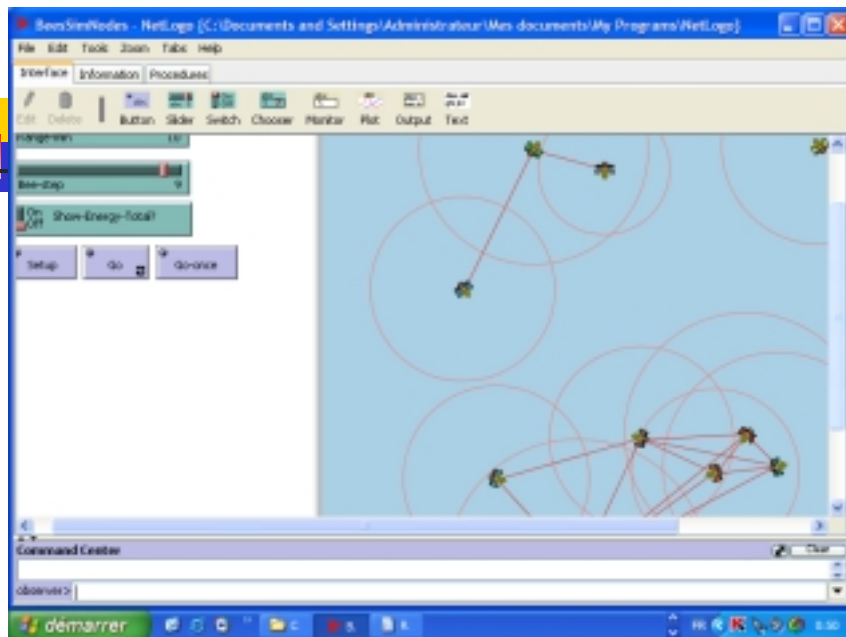
Simulation and results (2)

- We consider the variability of the covering zone radius of each node. For this, for each node, the **covering zone rayon** = **threshold_min** + **random_value** (between 0 and 15) specified by the experimenters.
- The following results are reached after 10 tests. The main goal of this simulation is to prove the connections possibility between the different nodes in direct or in indirect manner.

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The medium value of the covering zone rayon for nodes	The average rate of connection between a node compared to the others	Direct connections	Indirect connections
10	10 %	100 %	0 %
20	90 %	84 %	16 %
25	<u>100%</u>	85 %	15 %

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Simulation and results (3)

- We remark for covering zone rayon which is equal to: 10 units, a node can know only 10% of the network nodes and all these connections are direct (it knows only the nodes which are in its range).
- For a covering zone rayon that is equal to: 20 units, a node can know 90% of the network nodes, but 84% of the known connections are direct and 16% are indirect (these last are out of the range of the node). For covering zone rayon of: 25 units, a node can know **100%** of the network nodes. 85% of the known connections are direct and 15% are indirect.

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Conclusion

- We concluded that our approach helps to the topology management, even in the cases of distant nodes (which do not have a covering zone in intersection). 🌟
- For the medium value of the covering zone concerned node 'i' (**micro-level**) = 25 units, it is possible to know information 100 % about distance and direction for the other nodes: this is the network topology management (**macro-level**).

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Thank you very much

Salim BITAM 🌟
(From ALGERIA)
salimbitam@yahoo.fr



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