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

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Abstract:

The extraordinary evolution of the communication systems required a convergence towards tools of communication more modern, sophisticated, flexible, reliable and less expensive. In this way, the mobile ad hoc networks were quickly developed. This type of networks is very important for the applications which require a possible installation in any situation, a communication speed, a minimal consumption of energy and a very high safety.

Consequently, we define a mobile ad hoc network as a set of wireless mobile devices self-organize into a network without relaying on fixed infrastructure or central control. All nodes are equal, they can join and leave the network at any time, and can serve to route data for each other in a multi-hop fashion [Roy99].

One of the major problems in the mobile ad hoc network is the topology management (architecture and localization of network nodes).

This problem is relatively complex because the mobile ad hoc network is characterized by the mobility of nodes, their heterogeneity, the absence of a fixed infrastructure and a central administration. To resolve the topology management problem, we are proposed a new approach called Bees' approach inspired from the communication between bees [Bit06].

In this paper, we propose a simulation of this approach using the NetLogo simulator (version 3.1.3) [Wil99].

We start, on the one hand, by the input data which are a mobile ad hoc network. It is formed of a number of mobile and heterogeneous nodes but without any supervisory node (all nodes are equal in point of view service and responsibility). Between nodes exists wireless connections. A Node is in direct connection with another node, if this last is in the covering zone of the first node (it is in its range).

Our goal, on the other hand (the output data), is to obtain, for each node and in real time, a global view the network topology.

In other words, each node must know on its level the topology of the whole network (the destination and direction towards all the others nodes - the angle formed with the vertical and the node discovered).

We consider that each node carries out the Bees' approach on its level. This enables him to know information (distance and direction) concerning the nodes which are in its range (direct knowledge). It also allows him, to know information concerning of nodes out of its range but by the intermediary of a nodes in its range (indirect knowledge).

To represent the role of the vertical we propose a compass in the level of each node. To simulate this phenomenon and to make sure that each node will possess the whole vision of the topology (information of the other nodes - distances and directions -), we use the NetLogo simulator.

If node will possess only a of topology information of the network, we seek under which conditions it can obtain the totality of topology information (covering zone rayon, average number of nodes compared to the experimentation surface etc). We use 100 nodes, in a experimentation surface of 1200 × 1200 units. The nodes move in the surface in a random way with a step of one (1) unit.

We simulate during 100 iterations (each node can move 100 steps us maximum). We consider the variability of the covering zone rayon for any node, but we ensure a minimal threshold (between 10 units).

Thus, for each node 'i' :

the covering zone rayon = threshold_min + random_value (between 0 and 15).

After 10 tests, we obtained the following average results:

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	**100%**	85 %	15 %

We notice 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.

We concluded that our approach helps to the topology discovered, even in the cases of distant nodes (which do not have a covering zone in intersection).

Key words:

Bees' Communication, mobile ad hoc network, topology management, NetLogo, Self-organization, Emergence.