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Endurance Based AntNet Algorithm for Efficiency Enhancement Network

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Abstract: ***Routing algorithm is essential for every network to get the performance and reliability, hence there is a requirement for designing an algorithm with the understanding and adjustment of parameters for the delivery of network packet from source to destination. This algorithm presents a new value of parameters called endurance based AntNet. The objective of the algorithm is to get best routes between the source node and the network nodes during a certain period of time. The parameterswhich will affect the performance of the proposed routing algorithms are: endurance cost, number of nodes and number of Ants. The experimental setup demonstrates the proposed Endurance Based AntNet is best in minimizing the endurance cost, number of iterations and number of Ants in comparison to the defaultvalues of AntNet.***

Keywords: QAP, JSP

I. INTRODUCTION

The main motive behind the use of ant algorithm is that it is used to simulate indirect coordination to make it in a coordinated way. Initially, the ants select any path randomly because of absence of pheromone trail on any of the paths. However, the ant chooses that path which has shorter path distance with abundant amount of pheromone on that path. The path which is followed by ants is the optimal path. Ants deposit a liquid called pheromone for creating path from food source to nest. By sensing pheromone trails, the path to food is discovered by ants whichis followed by the other ants. Shortest routes have high availability of pheromone which becomes a best path for other ants to move on. This behavior shows a coordinated approach and unsupervised learning. As more and more number of ants traverses on shorter path, it further gives rise to increase in amount of pheromone deposition on that path, ultimately, with respect to time this results in abundant pheromone deposition on optimal path which ants follow.

II. CHARACTERISTICS OF AntNET ALGORITHM

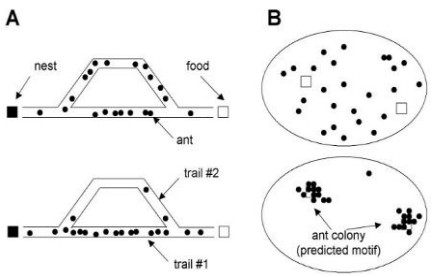
Following are the characteristics of ant algorithm:

- **Natural algorithm** since it is based on the behavior of real ants in establishing paths from their colony to source of food and back.
- **Parallel and distributed** since it concerns a population of agents moving simultaneously, independently and without a supervisor.
- **Cooperative**Each ant agent traverses a path on basis of information, pheromone trails deposited by the other agents.
- **Versatile**This algorithm can be applied to a number of similar applications of the same type.
- **Robust** This algorithm can be well applied to other combinatorial optimization problems with minimal or no changes such as quadratic assignment problem (QAP) and the job-shop scheduling problem (JSP).

Benefits of changing the parameters

- Diminishing computation time, which guaranties possibility of exploring new routes.
- Preservingnew and efficient routes, reducing the size of problem being searched, (for a pre-determined time slot) and pacifying the explorations of more routes.

This allows to cover the changes in dynamic road traffic.



- Discovering the derogated good route enforces fast recovery to obtain better routs.
- The adopted performance measures for evaluating the proposedmodified algorithm with the traditional AntNet are:
- The average travel time per simulation period for each node
- The average travel time at each simulation minute for allnodes.

Description of AntNet algorithm

The AntNet algorithm, makes use of two types of software agents, namely

- forward ants
- backward ants.

A forward ant gathers information regarding the state of the network, moving from a source to a destination. Whereas a backward ant manipulatesthis information to update the routing tables of every node while moving in the backward direction from destination node to source node.

Forward-Ant Algorithm:

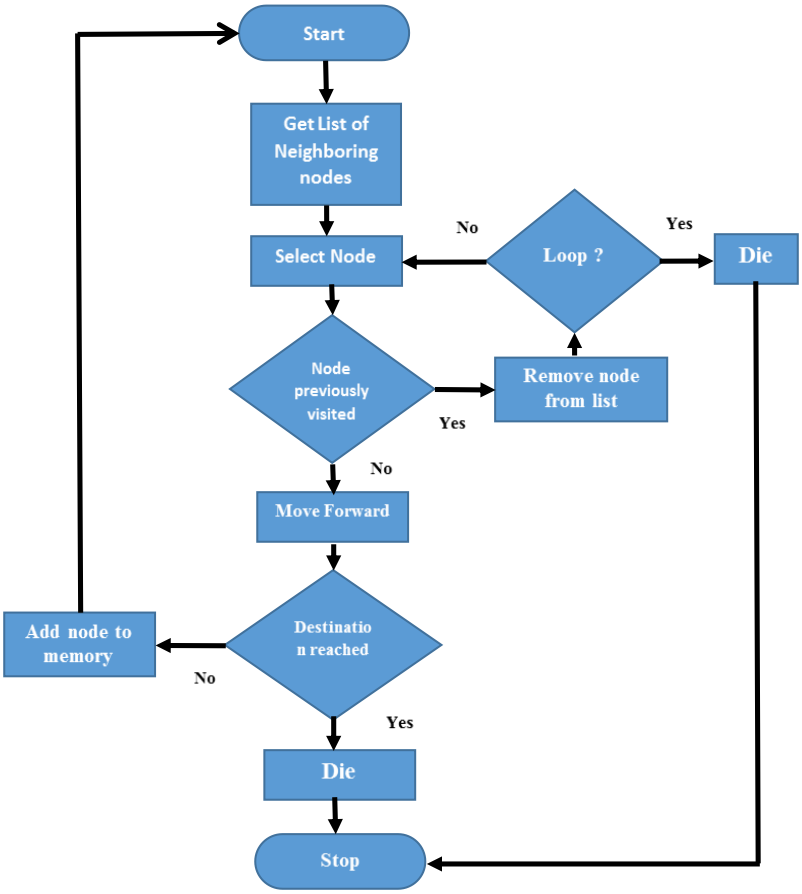
The pseudo –code for Forward-Ant is illustrated below:

Algorithm 1: AntNet- Forward-Ant
Input (source node, destination node)
Output (become a backward-ant)
Begin
Initialize data;
Q ← source node; //Q= current node
For i = 1 to n do; //n = number of ant
For j = 1 to m do; //m = number of nodes
Setting all ants memory to false;
// memory ant is empty
Endfor,
Endfor;
For i = 1 to n do;
Assign ants to a random initial city;
Endfor
V ← Q; // V = list of visited node
While (Q destination node);
x ← select next node;
// x = number of neigh-bors
Q ← x;
If (Q V) do
// check if ant is in a loop and remove it
Cycle ← get cycle length (Q, V);
Forward-ant ← Forward-ant – cycle length;
Else
Forward-ant ← Forward-ant +1;
V ← Q;
EndIf
EndWhile
Generate a Backward-ant (V, R);
// R = routing table
End Procedure

Backword- Ant Algorithms:

The pseudo –code for backword-Ant is illustrated below:
Algorithm 2: AntNet- Backward-ant (V, R)
Input (V, R)
Output (updates R, update traffic model M_i, update phero-
mone matrix T_i)
Begin
Q← destination node;
Backward-ant ←Forward-ant;
While (Q source node);
Backward-ant ← backward-ant **-1**;
x ← v[backward-ant];
go to next node;

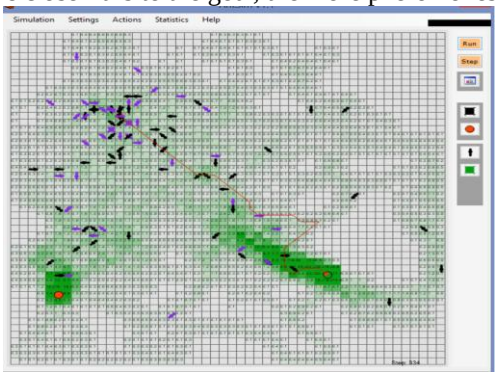
$Q \leftarrow x$;
For i = backward ant +1 **do // update all paths**
Update traffic model M_i;
$\mu_{id} \leftarrow \mu_{id} + \eta\ (o_{i \to d} - \mu_{id})$;
$\sigma^2_{id} \leftarrow \sigma^2_{id} + \eta((o_{i \to d} - \mu_{id})^2 - \sigma^2_{id})$;
get reinforcement *(r);*
update pheromone table*;*
P'id←Pid + r.(1-Pid)
update routing table;
EndFor
EndWhile
EndProcedure



The Ant Sim v1.0 application

AntSim 1.0,has been developed in VB by nightlab. Itrequires the .net framework. In this application, the ants will move very quickly and as soon as they discover the food, a solution is analyzed. There is an evaluation of the path, which does not exist in our implementation, and which the antsare not capable of.

The application has been released in January 2007 and is famous for its settings capability and the statistics provided while the ants are moving. The original ants-based algorithm has been fully implemented. However, it has been noticed that one niceimprovement would be to vary the amount of pheromones that an ant let on its way, according to its proximitywith the nest or the food. The closer it is to the goal, the more pheromones it should let.



This way and with the help of the evaporation process, the amount of pheromones will be more valuable and will give more information.

The Simulation of Original AntNet

The first step in simulating original AntNet execution is started by selecting Original method (default values in text box). When this selection is made for a certain test network, the source and destination nodes must be assigned in their text boxes. A certain parameter must be entered numerically like No. of nodes, No. of Ants, pheromone factor, pheromone function, max pheromone/field, max ant/field, statistics record interval to construct optimum path between source and destination.

Simulation of Endurance Based AntNet

The simulation program is designed and implemented to test the endurance based antnet algorithm and to compare its performance with the standard AntSim Net.

The objective of the algorithm is to get best routes between the source node and the network nodes during a certain period of time.

The simulation data is generated by initializing a source to destination time table. The table contains information about the travel times 1000 ms (1ms / movement of ant) between each node in the network and its neighbors.

Table 1

S.no.	Endurance	Total Food Solution	Avg Solution length
1	80	5	59.4
2	110	9	53.77
3	140	11	66.81
4	170	11	61.7
5	200	13	71.15
6	230	31	71.19
7	260	35	79.85
8	290	44	66.84
9	320	65	70.44
10	350	44	77.69
11	380	39	91.46
12	410	53	89.79
13	440	57	93.68
14	470	52	81.84
15	500	74	86.56

In Table 1 we can see that on gradually increasing endurance by 30 each we observe that the total food solution increases.

which shows that maximum ant agents are touching the routers. It is also observed that the average solution length is fluctuating from a plus to a minus.

The original antnet actually takes 300 endurance as the base. In this work we have tried to take all possible endurance values from very small to a higher one taking a difference of 30 between each. We observed that taking 330 as a base rather than 300 is more advantageous. It is because values like total food solution gradually increases meaning interaction between source and network nodes increases . In addition to this 330 is the average of all in column 2.

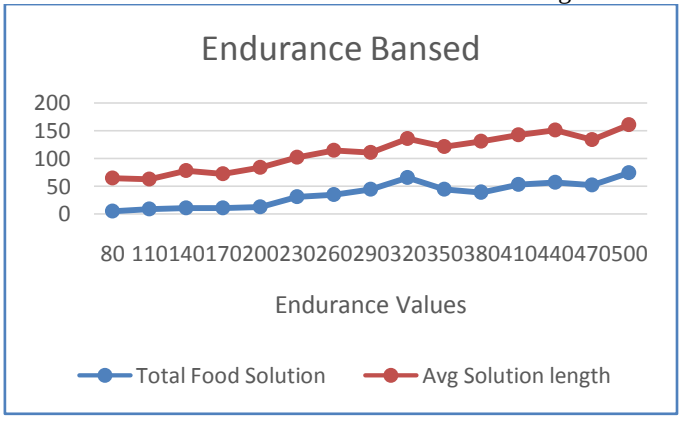


Table 2

	Original AntNet	Endurance based AntNet	Endurance based AntNet (with Decreased pheromone)
Ants/Steps (1000ms)	Avg Solution length	Avg Solution length	Avg Solution length
1	92.171	80.9642	68.127
2	67.085	64.034	55.577
3	56.601	56.273	49.4102
4	52.069	51.952	47.415
5	49.604	49.03	46.299
6	48.302	47.654	45.216
7	47.34	46.537	44.677
8	46.941	45.548	44.298
9	46.076	44.934	43.944
10	45.574	44.543	43.591

In table 2 we have taken four column namely

1. Ant/Steps(1000 ms)- This represent the steps of ant per thousand millisecond.
2. Original Antnet/Average Solution Length- Here we have taken the default values of original ants.
3. Endurance based AntNet-In this we increase the endurance value by 10% and all other factors are kept constant. We find that when we Compare this with the original ant we get better solution.
4. Endurance based AntNet (with Decreased pheromone) Keeping endurance as that of column 3 we have decreased pheromone factor by 20% taking it 200. We find that the result s are much better than column 3. This means average solution length of network is gradually decreased which is an outstanding and remarkable result.

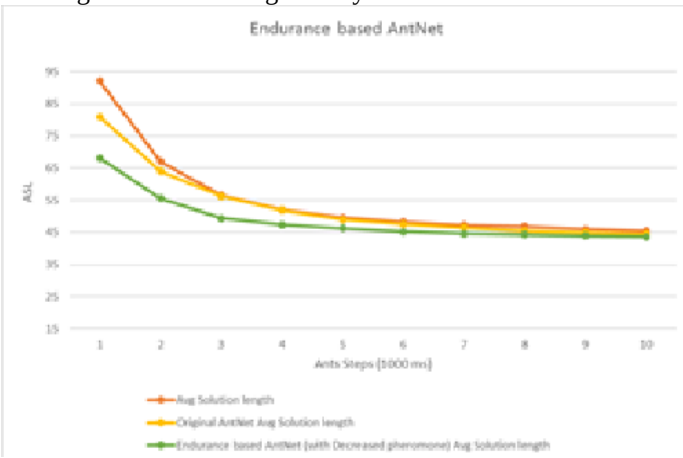


Figure 1

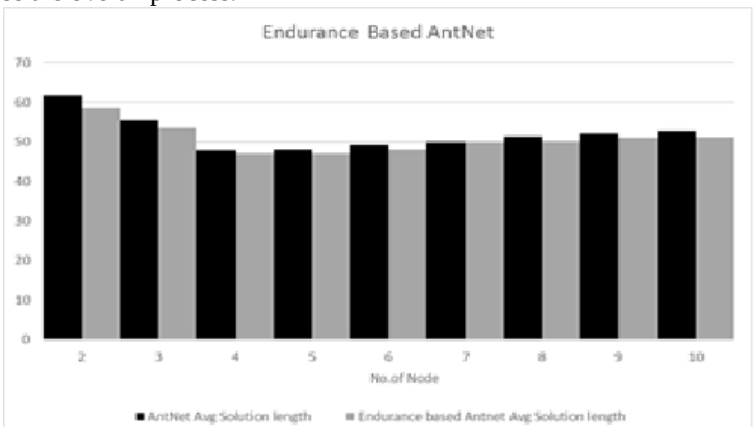
The following graph shows the pictorial representation of the table showing that the average solution length is reduced remarkably leading to better performance.

Table 3	AntNet	Endurance based Antnet
Nodes	Avg Solution length	Avg Solution length
2	61.922	58.5744
3	55.6133	53.625
4	48	47.066
5	48.08	47
6	49.23	48.111
7	50.012	49.958
8	51.451	50.145
9	52.213	51
10	52.874	51.245

In table 3 we are showing data in which we are changing the number of nodes from (2-10) including source node. The next column shows the values of original average solution length and the third column shows modified average solution length.

Keen observation of the table data shows the modified endurance based antnet gives reduced and more efficient values as compared to the original antnet.

It reveals that in the modified antnet also when we adjust the parameters we will get better results to connect the routers(nodes) and decrease the overall process.



IV. EXPERIMENTAL RESULTS DISCUSSION

Analysis of the experiments results indicates the following observations:

- At each simulation minute, the average solution length of all network nodes for the endurance based AntNet is less than that of original AntNet.
- Over all the simulation period, the average travelling time to each network node for the endurance AntNet is less than that of original AntNet.

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