International Journal of Engineering, Science & Mathematics
Vol. 11 Issue 04, April 2022,
ISSN: 2320-0294 Impact Factor: 6.765
Journal Homepage: http://www.ijmra.us, Email: editorijmie@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal - Included in the International Serial Directories Indexed & Listed at: Ulrich's Periodicals Directory ©, U.S.A., Open J-Gate as well as in Cabell's Directories of Publishing Opportunities, U.S.A

A Research Paper on Node Density Based Ant ColonyRouting Algorithm In Manet

Shuchita Sheokand

Dept. of Computer Science and Engineering, Swami Devi Dyal Group of Professional Institution
Kurukshetra University, Kurukshetra Haryana,India

email:shuchita.sheokand@gmail.com
DOI: 10.6084/m9.figshare.19766098

Abstract*—The biggest challenge in this kind of networks is to find a path between the communication end points, what is aggravated through the node mobility. MANET consists of mobile nodes, a router with multiple hosts and wireless communication devices. Mobile ad hoc network are used for specific purpose. But ad-hoc network is most popular network because it is more flexible as compare to another network .it is easily data transfer from one network to another network, it increasing flexibility and consuming less time.In this paper we present a new on-demand routing algorithm for mobile, multi-hop ad-hoc networks. The protocol is based on swarm intelligence and especially on the ant colony based meta heuristic. These approaches try to map the solution capability of swarms to mathematical and engineering problems. The introduced routing protocol is highly adaptive, efficient and scalable. The main goal in the design of the protocol was to reduce the overhead for routing. We refer to the protocol as the **A**nt-Colony-Based **R**outing **A**lgorithm (ARA).*

***IndexTerms*—**MANET, Scalability, RREQ, RREP, SNR, Ad-Hocs.

1 INTRODUCTION

MANET is a collection of mobile, decentralized, and self organized nodes. The distributive nature, infrastructure less and dynamic structure make it an easy prey to security related threats. A **mobile ad hoc network** (**MANET**), sometimes called amobile mesh network, is a self-configuring network of mobile devices connected by wireless links.Each device in a MANET is free to move randomly in any direction, and will therefore change its links to other devices again and again. Each must forward traffic unrelated to its own use, and therefore can acts as router. The major challenge in building a MANET is making each device to monitor and maintain the information required to trafficrouting.

Different types of vulnerability

Vulnerability is a weakness in security system [1]. A particular system may be vulnerable to unauthorized data access because the system does not verify a user's identity before allowing data ease to access. MANET is more vulnerable than wired network. Some of the vulnerabilities are as follows:-

(i) Lack of centralized management

MANET doesn't have a centralized monitor server. The absence of such management makes the detection of attacks difficult as it is not easy to monitor the traffic in a large scale ad-hoc network. Lack of centralized management will easily break the trust management for nodes.

(ii) Resource availability

Resource availability is a major issue in MANET. Providing secure communication in such changing environment as well as protection against specific threats and attacks, leads to development of various security

International Journal of Engineering, Science & Mathematics
Vol. 11 Issue 04, April 2022,
ISSN: 2320-0294 Impact Factor: 6.765
Journal Homepage: http://www.ijmra.us, Email: editorijmie@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal - Included in the International Serial Directories Indexed & Listed at: Ulrich's Periodicals Directory ©, U.S.A., Open J-Gate as well as in Cabell's Directories of Publishing Opportunities, U.S.A

architectures which provide safety to the user . Collaborative ad-hoc environments also allow us to develop such security mechanism.

(iii) Scalability

Due to mobile nature of nodes, scale of ad-hoc network change frequently. So scalability is a major issue concerning security and authentication. Security mechanism should be capable of handling various range and size of network.

(iii) Cooperativeness

Routing algorithm for MANETs usually assume that nodes are cooperative and non-malicious. As a result a malicious attacker can easily attack, disroute the mechanism and disrupt network operation by breaking the protocol specifications.

(iii) Dynamic configuration

Dynamic configuration and changeable nodes membership may disturb the trust relationship among nodes. The trust may also be disturbed if some nodes are detected as faulty.This dynamic behavior could be better protected with widely distributed and adaptive security mechanisms in terms of area.

(iii) Limited Power Supply

The nodes in mobile ad-hoc network need to consider restricted power supply. A node in mobile ad-hoc network may behave in a selfish manner when it is find that there is only limited power supply, it make use of it for itself .There are different types of attacker present in MANETs, which tries to decrease the performance of network by consuming more battery.

Here our algorithm of concern is:Ant colony optimization [3] algorithms have been applied to many combinatorial optimization problems, ranging from quadratic assignment to protein folding or routing vehicles and a lot of derived methods have been adapted to dynamic problems in real variables, stochastic problems, multi-targets and parallel implementations. It has also been used to produce near-optimal solutions to the travelling salesman problem.Theyhave an advantage over simulated annealing and genetic algorithm approaches of similar problems when the graph may change dynamically; the ant colony algorithm can be run continuously and adapt to changes in real time. This is of interest in network routing and urban transportation systems.

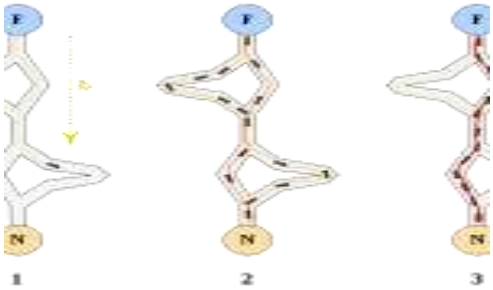


Figure Ant Colony Optimisation

REVIEW:

We propose a method to reduce the routing overhead in DSDV[2] (Destination-Sequenced Distance-Vector) networks. The proposed method benefits from the nature of DSDV, such as loop-free and shortest routing path, but alleviates the problem of control message flooding when the network topology changes. Given a destination node in a DSDV network, there exists a spanning tree using the destination node as its root and constructed by the paths from all nodes to this destination [2]. Based on this concept, we develop a mechanism for each node in mobile environment to dynamically identify its role (internal node or leaf node) in each spanning tree. When receiving a routing message from a destination node, the node checks its role in a corresponding spanning tree and determines whether the message should be forwarded. The proposed method is especially suitable for mobile Ad

International Journal of Engineering, Science & Mathematics
Vol. 11 Issue 04, April 2022,
ISSN: 2320-0294 Impact Factor: 6.765
Journal Homepage: http://www.ijmra.us, Email: editorijmie@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal - Included in the International Serial Directories Indexed & Listed at: Ulrich's Periodicals Directory ©, U.S.A., Open J-Gate as well as in Cabell's Directories of Publishing Opportunities, U.S.A

Hoc network with high node density, where filtering out the redundant routing messages at leaf nodes effectively saves the scarce bandwidth resource.

*1.Hierarchical:*Hierarchical techniques have long been known to afford scalability in networks. By summarizing topology detail via a hierarchical map of the network topology, network nodes are able to conserve memory and link resources. Extensive analysis of the memory requirements of hierarchical routing was undertaken in the 1970s. However, there has been little published work that assesses analytically the communication overhead incurred in hierarchical routing

*2. Clustering:*The concept of dividing the geographical regions into small zones has been presented as clustering in the literature. Fig 1. Route Establishment in Clustering Mechanism Clustering basically transforms a physical network into a virtual network of interconnected clusters or group of nodes. These clusters are dominated by cluster heads (CH) and connected by gateways or border terminals as shown.

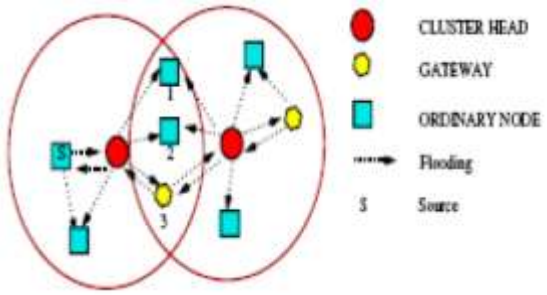


Figure:1

a) HelloOverhead: To reduce the hello overhead messages the frequency of hello messages generated by a node to learn about its neighboring node when a new link is formed should be at least equal to the link generation rate. The link generation between any two nodes can be notified by sending the hello messages and each of the nodes can hear the hello message sent by the other node.

b) Cluster message overhead due to linkbreak between cluster members and their cluster heads: This event causes the node to change its cluster or become a cluster head when it has no neighboring clustering heads. The cluster members send the cluster messages due to this type of link changes. To minimize the control message overhead the ratio of such link breaks to total link breaks should be equal to the ratio of links between the cluster members and cluster heads divided by the total number of links in the entire network.

c*) Clustermessage overhead due to link generation between two clusterheads:* When a link is generated between two cluster heads, one of the clusters heads needs to give up its cluster head role, which is decided by the clustering algorithm. Every time a link between two cluster heads appears, the number of cluster messages generated is same as the number of nodes in the cluster that needs to undergo clustering.

d) Routing overhead: When a particular node in the cluster should be updated withthe route to other nodes in the cluster, the routing storage overhead is proportional to the size of the cluster.

3) Header Compression

In literature it has been studied that [8] approximately half of the packets sent across the Internet are 80 bytes long or less. This percentage has increased over the last few years in partdue to widespread use of real time multimedia applications. The multimedia application's packet size is usually smaller in size and these small packets must be added with many protocol headers, while traveling through the networks. In Ipv4 networks there can be at least 28 bytes (UDP) or 40 bytes (TCP) overheads per packet. These overheads consume much of the bandwidth, which is very limited in wireless links. Small packets and relatively larger

International Journal of Engineering, Science & Mathematics
Vol. 11 Issue 04, April 2022,
ISSN: 2320-0294 Impact Factor: 6.765
Journal Homepage: http://www.ijmra.us, Email: editorijmie@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal - Included in the International Serial Directories Indexed & Listed at: Ulrich's Periodicals Directory ©, U.S.A., Open J-Gate as well as in Cabell's Directories of Publishing Opportunities, U.S.A

header size translates into poor line efficiency. Line efficiency can be defined as the fraction of the transmitted data that is not considered overhead.

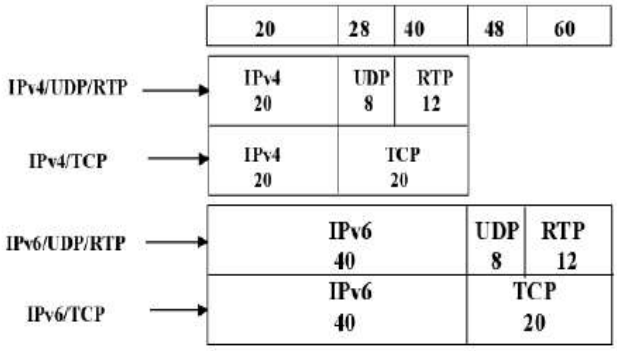


Figure shows Common Header Chains and their Sizes.

Ad hoc networks create additional challenges such as context initialization overhead and packet reordering issues associated with node mobility. The dynamic nature of ad hoc networks has a negative impact on header compression efficiency.

A context is established by first sending a packet with full uncompressed header that provides a common knowledge between the sender and receiver about the static field values as well as the initial values for dynamic fields. This stage is known as context initialization. Then the subsequent compressed headers are interpreted and decompressed according to a previously established context. Every packet contains a context label. Here the context label indicates the context in which the headers are compressed or decompressed.

A novel hop-by-hop context initialization algorithm is proposed in [6] that depend on the routing information to reduce the overhead associated with the context initialization of IP headers and uses a stateless compression method to reduce the overhead associated with the control messages. Context initialization of IP headers is done on a hop-by-hop basis because the headers need to be examined in an uncompressed state at each of the intermediate nodes. Caching the address information that is transmitted in the routing messages; in order to reduce the size of the context initialization headers reduces the context initialization overhead.

Also stateless header compression is proposed. It is stateless because the state of the context is fixed and it does not change with time. Header compression improves the line efficiency by exploiting the redundancies between the header fields within the same packet or consecutive packets belonging to the same stream. The overall result is the reduced overhead, increased network capacity and line efficiency even in the presence of rapid path fluctuations.

Simulation Parameters

The nodes are randomly deployed within the area of 400m X 400m. This area is divided into circular regions and each hop is selected on the basis of least distance from border of each region and remnant energy of sensor node in that cluster. For this simulation the population of nodes is 100 (i.e. n=100).

Many terms are used to evaluate the performance of proposed protocols with existing ant colony based protocols.The following metrics are often chosen to compare the Performance of various routing protocols:

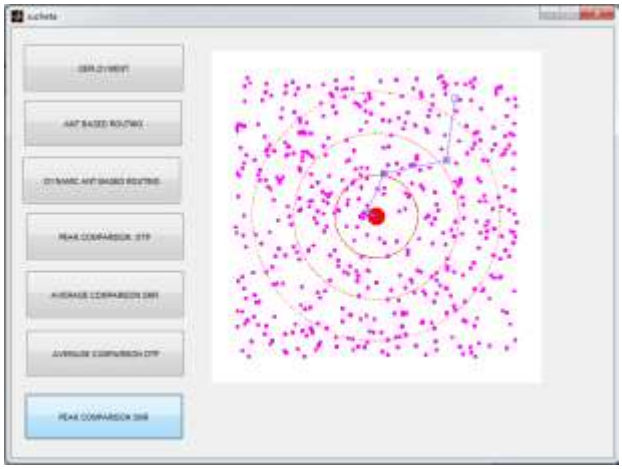


Figure shows Random deployment of nodes

International Journal of Engineering, Science & Mathematics
Vol. 11 Issue 04, April 2022,
ISSN: 2320-0294 Impact Factor: 6.765
Journal Homepage: http://www.ijmra.us, Email: editorijmie@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal - Included in the International Serial Directories Indexed & Listed at: Ulrich's Periodicals Directory ©, U.S.A., Open J-Gate as well as in Cabell's Directories of Publishing Opportunities, U.S.A

Optimal transmission Power

The ***oprimal***commontransmit power for **ad** hoc wireless networks. In **particular,**the optimal common transmit power has been defined **as**the minimum transmit power sufficient to preserve networkconnectivity. **An** analytical closed-form expression **for** theoptimal common transmit power is derived. This is particularlyuseful for network planning as it allows one to determine the**minimum** power **to use** while keeping the network connected.

SNR

In analog and digital communications, signal-to-noise ratio, often written S/N or SNR, is a measure of signal strength relative to background noise. The ratio is usually measured in decibels (dB).Signal-to-noise ratio is sometimes used informally to refer to the ratio of useful information to false or irrelevant data in a conversation or exchange, If the incoming signal strength in microvolts is V_s, and the noise level, also in microvolts, is V_n, then the signal-to-noise ratio, S/N, in decibels is given by the formula

$S/N = 20 \log_{10}(V_s/V_n)$

PSNR

Peak signal-to-noise ratio, often abbreviated **PSNR**, is an engineering term for the ratio between the maximum possible power of a signal and the power of corrupting noisethat affects the fidelity of its representation. Because many signals have a very wide dynamic range, PSNR is usually expressed in terms of the logarithmicdecibel scale.The signal in this case is the original data, and the noise is the error introduced by compression. When comparing compression codecs, PSNR is an*approximation* to human perception of reconstruction quality. Although a higher PSNR generally indicates that the reconstruction is of higher quality, in some cases it may not. One has to be extremely careful with the range of validity of this metric; it is only conclusively valid when it is used to compareresults from the same codec (or codec type) and same content.

1) Average SNR

The second parameter obtained from the input signals is Average SNR.This program estimates the Average SNR of a file; define as where power refers to the Root Mean Square (RMS) of the signal over a sliding window of 20ms, with a scrolling size of 10ms. A histogram is created using the RMS values and then the noise and speech values are computed.

There is a trade-off between network lifetime and reliability. Network lifetime includes both unstable and stable regions. For the same stable region, a smaller unstable region means more reliability but a shorter network lifetime.

Simulation Results

To get the simulation results MATLAB tool is used. As mentioned earlier Ant colony based algorithm in comparison with Dynamic Ant based Colony is being performed to observe the Average Optimal transmission power, Peak Optimal transmission power, Average Signal to noise Ratio, Peak Signal to noise Ratio,

Average OTP

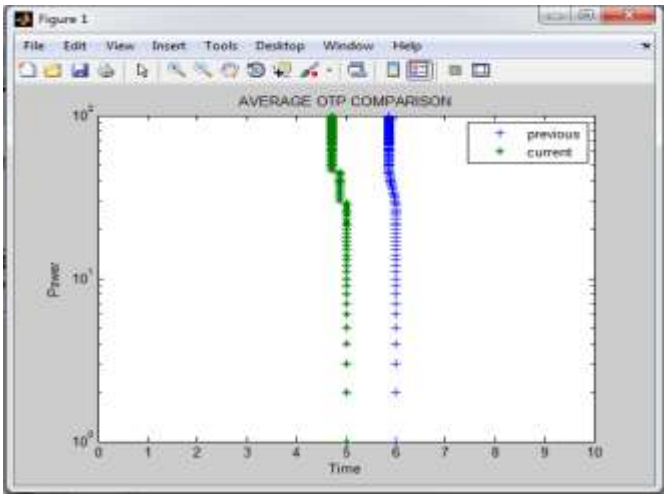
$$P_t^* = FkT_0R_b\left[\frac{2\alpha}{r_{\text{link}}^{\gamma}\Psi} - \alpha(1-e^{-\frac{\lambda L}{R_b}})I_{\text{grid}}\right]^{-1}$$

Where

$$\Psi \triangleq \left\{Q^{-1}\left[1-(1-\text{BER}_{\text{th}})^{1/\bar{n}_{\text{grid}}}\right]\right\}^2$$

and**Igrid**is given by ***(3).*** The expression given in above corresponds to the ***uptitiaZ***transmit power for a given data rate *Rb,* node spatial density **(Tlink_" l/G)**n**,**umber of nodes in the network c*z/2)*a,ntenna gains and carrier frequency *[a* depends on them).

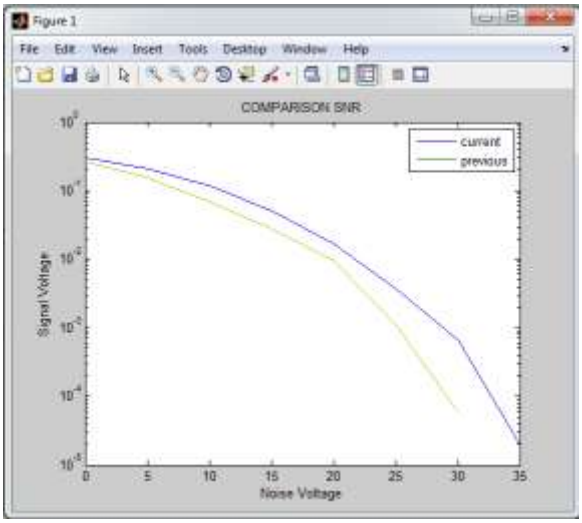
International Journal of Engineering, Science & Mathematics
Vol. 11 Issue 04, April 2022,
ISSN: 2320-0294 Impact Factor: 6.765
Journal Homepage: http://www.ijmra.us, Email: editorijmie@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal - Included in the International Serial Directories Indexed & Listed at: Ulrich's Periodicals Directory ©, U.S.A., Open J-Gate as well as in Cabell's Directories of Publishing Opportunities, U.S.A



Average OTP Comparison

Peak OTP Comparison

Peak comparison of OTP shows that there is gradual decrease in power required to perform the same set of sending from source to destination. The decrease in power is by 55% that again indicate increase in performance of Proposed routing algorithm in comparison with existing ant Based Routing Algorithm.



Average SNR Comparison

If the incoming signal strength in microvolts is V_s, and the noise level, also inthe signal-to-noise ratio, S/N, in decibels is given by the formula

$S/N = 20 \log_{10}(V_s/V_n)$.

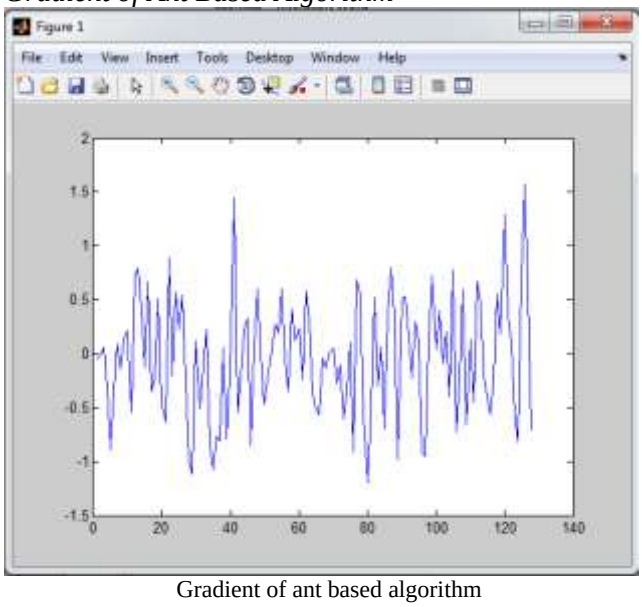
But if we take average of all noise voltage V_{an}, So the average Signal to Noise Ratio can be defined as:

$S/N = 20 \log_{10}(V_s/V_{an})$.The comparison graph shows that Dynamic ant based Algorithm has greater slope than Ant Colony Based Routing Algorithm. Better performance is achieved in terms more of signal is transferred than to noise as comparison to previous algorithm.

Peak SNR Comparison

Peak SNR Value of current algorithm is more better than previous value i.e. here PSNR increase by an amount 56%.This prove increase in performance of Routing Algorithm.

Gradient of Ant Based Algorithm



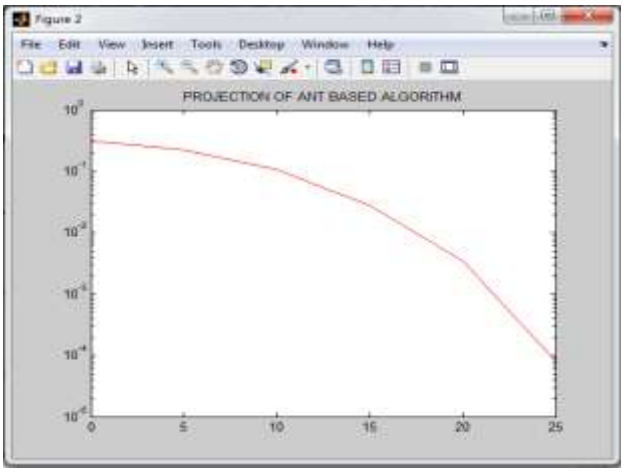
Gradient of ant based algorithm

This shows gradient of ant colony based algorithm which gives the information about the connectivity in network. The

International Journal of Engineering, Science & Mathematics
Vol. 11 Issue 04, April 2022,
ISSN: 2320-0294 Impact Factor: 6.765
Journal Homepage: http://www.ijmra.us, Email: editorijmie@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal - Included in the International Serial Directories Indexed & Listed at: Ulrich's Periodicals Directory ©, U.S.A., Open J-Gate as well as in Cabell's Directories of Publishing Opportunities, U.S.A

clearly depicts connectivity among different nodes in network.

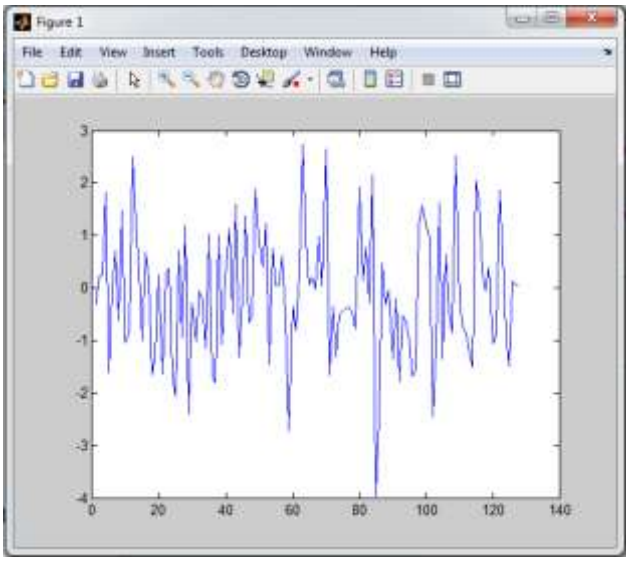
Projection of ant based algorithm



Projection of Ant Based Algorithm

This shows projection of ant colony based algorithm which gives the information about the how much information is being passed from source to sink. The clearly depicts the modes of data travel among different nodes in network.

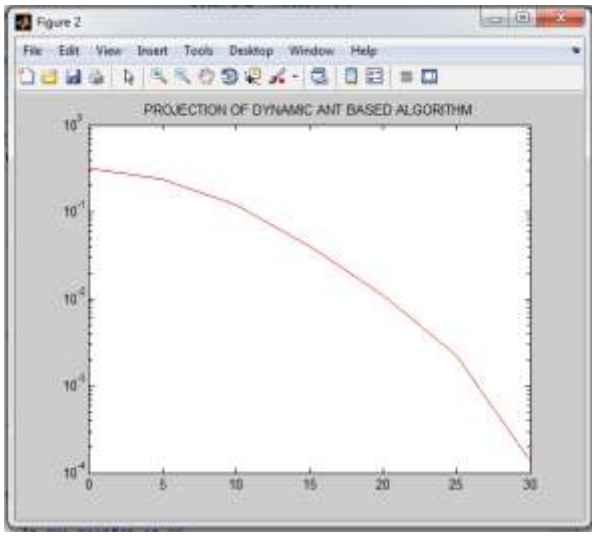
Gradient Of Dynamic Ant Based Algorithm



Gradient of Dynamic Ant Based Algorithm

This shows gradient of ant colony based algorithm which gives the information about the connectivity in network. The clearly depicts far better connectivity among different nodes in network.

Projection of Dynamic Ant Based Algorithm



Projection of Dynamic Ant Based Algorithm

This shows projection of ant colony based algorithm which gives the information about the how much information is being passed from source to sink. The clearly depicts better the modes of data travel among different nodes in network.

Conclusion

This paper, a new routing protocol for MANET environment is proposed based on Ant Colony Optimization principle coupled with other Dynamic techniques. The proposed Dynamic algorithm improves the OTP, robustness and SNR. The efficiency of proposed routing protocol is shown to better than other demand Ant colony based routing protocols .The proposed Dynamic routing protocol uses a optimal path routing and fast route discovery. The Established paths provide reliable, Shorter and faster communication. Simulation results show that the proposed protocol provides reliable and power efficient routing by

attaining high Signal to Noise ratio and low energy consumption compared to the existing protocol.

We have discussed the adaptation of the method to mobile multi-hop ad-hoc networks and showed through simulations its ability to perform well in such kind of networks. The performance for the considered simulation scenarios is very close to the performance of Ant based algorithm, but generates less overhead.

References

[1] Kalaavathi B; Madhavi S; VijayaRagavan S ; Duraiswamy K, "Review of Ant based Routing Protocols for MANET" Computing, Communication and Networking, 2008. ICCCn 2008. International Conference on ,18-20 Dec. 2008 ,pp:1 – 9

[2] MesutG¨unes¸, UdoSorges, ImedBouazizi **,"**ARA – The Ant-Colony Based Routing Algorithm for MANETs", Proceedings of the International Conference on Parallel Processing Workshops (ICPPW'02), 2002 IEEE,pp: 79 – 85

[3] D. Karthikeyan ,M. Dharmalingam ," Ant based Intelligent Routing Protocol for MANET "
,Proceedings of the 2013 International Conference on Pattern Recognition, Informatics and Mobile Engineering (PRIME) February 21-22 ,2013 IEEE ,pp:11-16

[4] Jain, S. ; Shastri, A. ; Chaurasia, B.K. Analysis and Feasibility of Reactive Routing Protocols with Malicious Nodes in MANETs Communication Systems and Network Technologies (CSNT), 2013 International Conference on ,6-8 April 2013 ,pp:356 - 360

[5] Haque, I.T. ,"On the Overheads of Ad Hoc Routing Schemes " ,Systems Journal, IEEE (Volume:PP , Issue: 99) ,pp:1 - 10

[6] Shu-Hsin Chang ; Wei-Chih Ting ; Jui-Wen Chen ,"Method for reducing routing overhead for mobile Ad Hoc network ",Wireless Communications and Signal Processing (WCSP), 2010 International Conference on , 21-23 Oct. 2010 ,pp:1 - 6

[7] Sucec, J. ;Marsic, I. ," Hierarchical routing overhead in mobile ad hoc networks ", Mobile Computing, IEEE Transactions on (Volume:3 , Issue: 1 ,Jan-Feb 2004 ,Page(s): 46 – 56

[8] S. Gowrishankar, T. G. Basavaraju, Subir Kumar Sarkar ,Advances in Electrical Engineering and Computational Science Lecture Notes in Electrical Engineering Volume 39, 2009, pp 329-341 ,Analysis of Overhead Control Mechanisms in Mobile AD HOC Networks.