The International Journal Of Engineering And Science (IJES)
|| Volume || 2 || Issue || 12 || Pages || 19-25 || 2013 ||
ISSN (e): 2319 – 1813 ISSN (p): 2319 – 1805

Hidden Markov model for tracking MANET based on structure free approach

[1,] P.Jaya Prakash, [2,] B.Venkateswarlu, [3,] S.Abdul Jeelan,
[1, 2, 3,] Assistant Professors, Dept.Of Cse, Sitams, Chittoor

---Abstract---

Mobile Adhoc Network does not require fixed infrastructure support for tracking to reach a Target node. We need to accomplish a goal is to improve the effectiveness of structure –free tracking..we already recognizes a problem of tracking of a mobile target node in a mobile adhoc network(set-up).we includes a generic tracking framework for a online tracking applications .we proposes a online statistically estimated hybrid estimated markov model of an gradient based protocols of the target's likely direction. A PMBT is a probabilistic online tracking algorithm that computes information utilities at each step,and then chooses the next step toward the target based on the maximum expected utility. We provides a light weight implementation of the state of nodes in each cell and a polite gossip mechanism for forwarding the tracking messages .we consider a benchmark approach to solve a tracking problem in MANET,A PMBT algorithm significantly outperforms both gradient-based and markov model with the help of polite gossip mechanism.

Keywords: MANET, PMBT, Gradient Model, HMM, target, tracking.

Date of Submission: 16 December 2013 Date of Acceptance: 30 December 2013

I. INTRODUCTION

Existing work on target tracking in MANETs mainly lie in two categories: structure-based approaches and structure-free approaches. The first type of protocols dynamically maintain certain structures, such as trees or overlay graphs, such that a message may simply follow the structure to reach the target. Tracking of a mobile target is an important service for MANETs that enables routing of a message to the mobile target [1, 5, 6]. Such target tracking in MANETs is challenging because the tracking protocols need to deal with---in addition to the mobility of the target--- the mobility of the intermediate nodes that maintain a track toward the target. Mobile ad hoc networks (MANETs) [1, 2] do not require a fixed infrastructure support for communication and routing, and hence find many applications in urban warfare, disaster recovery, and large-scale sensing/surveillance scenarios. In structure-free protocols, nodes take local decisions by making prediction over available knowledge to generate a path on demand for a tracking message to be forwarded to the target. In order to improve on the effectiveness of structure-free tracking approaches.To this end, we introduce a hybrid Probabilistic Model Based Tracking (PMBT) framework that integrates a Gradient model of the target's proximity and an online statistic Markov model of the target's likely direction. The goal of this protocol is to reach closer to the same effectiveness level of the structure-based frameworks without the periodic updating costs of the target. integrates a Gradient model and Markov model into a unified model for tracking in MANETs.

PMBT is a probabilistic online tracking algorithm that computes information utilities at each step, and then chooses the next step toward the target based on the maximum expected utility. We provide a lightweight implementation forwarding the tracking messages abstraction for all these models. Our abstraction is based on a loose synchronization the state of nodes in each cell and a polite gossip mechanism for forwarding the tracking messages.

II. PROBABILISTIC MODEL BASED TRACKING

The computation of the optimal track in Hidden Markov Model (HMM) is very costly especially when the number of nodes becomes large. The solution is to simplify the prediction process given that the movement of target can only take place between four neighboring cells. What's more, utility information is constructed in a distributed manner using a weighted average of the gradient and the transition probability. Nodes do not have a global view of the entire network. In contrast to the set up at [16] that assumes that nodes can monitor the target continuously in the field, we do not make any such assumptions. Nodes can sense/detect the target in a binary manner only when the target is in the same grid cell as the node. Historical data are cached by the mobile nodes who have encountered tracking targets. To save energy, they are not exchanged between nodes.

III. HIDDEN MARKOV MODEL

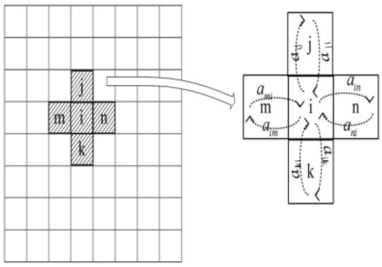
A discrete HMM can be applied when the division of the region is finite. The approach we describe here discretizes the target region into cells and formalizes the transition matrix in an online probabilistic model rather than deterministic transition parameters.

The HMM model for tracking contains the following parameters:

1. The possible states S=S1, S2,……S_N, each cell corresponds to one state.
2. The transition probabilities A=aij (1<=i<=N). where a_{ij} is defined as the transition probability of moving from state S_1 to S_2, that is aij=p(qk=sj/qk-1=si). Geometrically, a_{ij} is only meaningful when the states S_i and S_j are neighboring cells.

To simplify, we consider only four transitions, moving up, down, left and right (It is straightforward to allow more transitions such as moving upleft, upright, downleft and downright). The rest of the elements in matrix are all zeros.

3. An initial distribution of the target in each state ∏ =∏i(1<=i<=N)



Viterbi algorithm can be used to find the most likely track (state sequence) given the observations O1,O2,O3,….ON.(i.e., signals).

Although the HMM model has been used in target tracking applications, it adds some constraints when applied to distributed mobile ad hoc networks.

Firstly, the algorithm relies on the target's prior probability distribution, which is hard to acquire precisely; secondly, the HMM model assumes each state

P(S(tn))=P(S(tn)/S(tn-1)).P(S(tn-1)).

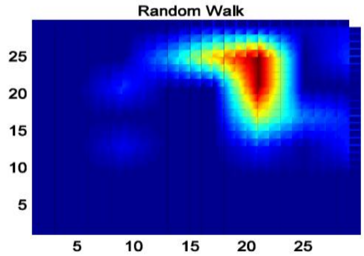
The transition information in each cell are loosely synchronized to reduce coordination overhead. A node enters a new cell, it drops old information and picks up the information in the cell by sending a DATA REQUEST message.

IV. GRADIENT-BASED MODEL

This gradient is maintained not by communication among nodes, but solely by the node mobility inherent in the MANET. When a node detects the target, its gradient value is set to 1 and the location and timestamp also remembered by the node. This gradient information tells us the location of target sometime ago. This is inspired by the decay law in physical phenomena that an event's effect decreases exponentially to the distance of the event,

i.e., N (d) α 1/ed.

Figure 2 shows the gradient distribution under two different mobility models - the random walk model and the random waypoint model, where all the nodes are mobile. We can see that the distribution simulates the decay law well enough in general for gradient based tracking algorithms to perform effectively, however some local maximas are also observed. Due to the uneven mobility of the nodes, the information distribution is not smooth. Local maxima, local minima, or flat regions where information gradients are either the same or zero, may exist. In practice, other factors such as obstacles or node failures, also causes such discontinuity in the decay distribution.



The tracking message marks the local maxima node to prevent the message being looped back by neighboring nodes. This way tracking messages can escape from local maxima and

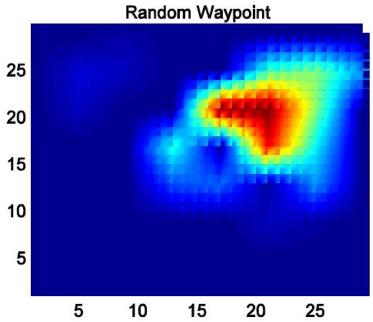


Figure 2: Information decay space distribution with mobile speed 2m/s. Both the random walk model and the random waypoint model show similar decay behavior

We show that a cell abstraction can be achieved easily given the assumption that the coordinates of any nodes are available (a node does not need any message exchange with other nodes to decide which cell it belongs to). Gradients are based on nodes rather than cells, and they are not exchanged between nodes. Hence we need a mechanism to decide which node in the cell is responsible to forward tracking messages. To this end, we use a polite gossip message forwarding scheme that does not require querying of all the nodes in a cell to decide which node should be used for forwarding the tracking message further. For this scheme, we associate the gradient information with an application layer backoff timer. the query message sets closer to the target with high probability.

V. PMBT MODEL (PROBABILISTIC MODEL BASED TRACKING MODEL)

The gradient-based model provides a progressive tracking scheme, but is quite limited to the freedom and the percentage of mobile nodes: in an extreme case where all nodes are static, the target's information cannot be distributed, hence the model will not work well.HMM only works when the target is highly predictable, and gradient model does not work well when the nodes are static as our gradient distribution relies on the node mobility. In order to reap the advantages of both the gradient-based model and the HMM model while minimizing their disadvantages, we use information utility for measuring the contribution of nodes in each cell. As both the transition probability and gradient measures the likely direction of the target,

$\varphi(i)=\alpha\phi(aij)\cos(\theta ij)+\beta\phi 2(g(i,t))$ (2)

Here, $\phi 1(aij)$ is the normalized weight of the Markov transition probability where aij is the best move for HMM model, and $\phi 2(g(I,t))$ is the weight for the gradient at cell i (as shown in Figure 1). We illustrate the definitions for in Figure 3. In the figure, θij is the angle between the line from cell to the estimated target and the line from cell i to j if we decide to take a forward from cell i to cell j. Note the exact θ is not known since the nodes may not know the current location of the target. Our θ is based on the gradient information
certain period ago when that gradient is initially created. The factor $\cos(\theta ij)$ indicates the projection of $\phi 1=(aij)$ on the gradient $\phi 2(g(i,t))$ as they are not in the same direction. As
$-1<=\cos(\theta)<=1$,, $\phi 1=(aij)$ has positive impact on the gradient when 0 $0<=\theta <= \pi/2$ and
negative impact on the gradient when $\pi/2 <\theta <\pi$.

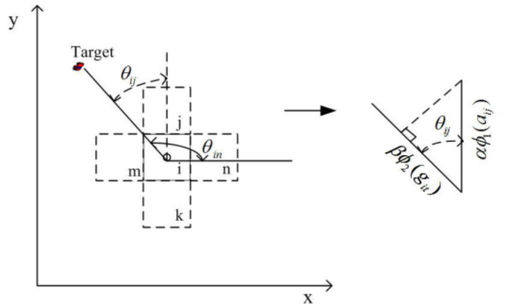


Figure 3: The figure shows the construction of the information utility. The coefficient cos(ij) is indicates the projection of 1=(aij) on the gradient 2(g(I,t)), and are the weights for each model.

Given the information utility, the message forwarding strategy is as follows: when a message arrives at a cell, the nodes in the cell make a decision based on the calculated information utility as to which cell the message should be forwarded. Nodes in a cell hold same aij but different git. Hence nodes in the same cell have various utility values at each snapshot. The node with highest utility decides the next forwarding direction. Our implementation (Section 3) avoids communication between nodes in this decision process by associating the utility value to an application layer backoff timer.

Theorem 1 (Convergence Theorem).

PMBT is guaranteed to deliver all tracking messages to the target's location in a connected network given that β *is not zero and*
Satisfies the following condition: step from i *to* j ,

$\phi 2(g(j,t))>=\phi 2(g(I,t))+(\alpha/\beta)\ \phi 1(1)\cos(\theta)(0<=\theta<=\pi)$.

PMBT is guaranteed to deliver all tracking messages to the target's location given the conditions. Note that during the tracking process a querying message does not know the real location of the target. We can only use the recorded/estimated target location to compute the projection angle θ. obviously; the effectiveness of the tracking algorithm is affected by the precision of estimating θ. In the following discussion, we first prove that the estimation error
(of θ) is bounded, and then derive the formula to calculate the confidence as the quality.

VI. DISTRIBUTED IMPLEMENTATION

Implementations of PMBT are:
1) How data is coordinated in cell layer, and
2) How to forward tracking messages efficiently. Moreover, as we show in the following discussion, our design of soft-state loose synchrony for each cell and polite gossip message forwarding further reduces message overhead to keep the system lightweight.

Note that each cell only holds the information locally, without knowing the neighboring cell's information. To select next move, the cell may ask neighboring cells for their utility information before making a decision. However, this operation not only requires cell synchronization over the data within each cell but also introduces large overhead.

VII. LOOSE SYNCHRONY

To maintain the data consistency in a cell, previous mobile tracking frameworks such as VINESTALK [6], GLS [8], and HGRID[19], used strict synchronization: nodes constantly exchange information with neighboring nodes to keep synchronization. This causes extra overhead and consumes unnecessary network bandwidth when all nodes are mobile. We observe that such strict synchronization for cells may not be necessary. Considering the constant changing of topology in our model, the loose synchrony approach is most appropriate because it avoids extra traffic in high mobility circumstances In PMBT, we loosely synchronize the state of nodes in each cell through snooping the target event by utilizing the nature of wireless broadcast communication. In our implementation, nodes in a cell hold different gradients and utility information that are not exchanged. Markovian transition information used in constructing utilities are cell-based and shared among nodes in a cell. More specifically, the operations of PMBT are: 1) when a new node enters a cell, it picks up the Markov information in this cell by sending a DATA REQUEST message. 2) when a node leaves a cell, the old information associated are simply dropped. 3) when a query comes, the node with maximum utility in the cell decides the next move and forwards the message with ``Polite Gossip mechanism'', which is described in the following subsection.

Of course, such lightweight implementation trade-offs the possibility of failures. Transient data loss will occur when all the nodes holding the shared information move out of a cell, while those newly joined nodes have no clue. In this case, the nodes simply forward the message to a randomly selected neighboring cell. The reasons of a message failure could be: a message is forwarded to an empty cell or a message is lost due to collisions.

VIII. POLITE GOSSIP FORWARDING

We make all nodes in a cell behave uniformly as a single node by employing the following polite gossip mechanism. In polite gossip, a node suppresses sending a message on hearing the same message sent by other nodes within the same cell: if during the backoff period, a node hears any other node sending the same message, it drops the message from the sending queue.

To realize polite gossip forwarding effectively, we use two types of backoff timer: a default CSMA backoff timer and an application layer backoff timer. These two timers perform different functions in our model: the default CSMA backoff timer is used for reducing collisions between cells, and the application layer backoff timer is used for suppressing the sending of duplicated messages in a cell. We set the application layer backoff timer of each node inside a cell to be proportional to the node's utility function. Therefore, nodes with high utility functions are more likely to trigger the response messages. The implementation of this scheme nicely integrates PMBT and message forwarding, and is lightweight and scalable.

The application layer back off timer should be carefully designed to reduce message duplications and conflicts in forwarding. Let T_{app} denote the application layer maximum back off time and T_{msg} be the time to send a message. If there are n nodes within the same cell, the joint probability of back off timer for n nodes in the cell p(t1,t2,,,,tn) can be written in conditional probability.

p(t1,t2,,,,tn)=p(t1/t2,t3,,,,,tn)* p(t2,t3,,,,tn)

The probability that the rest n-1 nodes can hear the first nodes transmission attempts is:

p=(1-Tmsg/Tapp)n

Using this formula, we can set T_{app} appropriately according to system requirements. For example, assuming there are two nodes in a cell on average and requiring that the duplication of sending is less than 20%, the application layer back off is:

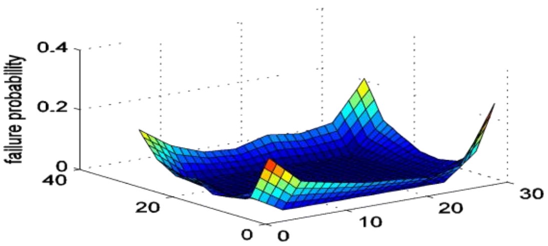
Tapp=10*Tmsg

In our implementation of polite-gossip forwarding, we use implicit acknowledgment. When a node that transmits a message to the next cell does not hear this message forwarding further by that cell, it will resend its message. This is a best effort mechanism and it fails if the transmitter node leaves its cell before it had a chance to resend the message.

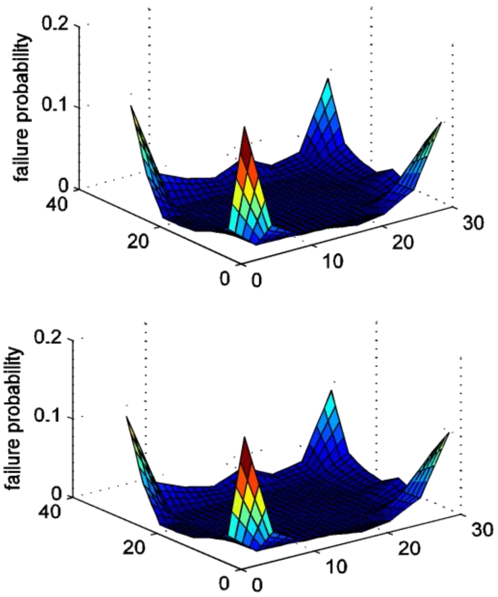
IX. SIMULATIONS

We consider the random waypoint mobility model: a node selects a random point which is uniformly distributed in the field and moves toward the destination at a certain speed. When the node reaches the destination, it rests for a a certain period of time and selects the next point. The performance of the framework is closely related to the mobility process as a cell's behaviors are simulated by the physical nodes in the cell that are loosely synchronized.

In other words, if all the nodes move out of a cell (i.e., the cell becomes empty), the cell may simply lose the information, leading to a potential failure. The analysis of cell failure can be used to quantify the usability and scalability of the framework, depending on the design requirements of the system.



400 NODES



600 NODES

Figure 6: Cell empty probability distribution, random waypoint model

We plot the cell failure probability in 2D as shown in figure 6. The failure probabilities decrease with the increase of node density, which is an obvious observation due to the soft-state implementation. For random waypoint mobility model, cells closer to borders are more likely to become empty. With 400 mobile nodes in the field (4 nodes/cell in average), the average failure probability is below 4%; if we increase the node sensity to 6 nodes/cell, the average failure probability is below 1%. This implies that given any node can be negligible a reasonable dense mobile network, the probability of a cell without any node negligible.

X. FUTUREWORK:

Framework is proposed for acoustic target tracking in wireless sensor networks. Self-organizing and robust ad-hoc network Lightweight protocols with low packet overheads Optimization of protocols for power Efficiency Attribute or location- based connectivity. It Supports Potential use of in-network processing & Storage New privacy and security considerations New socket abstractions &TP options. HMMs are used to calculate most probable object paths given historical observations. As we mentioned before, HMM models haves limitations in nature when applied in WSNs: HMM predicts next move only based on the last location, hence leads to large errors against real trails; Moreover, HMM is more appropriate for offline processing than online tracking. As a node detects the target, it pushes the event into the tree until the event reaches the root. Hence a frequent update scheme is needed to keep the information up-to-date. a framework is proposed for acoustic target tracking in wireless sensor networks. All these structure based approaches involves structure reconfiguration via explicit message exchanges at each move for every mobile nodes, hence cost considerable amount of energy. Information driven PMBT model is different from all aboves in that it does not have a 'tree structure' at all, and thus such coordination cost is reduced. Gradient based structure-free approaches are also commonly used in routing and tracking applications. GRAB [12] builds and maintains a cost field, providing each node the direction to forward messages. FRESH constructs age gradients for all nodes encountered. Messages are forwarded anchor by anchor that is discovered by broadcast-based searching at each step.

XI. CONCLUSION:

We are providing generic framework results of information. It can provides perfect target direction of information. PMBT model provides good quality locations with performance results specification process. We are going to reduce the overall transmission cost of information In this paper, PMBT achieves O(1) updating cost with comparable performance as deterministic protocols such as GLS. The A-PMBT model, a PMBT model capable of tuning the weights adaptively based on the evaluation of the gradient quality, provides a slight performance improvement.

REFERENCES:

[1.] C. Westphal. Little tom thumb went straight home. In Proc. 26th IEEE International Conference onComputerCommunications.,2007. http://dx.doi.org/10.1109/INFCOM.2007.215

[2.] F. Ye, G. Zhong, S. Lu, and L. Zhang. Gradient broadcast: a robust data delivery protocol for large scale sensor networks. ACM Wireless Networks(WINET),11(3):285–298, 2005. http://dx.doi.org/10.1007/s11276-005-6612-9

[3.] Q. Zhang, G. E. Sobelman, and T. He. Gradient-driven target acquisition in mobile wireless sensor networks. MSN,

[4.] H.ubois-Ferriere, M. Grossglauser, and M. Vetterli.Age matters: efficient route discovery in mobile ad hoc networks using encounter ages. In Proc ACM International Symposium on Mobile Ad Hoc Networking and Computing , pages257–266,June,2003. http://dx.doi.org/10.1145/778415.778446

[5.] S. Ratnasamy, B. Karp, L. Yin, F. Yu, D. Estrin, R. Govindan, and S. Shenker. Ght: a geographic hash table for data-centric storage.In WSNA '02: Proceedings of the 1st ACM international workshop on Wireless sensor networks and applications, pages 78–87, 2002. http://dx.doi.org/ 10.1.1.1.4507

[6.] J. Faruque, K. Psounis, and A. Helmy. Analysis of gradient-based routing protocols in sensor networks. IEEE/ACM Int'l Conference on Distributed Computing in Sensor Systems (DCOSS),June2005. http://dx.doi.org/10.1007/11502593_21

[7.] C. C. Ke, J. G. Herrero, and J. Llinas. Comparative analysis of alternative ground target tracking techniques. Proceedings of the Third International Conference on Information Fusion, 2:WEB5:3–10, 2000. http://dx.doi.org/ 10.1109/IFIC.2000.859832

[8.] F. Martinerie. Data fusion and tracking using hmms in a distributed sensor networks. IEEE Trans. On Aerospace andElectronicSystems,33(1):11–28,1997. http://dx.doi.org/10.1109/7.570704

[9.] S. Philip. Scalable Location Management for Geographic Routing in Mobile Ad hoc Networks. PhD thesis, University at Buffalo, SUNY, 2005.

[10.] W. Chen, J. C. Hou, and L. Sha. Dynamic clustering for acoustic target tracking in wireless sensor networks. IEEE Transaction on MobileComputing, 3(3):258–271,2004. http://dx.doi.org/10.1109/TMC.2004.22

[11.] M. Demirbas, X.Lu, and P.Singla. An in-network querying framework for wireless sensor networks. IEEE Transaction on ParallelandDistributedComputing,2009.http://dx.doi.org/10.1109/TPDS.200