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A Survey: Different Mobility Model for FANET

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Abstract— FANET(Flying Ad-Hoc Network) is a collection of small unmanned aerial vehicles (UAVs). UAVs fly in the sky and communicate through each other with the help of satellite or base station and create a ad-hoc network. This makes them a very attractive technology for many civilian and military applications. As a large amount of research for mobile ad-hoc networks(MANET) and Vehicular-ad-hoc networks (VANET) has been conducted in recent years, new emerging research challenge, aircraft ad-hoc networks, has attracted considerable attention from the research community. These networks aim to construct self organizing networks with flying aircrafts in the sky instead of typical aircraft-ground aircraft communications. One of the most important design problem for multi-UAV system for FANET is the Mobility which is necessary for cooperation and collaboration between the UAV. To address this problem various Mobility model of FANET are introduced. Mobility Model define path and speed variations of the UAV and represent their position.

Keywords— FANET, Ad-hoc Network, UAVs, MANET, VANET, Mobility Model.

I. INTRODUCTION

FANETs are a special case of mobile ad hoc networks (MANETs)[1]. In a FANET, the topology of the network can change more frequently as compare to MANET or vehicle ad hoc network (VANET). One of the most important design challenge for the multi UAV systems is the communication. Unmanned Aerial Vehicle (UAV) systems fly autonomously without carrying any human help. Usage of UAVs promises new ways for both military and civilian applications[2] ranging from search and rescue operations to disaster monitoring. FANET develop a group of small UAVs will form a special kind of ad hoc network Architecture. This type of networking architecture is called Flying Ad Hoc Networks (FANETs) which also have unique challenges other than MANETs or VANETs. In FANET each UAVs can connect directly through the satellite or ground station to establish an ad hoc network among all UAVs as show in Fig 1.. Ad hoc network between UAVs, is one of the most effective communication architectures for multi UAV systems . By the help of its multi hop communication schema, FANET architecture certify that all UAVs are connected to each other and to the base station or satellite for all time without any infrastructure, even if a UAV cannot directly communicate with the base station or satellite. In this way, not only it can transfer the collected data to the control centre immediately, but also it can support the inter-UAV communication which is crucial to realize the collaboration among UAVs[3]. FANET have high mobility degree as comparison to other ad hoc network . However, because of high mobility of the UAVs, the topology of FANET nodes changes very frequently, and all-time connectivity becomes an important constraint for the FANET based multi UAV task planning. distance between UAV nodes is larger. High gain antenna is required to achieve longer range. long range transmission can also help to reduce hop count and enhance latency performance. most UAV perform real time operation (video transmission etc), where high data rate is required. this leads to high bandwidth requirement compared to MANET or VANET.FANET require high speed as compare to the MANET and VANET.

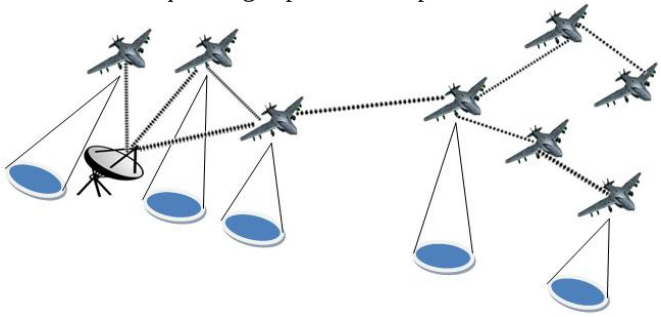


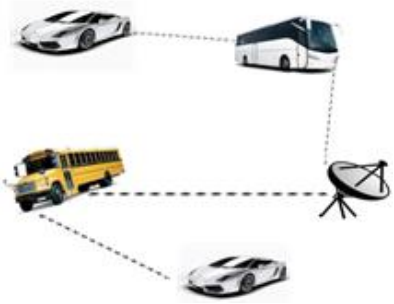
Fig.1

FANET treat as a MANET and VANET. But, differ in many ways :

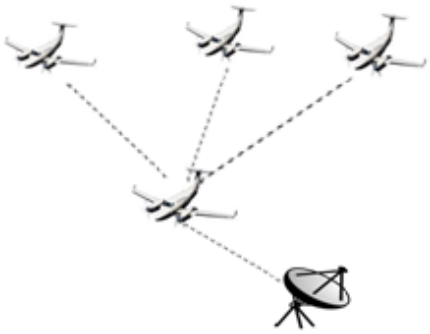
- Mobility degree of FANET nodes is much higher than the mobility degree of MANET or VANET nodes[15]. While typical MANET are mobile nodes such as mobile phones, laptops etc and VANET nodes are vehicles such as cars bikes, FANET nodes fly in the sky.

- Due to the high mobility of FANET nodes, the topology changes more frequently than the network topology of a typical MANET or even VANET.
- Distances between FANET nodes are much longer than in the MANETs and VANETs . In order to establish communication links between UAVs, the communication range must also be longer than in the MANETs and VANETs.
- MANET, VANET and FANET show in fig 2(a),(b) and 2(c).

MANET
Fig 2(a)



VANET
Fig 2(b)



FANET
Fig 2(c).

II. MOBILITY MODELS

Mobility models Represent the movement of node and how their location ,velocity and acceleration change over time. mobility models are used to create a realistic simulation environment. it showed how the performance of an ad hoc protocol can vary significantly using different mobility models. They compared the impact of the most common mobility models on a well-known ad hoc routing protocol. Fig 3 show the four mobility model that we use in FANET.

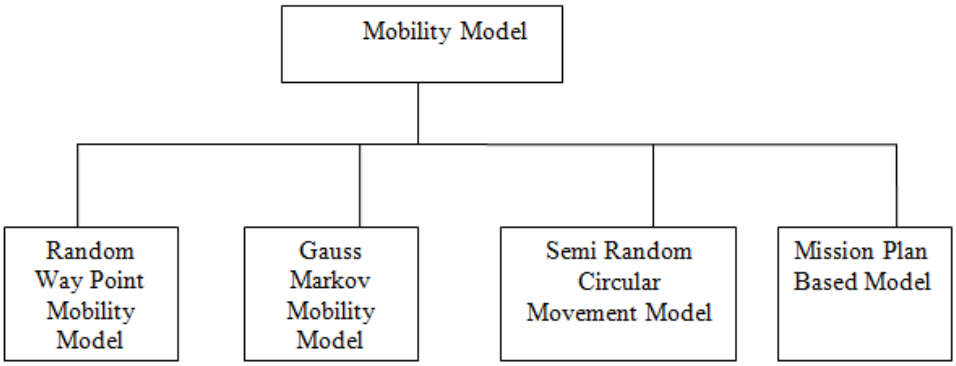


Fig.3

Random way point mobility model:

The Random Waypoint Mobility Model used by Johnson [13] and Lee [14] includes pause times between changes in direction and/or speed. In all the random based mobility models, the UAV nodes are set free to move randomly in any direction within the simulation area. We can say that a node is free to select its destination, speed and direction independent of the neighbor nodes.[7]UAVs decide on their action according to fixed probabilities. Until now, random waypoint model is used as synthetic one for mobility in most of simulation scenarios. however , it is not suitable for aircraft case because aircraft do not change their direction and mobility speed rapidly at one time and cannot stay for a while at the same point like random waypoint model. This mobility models are based on three actions: going "straight" , "turn left" and "turn right" [4].simulation of random waypoint mobility model is look like that fig.4.

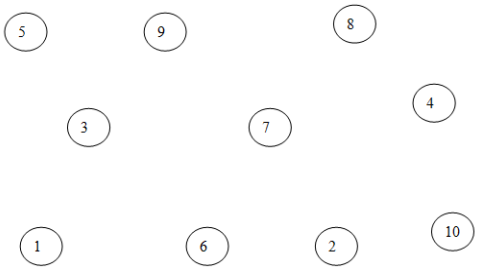


Fig 4.

Gauss-Markov Mobility Model:

Gauss Markov Mobility Model is used to simulate the UAV behaviour in a swarm .The size of simulated area is variable. Node position is always directed by its previous position due to high moving speed. The path of a drone is determined by the memory of the model. In the Gauss-Markov Mobility Model each node is initialized with a speed and direction. By fixed intervals of time movement occurs to updating the speed and direction of each node. To be specific, the value of speed and direction at the nth instance of time is calculated based upon the value of speed and direction at the n - 1st instance and a random variable. As show in fig 5 the nod move according to previous node position .

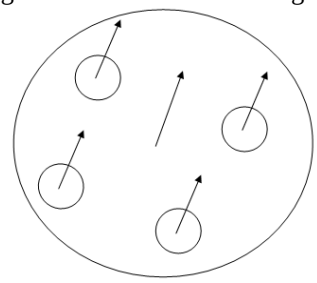


Fig 5.

Semi random circular movement:

This mobility model is designed for the curved movement scenarios of UAVs[4]. it is applicable for simulating UAVs turning around a specific position in order to gather some information. mobility model with hexagon route rather than random waypoint model for unpredicted helper node such as UAVs, their flight plan is not predetermined[15]. in this model at every instant ,each aircraft is looking at different place where it chooses the desired object in a square area as show in fig 6.

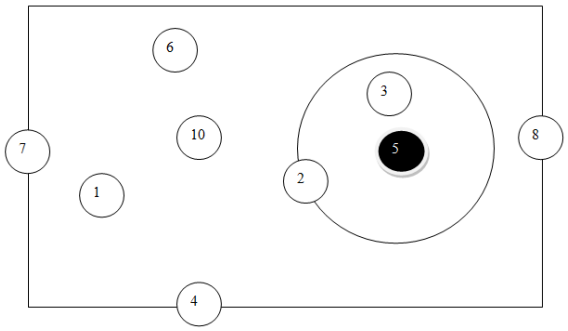


Fig 6.

Mission Plan Based Mobility Model:

In MPB model, aircraft are already aware of the entire abundant trajectory information which is usually planned in advance[15] it implies that the aircrafts travel along the predetermined path consistently where potential target location information is available as show in fig7 aircraft reach at mission area. In MPB mobility model , the mobility files are created and updated frequently after some period of time is over .[6]mission plan based mobility model for aircraft which is supposed to move towards or away from destination. for each aircraft, starting and ending point are randomly selected while velocity and flight time are given. if an aircraft reaches destination before flight time is over, it changes direction to the starting point and continues flight as round trip.

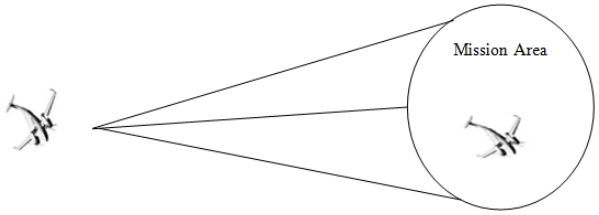


Fig 7

III. CONCLUSIONS

In this paper we have presented basically a survey of four mobility models for FANET. Mobility is one of the most challenging problem for FANET. we have discussed the difference between FANET and other ad hoc network.

IV. FUTURE SCOPE

In this paper , we have studied some mobility model .As future work we want to compare all these mobility model using one routing protocols and choose which one is best for FANET.

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