A Study of Mobility Models for UAV

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Abstract

A Unmanned Aerial Vehicle (UAV) is a category or flock of unmanned aerial vehicles that can be used for particular martial purposes and for purposes other than human action. Topological changes influence the communication and interaction between UAVs and this network presents a design problem linked to the mobility of the network. To control the traffic of UAVs, different mobility models must be investigated in order to solve this communication issue. In this paper, we will show present the different mobility models and demonstrate purely randomised mobility models performance in 3D spaces.

Key words: Mobility Models, Wireless communication, UAV

1 Introduction

To this day, the exploitation of UAVs has become extremely popular thanks to automation and sensor technology advances that encourage many researchers to study the use of several collective UAVs in order to turn down human intervention as far as possible. UAVs build networks for communication in the air, increasing demand to reach a larger area for a particular mission. UAVs must exchange information between them (within the swarm) and with the control station (outside the swarm) and these nodes move freely through the free space at various speeds. Nevertheless, it creates communication problems because of the high. This issue is not avoided due to sensitive and reliable applications in real-time. But researchers are developing new mobility models for a specific environment and applications in order to meet mobility challenges. Routing is important in UAV communication which is dependent on mobility patterns. Random movement of nodes due to environment changes and localization is re quired to redefine paths. Still, the randomized mobility model is used to model the communication scenarios of UAVs. This article follows this structure in the first section we will de scribe the different mobility models and we will show how works purely randomised mobility models in 1500 steps.

2 Mobility models

Mobility models characterize the way mobile users move according to position, speed and way over a period of time. They play a leading role in the progression of mobile ad hoc networks (MANET). In most cases, simulators play a huge role in testing the features of mobile ad hoc network simulation models. Models of this kind can allow valuable solutions for more complex cases. Mobility models that may be used for UAVCN are categorised as pure randomized mobility models, Time Dependent Mobility Model, Planned Lane Mobility Mode, Group Mobility Model and Topological Control Based Mobility Model which are further classified.The typical mobility models include:

- Random way point model
- Random walk model
- Random direction model
- Truncated Levy Walk
- Gauss-Markov
- Reference Point Group Mobility model
- Time-variant Community

2.1 PURELY RANDOMISED MOBILITY MODELS

PMRM (purely randomized mobility models) are random in natural world. UAVs float in the environment at random in terms of way, motion time and velocity. These patterns are commonly used for mission-based zone exploration using UAVCN. Random models are straightforward and primarily used in exploration. The types of pure randomized models are RWP (random way point) Mobility Model, RW (random walk) Mobility Model, RD (random direction)

2.1.1 Random way point model

The Random Way Point model(RV) was originally suggested by Johnson and Maltz. [1] The movement of the nodes is controlled as follows: Each node starts with a break of a fixed number of seconds. The node then selects a random destination. The node moves towards that destination and pauses again for a set period of time before another random location and speed. Fig. 1.

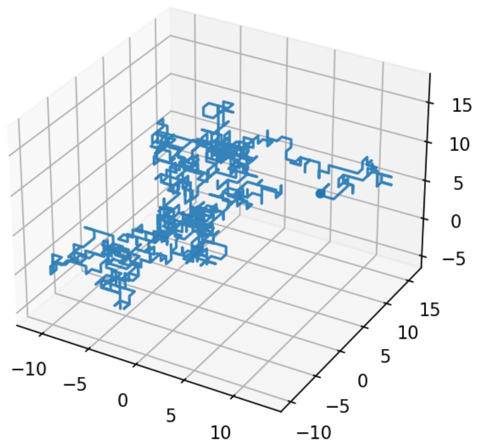

Figure 1: Random waypoint model

2.1.2 Random walk model

A random walk is a random action that turn back a path comprising a sequence of random steps in the mathematic position.Fig. 2 Traditional random paths can be used to calculate proximity between nodes and extract topology from the network. [2] Algebraically a random walk is represented as follows:

$$y_t = y_{t-1} + \epsilon_t \tag{1}$$

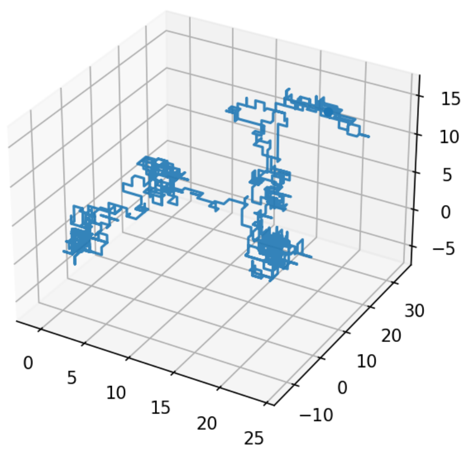

Figure 2: Random walk model

2.1.3 Random direction model

Two of the most popular are random way point and random directional patterns. The random way point model is physically attractive but not easily understood. Although the direction model is less physically attractive, it is much more easily understood. User speeds are easy to calculate, in contrast to the way point model, and as observed, user positions and directions are evenly distributed. [3] Fig. 3.

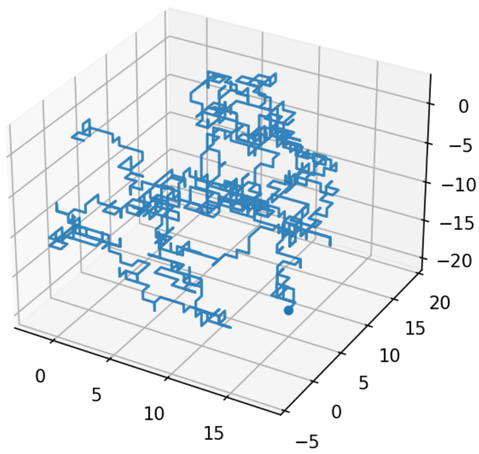

Figure 3: Random direction model

2.2 Truncated Levy Walk

A Levi flight is a random walk in which the steps have a distribution of Levi, a distribution of probability that is heavy-tail. When defined as a walk in an area larger than one, the steps taken are in isotropic random directions. Later, researchers extended the use of the term "Levi flight" to cases where the random walk takes place on a discreet grid rather than in continuous space [4].

$$\int_{-\infty}^{\infty} e^{tx} dF(x) \quad = \quad \infty \qquad \text{for all } t > 0. \tag{2}$$

2.3 Gauss-Markov

The Gauss-Markov mobility model has been designed to accommodate various levels of chance via an adjustment parameter. The Gauss-Markov mobility model also provides motion patterns which can be expected in the real world if suitable parameters are selected. [5]

$$s_n \quad = \quad \alpha s_{n-1} + (1-\alpha)\bar{s} + \sqrt{(1-\alpha^2)\, s_{x_{n-1}}} \tag{3}$$

$$d_n \quad = \quad \alpha d_{n-1} + (1-\alpha)\bar{d} + \sqrt{(1-\alpha^2)\, d_{x_{n-1}}} \tag{4}$$

2.4 Reference Point Group Mobility model

This model is described as an alternative way of simulating group behaviour in [6]. Where each node belongs to a group where each node follows a logic center (group leader) which determines the movement behavior of the group. The nodes of a group are generally randomized around the reference point.

$$T \quad = \quad t_0 + \Delta t \tag{5}$$

2.5 Time-variant Community

Time variant community mobility model - which consists of two kinds of periods and one community at each time, for a clear presentation. Despite its simplicity, it is enough to understand the main trends of the two mobility features mentioned above.

3 Why choosing a mobility model is important

In this part, we show that choosing a mobility model can have a significant impact on the performance survey of an ad hoc network protocol. The results presented illustrate the importance of selecting one or more suitable mobility models to evaluate the performance of a particular ad hoc network protocol. We use 1500steps to compare the performance of the Random Walk Mobility Model, the Random Way point Mobility Model, the Random Direction Mobility Model via a simulation it in 3d space.Fig. 4 In this performance Random Direction mobility model gets the least time results compared to Random Way points and Random Walks.

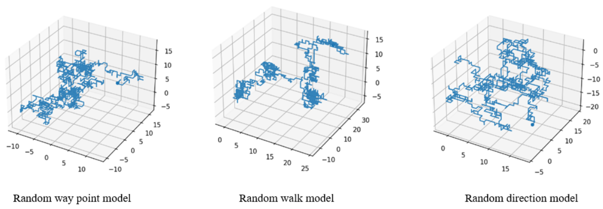

Figure 4: Performance of models.

4 Conclusions

In this paper, we have explored the edge technology related mobility models for specific environment situation path in the communication networks of UAVs. The research society focused on the leading-edge issue of a swarm of UAV communications in this area. In this paper, we did an experiment with purely randomized mobility models in 3D spheres and we saw that every model gets a different time of working at the same distance. This gives researchers the opportunity to explore the new area of research, ad hoc networking and UAV communication networks.

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