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Flow mobility modeling in vanet

Divya Shree

Assist Proff ln Computer Science, DPG Institute of Technology and Management, Gurgaon, Haryana India

Abstract
The most important feature of Vehicular Ad hoc Networks (VANETs) is the high mobility of nodes, which makes the mobility model one of the most important parameters that should be carefully selected when evaluating any protocol. To correctly and faithfully evaluate protocols in a simulation study, the model should be as realistic as possible. Vehicles communicating wirelessly play an important role in the simulation of Vehicular Ad Hoc Networks (VANETs). In this paper, one of the main mobility modeling approach is discussed to the extent that it can help to understand models formulation and integration strategies with network simulators. This approach is called as flow mobility modeling. It is put into the discussion and elaborated in such way it clarifies basics of flow modeling and its impact. It also finds a different ways of modeling and implementation into existing traffic simulators viz. SUMO, VISSIM etc.

Keywords: VANET, Flow modeling, Integration strategy.

1. Introduction

Vehicular Ad Hoc Networks (VANETs) are a special case of Mobile Ad Hoc Networks (MANETs) and consist of a number of vehicles traveling on urban streets, capable of communicating with each other without a fixed infrastructure. Vehicles move on road and these road segments (maps) contains traffic lights, speed breaker, diversions, other obstacles etc. due to which movement of vehicle is not the constant from source to destination which changes due to above factors [1].
One key component of VANET simulations is the movement pattern of vehicles, also called the mobility model. Mobility models determine the location of nodes in the topology at any given instant, which strongly affects network connectivity and throughput. The current mobility models used in popular wireless simulators such as NS-2 [2] tend to ignore real-world constraints such as street layouts and traffic signs.
Due to phenomenon of dynamic topology implementation of mobility model into traffic simulator or into network simulator real motion constraints as well as motion pattern [1, 3] with obstacles to be considered. This indicates that vehicles motion is major concern in VANET'S advancement.

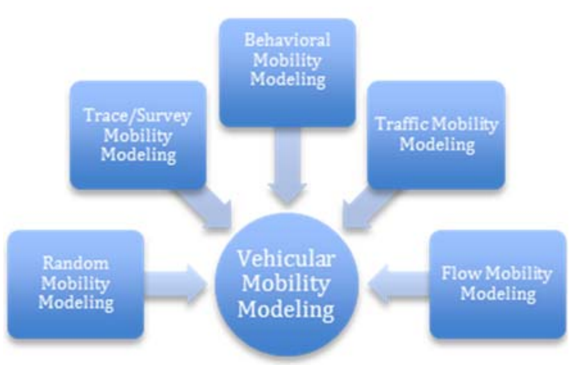
Related Work

The authors "Atulya Mahajan, Niranjan Potnis, Kartik Gopalan and An-I A. Wang" [1] in 2005 studies various Mobility Models that account for vehicular movement constraints such as traffic lights multilane roads and acceleration/deceleration. By comparing various Mobility Models effect on delivery ratio and packet delays are demonstrated at intersections. Routing performance is calculated by simulation of multiple lanes and synchronization of traffic lights. Their work provides a sound starting point for further understanding and development of more realistic and accurate Mobility Models for VANET simulations.
The Author "Nidhi and D.K. Lobiyal" [5] proposed in February 2012, evaluate the performance of VANET in a realistic environment by generating a real world road Map of JNU using existing Google Earth and GIS tools. The realistic mobility model used here considers the driver's route choice at the run time and studies the clustering effect caused by traffic lights used at the intersection to regulate traffic movement at different directions. Finally, the performance of the VANET is evaluated in terms of average delivery ratio, packet loss with traffic light scenario. This experiment has provided insight into the performance of vehicular traffic communication for a small realistic scenario.
The Author "Aamir Hassan" [2] in May 2009 uses a simulator tool, which is simple, easy and cheap for vehicular safety. In VANET traffic and network simulator are used together to perform the test. A good simulator is needed to analyze the effect on external communication. So first of all study of current simulators is done and then simulation is performed
The Author "Nayana. P.Vaity &Dnyaneshwar. V. Thombre" in May 2012 discusses and elaborates basic approaches of flow mobility modeling and also finds a different ways of modeling and implementation into existing traffic simulators viz. SUMO, VISSIM etc.

Analysis

Types of Mobility Models

Basically mobility models are characterized in 5 different types of models: -



1. Random models: The mobility parameters like speed of vehicle, destination point etc. is considered random. The popular models are Random waypoint Model (RWM), Reference Point Group Mobility Model (RPGM), Freeway Model [8], Manhattan Model. These models are rather inappropriate for modeling VANET application; however these models are most popularly used. A very limited interaction between vehicles is there in this model.
2. Flow models: Here movement of vehicle as a single entity, group entity and entity having probability density function are concerned. Here, there is a small interaction between vehicles and environment. These types of models are used to evaluate traffic and safety related applications. These models cover the static and dynamic behavior of cars in motion, which can lead to simulate realistic behavior of vehicles. The approach of flow mobility is emphasized and focused to understand clear idea behind consideration of smallest to largest details of car behavior [10].

This model can be subdivided into 3 types.

I. Microscopic modeling: Microscopic mobility modeling is way of flow modeling in which flow of vehicle is considered in detailed level i.e. local characteristic of vehicle [9, 10] is attributed. In other words, Car's properties such as car's acceleration / deceleration, driver's behavior, car's length, car's speed etc. are to be modeled. E.g.: Car following model (CFM), Intelligent Driver Model (IDM), Krauss Model, The Weidman Model, Cellular automata model (CA) is Microscopic flow models.

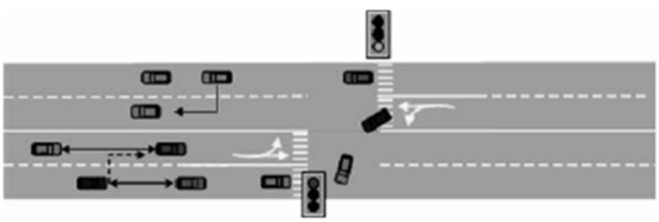


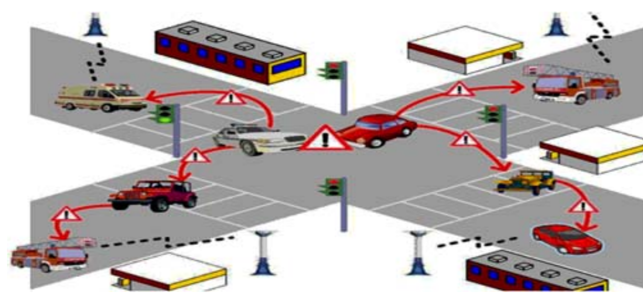
Fig 1.6: Movement of vehicles in directional flow

II. Macroscopic Flow models: This is an approach of flow modeling, which considers flow of vehicle at global perspective. Macroscopic properties are global in nature that is when large number of vehicles is in motion; global parameters can be represented as flow, mass and density respectively. E.g.: Light hill whit ham Richard model (LWR) is a macroscopic flow model.

III. Macroscopic flow models: Macroscopic modeling represents an intermediate modeling level of traffic flow. It is a way of modeling in which microscopic and macroscopic modeling is merged. It may lead to efficient trade-off between modeling of individual vehicles and the modeling of large quantities of vehicles. This type of models may take different forms such as the modeling headway distance as an average of large number of vehicles sometimes size or density of cluster of vehicles. One of mesoscopic model called as queue model. This model includes dynamic behavior of vehicle and macroscopic properties such as density and velocity for large number of vehicles. E.g.: Gas kinetic traffic flow model.

3. Traffic models can be subdivided in two motion patterns, trip planning, which first defines origin and destinations, and path planning which then fixes the sequence of directions to be taken by each vehicle [11] Two random trip-planning approaches exist: Random trip which randomly chooses an origin and a destination, and stochastic turn which chooses a random direction at each intersection, which are the most commonly implemented in existing vehicular mobility models. The last trip planning approach brings more realism by defining a set of departure and destination points, also referred to as attraction points, either user-defined as in NCTUns or based on a sequence of activities (e.g. hotel, restaurant, etc.) extracted from realistic maps, as in the mobility traces generator Canu MobiSim, its extension Vanet MobiSim and the traffic simulator SUMO.
4. Behavioral models: Driver of vehicles are humans. They are not machines and cannot follow a specific behavior in all cases. Local parameters influence Human behavior, rather than some specific behavior. This helps in traffic modeling as human behavior is added to him. Balmer [13] proposed a behavior model in 2007. These models help us in studying whether the human will follow the traffic advice or not. These types of models are used to study human behavior in any emergency situation.
5. Trace based models: Trace-based and survey-based models are an alternative to complex Mobility Models development and calibration using real traffic data. They instead allow defining generic mobility patterns from real vehicular traces. These types of models are basically very new ones and require a lot of work to do upon. These models are used to understand the movement pattern of vehicles so that proper realism can be achieved. These types of models are the models of future and are for evaluating traffic, safety and user applications

Communication between Simulator and Traffic Generator



Interaction between traffic generator and network simulator is needed to establish properly to achieve smooth communication. Below mentioned Interaction strategies may give us idea about existence of architectural techniques for traffic generator that historically generates random, microscopic, real world (survey based) traces. Various ways of simulation:

1. Isolated simulation: In this class of integration, vehicular, mobility traces are generated as static and parsed to network simulator. These traces can be real world traces or randomly generated traces. No specific interface is defined for communication. Unfortunately, all historical models and most of the recent mobility models available to the research community fall into this category
2. Embedded simulation: A vehicular traffic simulator is into network simulator or conversely a network simulator is

embedded into a vehicular traffic simulator allowing bidirectional interaction between both the simulators.
3. Federated simulation: Coupling between traffic simulator and network simulator communication occurs via external interface which controls as well as permits smooth communication to pass between two. In this type of method, interface will be bidirectional for two separate entities

Conclusion

VANET is a advanced technology composed of modules which helps in simulation of vehicular network for last many years. But recent development in network simulator requires another or more advance modules which can simulate more realistic behavior of highway and urban scenarios. This paper surveys flow mobility modeling approach in which flow model is developed in fact it gives clear idea about what is flow model and its various ways to develop it. Flow of vehicles is focused in these models. Flow can be seen as local or global parameter in order to incorporate it into the mobility generator. It may lead to implementation of traffic simulator which can generate realistic traffic.

Future Work

In real world, road can be of multilane and movement of vehicles on this topology is different than single lane road. Therefore research in future should be conducted to have road map which is multilane structure and flow of vehicles is not in one direction or in one lane only in other words lane changing models can also be analyzed and developed in detailed. Other than this, intersection management and real world traces can be used in formulation of models when bridge scenarios [9, 11] to be simulated. It can give large impact on generation of traffic since city scenarios such as bridge (flyover) is common in road layout.

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