Chapter 21

MOVE:
A Practical Simulator for Mobility Model in VANET

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ABSTRACT

Vehicular Ad-Hoc Network (VANET) is surging in popularity, in which vehicles constitute the mobile nodes in the network. Due to the prohibitive cost of deploying and implementing such a system in real world, most research in VANET relies on simulations for evaluation. A key component for VANET simulations is a realistic vehicular mobility model that ensures conclusions drawn from simulation experiments will carry through to real deployments. However, VANET simulations raise many new questions about suitable levels of details in simulation models for nodes mobility. In VANET simulations, the mobility models used affect strongly the simulation output. The researchers need to decide what level of details are required for their simulations. In this chapter, the authors introduce a tool MOVE that allows users to rapidly generate realistic mobility models for VANET simulations. MOVE is built on top of an open source micro-traffic simulator SUMO. The output of MOVE is a realistic mobility model and can be immediately used by popular network simulators such as ns-2 and Qualnet. The authors show that the simulation results obtained when using a realistic mobility model such as MOVE are significantly different from results based on the commonly used random waypoint model. In addition, the authors evaluate the effects of details of mobility models in three case studies of VANET simulations (specifically, the existence of traffic lights, driver route choice and car overtaking behavior) and show that selecting sufficient level of details in the simulation is critical for VANET protocol design.

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INTRODUCTION

VEHICULAR Ad-Hoc Network (VANET) communication has recently become an increasingly popular research topic in the area of wireless networking as well as the automotive industries. While it is crucial to test and evaluate protocol implementations in a real world environment, simulations are still commonly used as a first step in the protocol development for VANET research. Several communication networking simulation tools already existed to provide a platform to test and evaluate network protocols, such as ns-2 (T. N. S. ns 2, 2009), OPNET (O. Simulator, 2009) and Qualnet (Q. N. Simulator, 2009). However, these tools are designed to provide generic simulation scenarios without being particularly tailored for applications in the transportation environment. On the other hand, in the transportation arena, simulations have also played an important role. A variety of simulation tools such as PARAMICS (P. M. T. Simulation, 2009), CORSIM (CORSIM, 2009) and VISSIM (P. simulation VISSIM, 2009) etc have been developed to analyze transportation scenarios at the micro- and macro-scale levels. However, there was little effort in integrating communication techniques and scenarios in a realistic transportation simulation environment.

One of the most important parameters in simulating ad-hoc networks is the node mobility. It is important to use a realistic mobility model so that results from the simulation correctly reflect the real-world performance of a VANET. A realistic mobility model should consist of a realistic topological map which reflects different densities of roads and different categories of streets with various speed limits. Another important parameter should be modeled is the obstacles. In the real world, a vehicle node is typically constrained to streets which are separated by buildings, trees or other objects. Such obstructions often increase the average distance between nodes as compared to that in an open-field environment. In addition, each vehicle needs to decide a turning directions at the intersection (e.g. turn left, turn right or go straight). Such a turning model could have an effect on the congestion of the road as well as on the clustering of the vehicles. Furthermore, a smooth deceleration and acceleration model should be considered since vehicles do not abruptly break and move. Some prior studies (Saha et al., 2004; Heidemann et al., 2001) have shown that a realistic model is critical for accurate network simulation results. Selecting appropriate level of details in the mobility model for a VANET simulation is a critical decision. Unrealistic mobility model can produce simulations that are misleading or incorrect. On the other hand, adding details requires time to implement and debug. In addition, it might increase simulation complexity, slow down simulation, and distract the research problem at hand.

In this chapter, we develop a tool MOVE (MObility model generator for VEhicular networks) to facilitate users to rapidly generate realistic mobility models for VANET simulations. MOVE provides an environment that allows the user to quickly pinpoint incorrect details and manage details overhead. Our tool is built on top of an open source micro-traffic simulator SUMO (S. S. of Urban Mobility, 2009). The output of MOVE is a mobility trace file that contains information of realistic vehicle movements which can be immediately used by popular simulation tools such as ns-2 or qualnet. MOVE allows users to rapidly generate realistic VANET mobility models in two aspects:- by interfacing with real world map databases such as TIGER (Topologically Integrated GEographic Encoding and Referencing) (TIGER, 2009) and Google Earth, MOVE allows the user to conveniently incorporate realistic road maps into the simulation. In addition, by providing a set of Graphical User Interfaces that automate the simulation script generation, MOVE allows the user to quickly generate realistic simulation scenarios without the hassle of writing simulation scripts as well as learning about the internal details

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