Abstract

Localization (location estimation) of a vehicle in Vehicular Ad-hoc Network (VANET) has been studied in many fields since it has the ability to provide a variety of services like navigation, vehicle tracking and collision detection etc. Global Positioning System (GPS) and Inertial Navigation System (INS) both are very useful method of localization. By using Kalman Filter it is possible to combine these two systems to get better accuracy of localization. Now day’s typical localization techniques combines GPS receiver measurement and measurements of the vehicle’s motion by INS. However, when the vehicle traveling through an environment that creates a multipath effect, these techniques fail to produce the high localization accuracy that they attain in an open environments because of loss of satellite signal in a multipath area, such as areas with high buildings, trees, or tunnels. In this new advance localization technique is proposed to improve localization accuracy. Also Artificial Neural Network is used to detect multipath environment and then by using Nelder Mead Optimization method we can reduce the localization error of a vehicle when it travelling through multipath environment.

Keywords: VANET, GPS, INS, ANN.

I. Introduction

A Vehicular Ad-Hoc Network (VANET) is a technology that uses moving cars as nodes in a network to create a mobile network. VANET turns every participating car into a wireless router or node, allowing cars approximately 100 to 300 meters of each other to connect and, in turn, create a network with a wide range. As cars fall out of the signal range and drop out of the network, other cars can join in, connecting vehicles to one another so that a mobile Internet is created. It is estimated that the first systems that will integrate this technology are police and fire vehicles to communicate with each other for safety purposes. Vehicle location estimation is an important role in VANET environment and it is recently attracted attention in wide range of application. The Global Positioning System (GPS) is a technology that has been develop and operated by the U.S. Department of Defense. GPS is a solution for the vehicle localization problem but, the GPS based localization is inaccurate and unreliable due to GPS’s poor performance in multipath environment. Thus a new optimization technique is to implement for vehicle location estimation when multipath environment occurs. A Vehicular Ad hoc Networks (VANET’s) is a type of wireless network is able to provide many communication services via the collaboration of the vehicles in the network. However, the accuracy of its localization is not satisfactory for some vehicular applications. It means when vehicles passes through the environment having large buildings and number of trees present near to the road side. Vehicle localization is a key issue that has recently attracted attention in wide range of application. Also the localization of a vehicle is important issue. But, when vehicle suffering through multipath environment GPS signal can be lost and we can’t get accurate location of a vehicle. Thus it is important to improve accuracy of localization of a vehicle when it is travelling through multipath environment.

II. Background

In the early 1970’s, the DoD has proposed a Global Positioning System (GPS) called NAVSTAR (NAVigation Satellite Timing And Ranging).The first NAVSTAR satellite was launched by the U.S. Air Force in early 1978 for military use NAVSTAR was expanded for civilian use in the 1980’s. In 1994, a full constellation of 24 satellites was achieved. GPS is a satellite-based system that uses a constellation of 24 satellites to give a user an accurate position. [6] The Navigation is the process used to estimate the position, orientation and velocity of a vehicle and inertial navigation means the
inertial sensors are utilized for the navigation, basically an Inertial Navigation System (INS) is to provide accurate worldwide navigation information independent of external aids; the system neither transmits nor receives any signals. After being supplied with latitude and longitude of the ramp position prior to departure, INS is capable of continuously updating extremely accurate displays of position, ground speed, attitude and etc. There are several localization technique are available like Assisted Global Positioning System (A-GPS), Differential Global Positioning System (D-GPS), Map Matching, Dead Reckoning System etc. But they have some limitations.

**Limitations of existing systems:**

The following are the limitations of existing systems

a) GPS Based system: Low latency to localize vehicles inside a building, underground, underwater or in tunnel. Accuracy is not adequate for emerging safety applications. Unreliable in multipath effect.

b) DGPS Based System: Requires fixed ground based reference station to broadcast differential information.

c) Map-matching technique: It is not a localization technique by itself: It can be used for improving the performance of many positioning systems.

d) Dead reckoning system: It can accumulate errors easily over a long period of time and long distances.

e) Cellular Localization: Less precise than GPS.

1. **Introduction of Kalman Filter (GPS/INS Integration):**

The Kalman filter is a set of mathematical equations that provides an efficient computational (recursive) means to estimate the state of a process, in a way that minimizes the mean of the squared error. The filter is very powerful in several aspects: it supports estimations of past, present, and even future states, and it can do so even when the precise nature of the modeled system is unknown. A Kalman filter is a method of estimating the true value of a set of variables from a set of noisy measurements. The important part of Kalman Filter in this paper is to combine two systems, one is INS and other is GPS. The Kalman Filter can be implemented by considering the vehicle moving on a straight road with constant speed and direction. [6] Thus all the experiments will be simulated in MATLAB. But Kalman Filter is not efficient in multipath environment because of loss of satellite signal. Thus it is important to find accurate localization in it.

2. **Artificial Neural Network (ANN):**

It is also important to detect a multipath environment because we have to improve accuracy of a vehicle when it suffers through multipath environment.

The ANN can be used to detect presence of multipath effect. A neural network is an artificial intelligence method that models the human brain. A neural network can be trained to classify different patterns that belong to known classes via supervised or unsupervised learning methods [6]. The type of neural network that has been chosen in this study is Feed-Forward Back propagation Network (FFBN) since it falls under the supervised learning category of Artificial Neural Networks (ANN). It can be easy to construct and implement in MATLAB. In the neurons of the input and hidden layers a hyperbolic tangent sigmoid transfer functions have been used. The output layer is consisting of one neuron, which can provide a weighted linear combination of the output of the hidden neurons. [6]

### III. Proposed Block Diagram

**Fig 1: Block diagram of proposed technique. [6]**

First Kalman is used to combine GPS and INS systems. But Kalman filter technique is fail in multipath environment because of loss of satellite signal in it. Thus it is important to detect whether multipath environment is available or not by ANN. Once ANN is able to detect multipath environment the output of Kalman filter can be given to optimization method in which least mean square error is reduced and can be improved localization accuracy.

Basically in optimization technique, concept of communication amongst the vehicle is used because all the necessary information is collected by those vehicles which are accurate about their position by GPS and that information is used by this technique. There are several methods used for localization of nodes in VANET. The main methods are Angle of arrival (AOA), Time of arrival (TOA) and Time Difference of Arrival (TDOA) and Received Signal Strength (RSSI) [5]. Thus with the help of Nelder Mead method of optimization we can reduce the error and accuracy of localization will be improved.
IV. Conclusion

Here in this paper advance localization technique has been proposed to improve localization accuracy of a vehicle when it travelling through multipath environment. As we know that VANET’s vehicle localization is important role. Thus we can find it by Kalman Filter but Kalman Filter is not efficient in multipath environment where GPS signal can lost due to high buildings, number of trees and tunnel etc. Thus this drawback is overcome by optimization technique and corrects the Kalman Filter’s output in multipath environments. For detection of multipath environment here ANN has been proposed. The future work is to implement simulation of all these work in MATLAB to observe whether it is improving accuracy of localization in multipath environment or not.

V. References


