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## Burg Spectral Frequency Estimation For Automative Vehicle Localization

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**ABSTRACT:** Vehicle self-localization, the proficiency of a vehicle to search its own place, is a crucial for many aspects of Intelligent Transportation System (ITS). Though the localization information can be get with the Global Positioning System (GPS) technology but challenges arises in urban environment, where satellite visibility and multipath conditions are common. This paper aims to develop a Integrated and Smart vehicle localization by using Burg Spectral Frequency Estimation algorithm for ITS, which can deliver good localization accuracy under different geographical environments give a strength of vehicle signal using BSF (Burg Spectral Frequency Estimation). This algorithm was originally developed to support road transportation and solves the traffic congestion problem, in addition to ensuring safety. The Smart localization algorithm is found to deliver the required localization accuracy at the least amount of complexity.

**KEYWORDS:** Vehicle self-localization, BSF,ITS,GPS, traffic congestion

### I. INTRODUCTION

Intelligent Transportation Systems (ITS) are systems that use intelligent technology to make the roads safer and more efficient, as traffic, congestion and uncertainty have increased at an alarming rate in recent years. It plays a crucial role in traffic management systems, traveler information systems, vehicle navigation systems, information dissemination, law enforcement and security, safety, environmental monitoring and protection, accessibility to traveler information and comfort factors. The Vehicle position is generally achieved using satellite positioning technology, of which the Global Positioning System (GPS) is the most established. However, GPS technology is identified to generate inaccurate position estimates in certain conditions. The most significant Contributors to these inaccuracies are: satellite visibility, where the location cannot be found because satellite signals cannot reach the receiver due to large surrounding structures or dense foliage signals cannot reach the receiver; and multipath conditions, where signal reflections off of large buildings create large errors in the location estimate. Definite and prosperous location of vehicle is acquired by enhancing GPS technology with complementary sources of information, including dead-reckoning sensors, digital maps and machine vision. Also with GPS ,V2V, V2I, V2P, RFID technologies used for vehicle localization. The realization of localization varies depending on what type of map is used to represent the environment. There are two main categories of map representations: metric and topological. Localization for the metric map refers to the task of determining the position of the vehicle with respect to the coordinate system, while localization for a topological map requires landmark detection using vision, range finding or a combination of both to determine the object's relative distance to landmarks within the map. This type of localization is very effective in structured environments, such as indoor environments. Absolute localization refers to localization techniques that provide a direct measurement of global position. Relative localization, also known as dead reckoning, is the process of determining position relative to a starting point. This starting point may be a location with known global coordinates, or it may be considered the origin of an arbitrary position frame. In either case, relative localization is characterized by the exclusive knowledge of initial position, with no means of directly measuring position afterward. The challenges posed during localization include vision, data association and data fusion.

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This Paper is organized as follows. In the next Section Problem Definition of Proposed work Section 3 shows Methodology for Integrated and Smart Localization Algorithm for Vehicle Localization and BSF. Section 4 Provides Simulation and Results Section 5 for a Conclusion then 6 Future work.

## II. RELATED WORK

Intelligent Transportation Systems (ITS) [2] have emerged to utilize different technologies to enhance the performance and quality of transportation networks. Numerous works have been reported in support of vehicle localization. Reza et al have proposed a method of asynchronous wireless sensor localization using Time of Arrival (TOA) [11]. In TOA localization, the travel time of the signal between the source node and anchor nodes was measured and used to estimate range. A non-cooperative localization algorithm is presented in [4], wherein every communication has to be performed through a base station and no two neighboring vehicles connect directly to each other. In [12], cooperative localization has been deployed. Here, the vehicles communicate with the infrastructure as well as to each other, eliminating the need for dense infrastructure and long communication range. Eun et al [7] have proposed an RFID-assisted localization system. The proposed system employs the DGPS concept to improve GPS accuracy. A new localization methodology based on the PLICP (Iterative Closest/Corresponding Point Based on Point to Linemetric) [5] algorithm has been proposed by Yinglin et al to provide accurate position estimation of the vehicle. Here, autonomous hovering and trajectory tracking control were achieved via on-board sensor and processors.

## III. PROBLEM DEFINITION

The significant growth of population and vehicles demands more reliable and efficient transportation networks everywhere, from large and small cities to suburb and rural areas. The performance of the current transportation systems can be enhanced by using information technology and making them more intelligent. Therefore, Intelligent Transportation Systems (ITS) have derived to promote safety, efficiency, and navigation quality of the transportation networks by exploiting different types of technologies. Current vehicle positioning techniques highly rely on the Global Positioning System (GPS). However, GPS cannot provide reliable location information for all applications under all situations. The one more major issue in this field is that particular application of ITS requires a specific localization accuracy at a specific latency. For example, safety purpose application of ITS that is collision warning message requires highly proper location information from the vehicles at the least amount of latency. The reason is that a small error in the location information of the vehicles may cause a tragic accident. Moreover, the message warning should be processed as fast as possible to enable the drivers to decide accordingly and prevent the accident. On the other hand, tourist information is another application of ITS which does not need proper location information. In this case, once the vehicle enters in a specific area, useful information is provided for the driver. Therefore, accurate location of the vehicle is not required. Moreover, this information is not required to be received by the driver very quickly and high latency is acceptable. Hence, there is a need for a Smart localization technique that can deliver the required localization accuracy at the required latency, depending on different applications

## IV. METHODOLOGY

Vehicle localization involves the estimation of the vehicle's location from a series of range measurements obtained from GPS satellites, V2I, V2V, and RFID connections [10]. The two main components that enable vehicle localization in the proposed work are (a) Integrated Localization Algorithm (b) the Smart Localization Algorithm. The Integrated Algorithm uses GPS, V2V, V2I, DR and RFID technologies [7] [12]. Power spectral density estimation is used to recognize the frequency of incoming signal. The accuracy of vehicle localization increases with the number of connections, but complexity gets intensified. The smart localization algorithm aims to maintain a tradeoff between accuracy and complexity through filtering out the redundant connections, which improve the accuracy level, and providing the desired connections to the integrated algorithm.

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## Burg Spectral Frequency Estimation:

The signal which has greater peak that signal is having a more frequency than other signal. According to BSF (Burg Spectral frequency estimation) it gives strength of that signal using frequency/db verses Normalized frequency graph. The BSF graph also shows the localization error of vehicle .The BSF graphical representation gives the idea of intensity of vehicle on that area of network.

## Flowchart:-.

This flowchart is for Smart Vehicle Localization Algorithm. It provides concept of the smart localization algorithm. when the running time of the connection selection process plus location estimation based on those connections is less then the Smart algorithm is only pragmatic than that of the fully-Integrated algorithm using all connections.

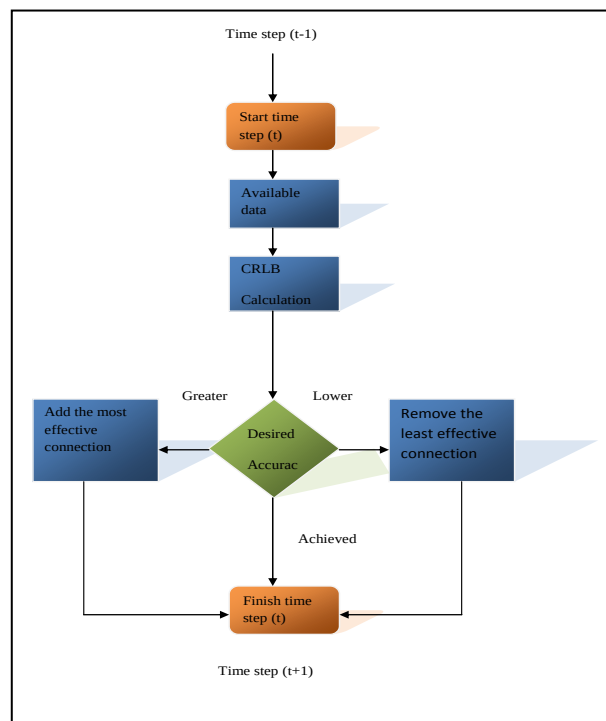


Fig 1. The flow chart of the proposed Smart Algorithm.

## V. SIMULATION AND RESULT

### A. Experimental Results

The vehicle localization approach is done with the help of user interface from ISR-TrafSim v2.0 [9]. The layout of the interface is in Fig. 2. There are many directions in the road. In each direction, the traffic light is fixed. Each traffic light indicates the condition for the vehicle movement.

- The green light allows traffic to proceed in the direction denoted, if it is safe to do.
- The yellow light warns that the signal is about to change to red. In a number of countries – among them the United Kingdom – a phase during which red and yellow are displayed together indicates that the signal is about to change to green. Actions required by drivers on a yellow light vary, with some jurisdictions requiring drivers to stop if it is safe to do so, and others allowing drivers to go through the intersection if safe to do so.

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- The red signal prohibits any traffic from proceeding. flashing red indication is treated as a stop sign.  
Traffic lights alternate the right of way accorded to users by displaying lights of a standard color (red, yellow and green) following a universal color code.

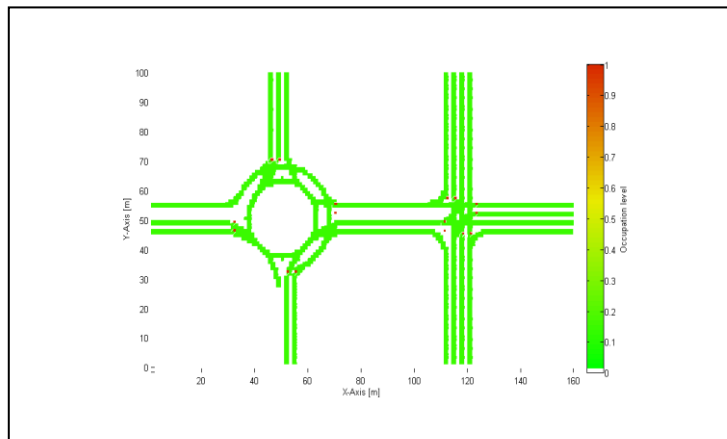


Fig 2.Layout of the user interface for vehicle localization.

The experimental set up of vehicle localization is done based on the graphical user interface. The localization pattern is simulated with this process. The interface which is used for the purpose of localizing vehicle is shown in Fig. 3. The traffic signal is the, main thing to follow while driving. The two signals used in interface are red signal and green signal.

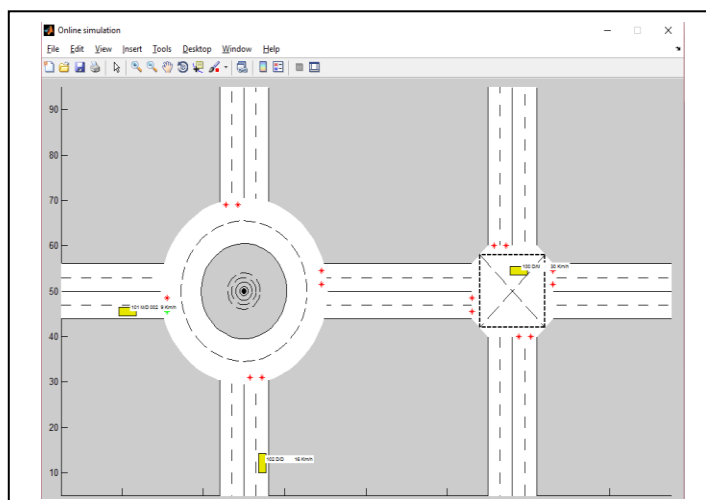


Fig 3. Layout of the user interface for vehicle localization.

The red indicates that to stop the vehicle and the green signal indicated to proceed the vehicle in a particular direction. In each directions, there are concerned signals. The localization of the particular vehicle moving in the road is shown in Fig. 4. Here the red light indicates to stop the vehicle. The vehicle with green color is the vehicle which we are localizing in this experiment. The particular vehicle is localized based on its velocity of movement and also the

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traffic problems. It can identify in which direction the vehicle is moving. The speed of the localized vehicle can also be determined.

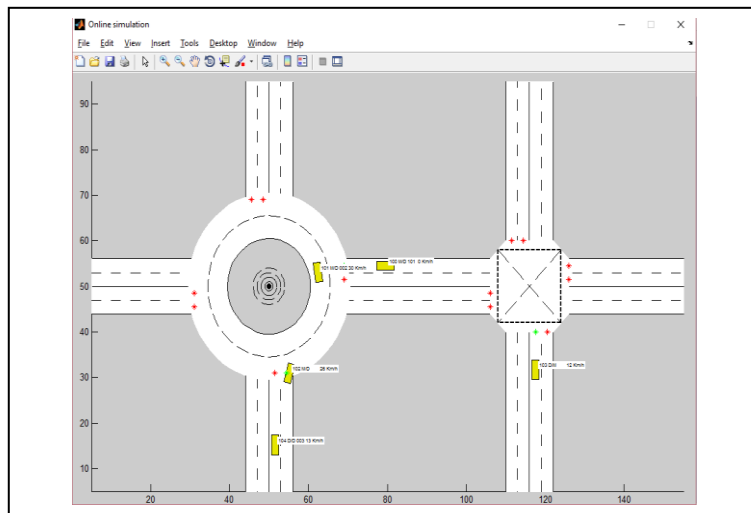


Fig 4.Vehicle localization.

## B. Localization error for the Smart Algorithm

Though the smart algorithm improves the localization performance, the vehicle need not use all its available connections because using all information does not necessarily lead to a noticeable higher accuracy and it increases the localization complexity considerably [1]. In addition, in some situations it is not very critical to have a very precise accuracy or it would be preferred for the location to be estimated in a least amount of time with minimum accuracy requirement[2]. The graphical representation of the localization error formed in vehicle localization is shown in Fig.5.

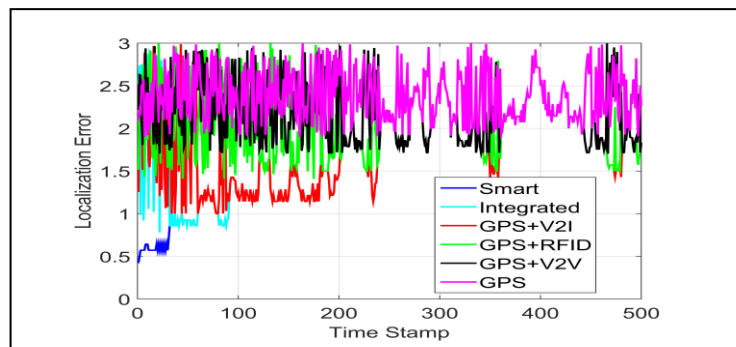


Fig 5.Graphical representation of localization error.

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## C. Distribution of localization

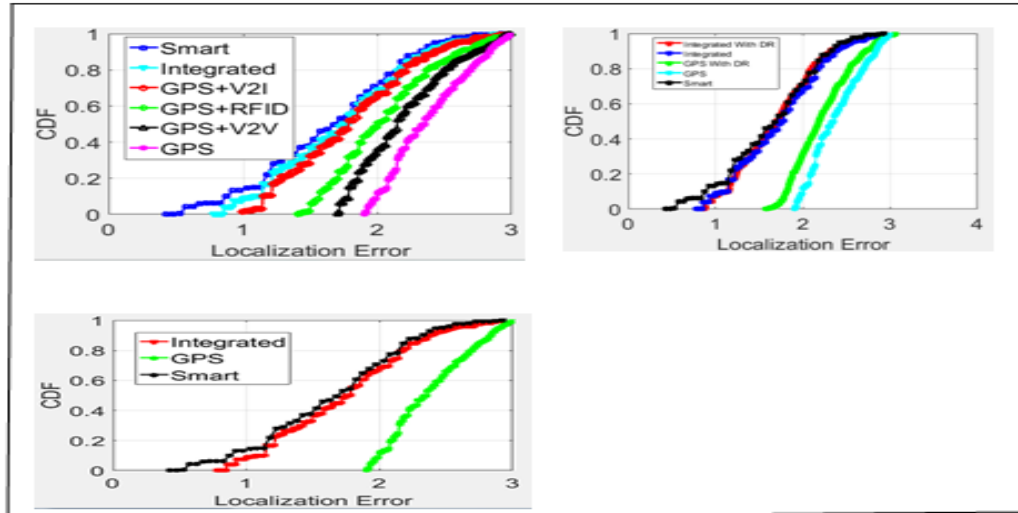


Fig 6. Graphical representation of distribution of localization.

The comparison of the cumulative distribution of vehicle localization of the smart algorithm with the conventional algorithms is shown in Fig. 6. The analysis reveals that the localization error for smart algorithm is minimum [2].

## D. Velocity of the vehicle

The velocity of the vehicle in different direction in particle time is shown in Fig. 7.

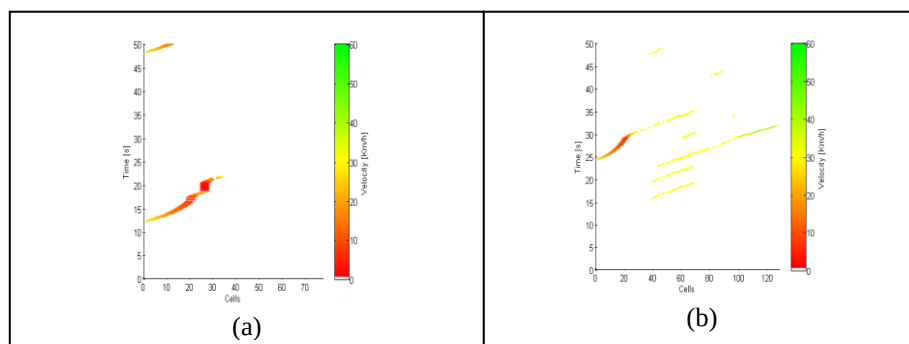


Fig 7. Velocity of the vehicle in different location (a) Path1 (b) Path 2.

The user interface system consists of many cells which represents different directions. Here the vehicle localization is determined in two different paths. In path 1, the velocity is 30 km/hr in 20s. In path 2, the velocity is 50 km/hr in 50s. The speed of the vehicle at different distance varies according to the distance.

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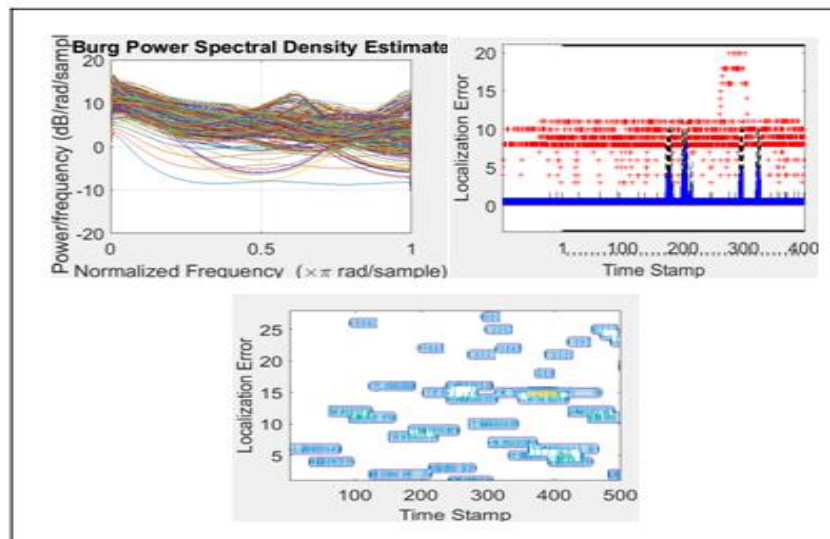


Fig 8. Power spectral density estimate.

The power spectral density of signal of vehicles that has been shown in graphical format in Fig. 8.

This graph shows power spectral density of signals. The signals are considered from incoming signal of vehicles. According to that the signal which gives better peak, that signals having a good strength of signal.

## E. The RMSE and running time of the Smart algorithm

The Root Mean Square Error (RMSE) of different version of smart algorithm is compared in TABLE I. For Smart-3, Smart-7, and Smart-10, the achieved RMSE is larger than the required accuracy. The reason is that the Smart algorithm uses the CRLB to predict the error and the CRLB is a lower bound and typically lower than the actual error. Hence, achieving the CRLB is too optimistic[2]. Despite the fact that the difference is less than 10% in these cases, the user can set the required accuracy more conservatively. This means that if the user would like to achieve the RMSE of 3m, they can set the accuracy for the Smart algorithm to 2m.

TABLE I. THE RMSE AND DISTRIBUTION OF DIFFERENT ALGORITHMS

| Algorithm             | RMSE   | CDF (80% localization error) |
|-----------------------|--------|------------------------------|
| Smart                 | 1.7188 | 2.1786                       |
| Integrated            | 1.7651 | 2.1054                       |
| GPS-V2I               | 1.8562 | 2.22                         |
| GPS-RFID              | 2.0877 | 2.3763                       |
| GPS-V2V               | 2.223  | 2.5025                       |
| GPS                   | 2.2504 | 2.5408                       |
| Integrated without DR | 1.7993 | 2.1804                       |
| GPS without DR        | 2.3979 | 2.7107                       |



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## VI. CONCLUSION

A Smart algorithm has been proposed to regulate the number of resources used for localization, in order to achieve the desired accuracy at a reasonable complexity. The Smart algorithm uses only the necessary connection which has better accuracy and reduces the complexity of vehicle localization and the Integrated Algorithm uses all the connections such as V2V, V2P, V2I, RFID so it has more complexity than the smart algorithm. The proposed Smart algorithm has considered the connections availability and geographical conditions to deliver the minimum positioning requirements of a given ITS application at the least amount of time. The Root Mean Square Error (RMSE) and CDF (Cumulative Distribution Function) also helpful in localization. Localization Error calculated by RMSE from desired and actual localization results. The 80% CDF also used in calculation of localization error. The simulation results have shown that the Smart algorithm was able to achieve the desired accuracy at the least amount of complexity. More specifically, for the considered transportation network, the Smart algorithm has provided higher accuracy than the stand-alone GPS with the same level of complexity and processing time. This BSF uses the Power/frequency verses Normalized frequency graph, in that the signal which has greater peak that has a good strength. Using BSF the strength of vehicle signal in transportation network can be calculated in form of graphical representation. This all work is useful in ITS (Intelligent Transportation System) for safety and secure transportation to passengers.

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