The Concept of Parking/Moving Vehicle Discrimination by Three-Line Scanner Imagery

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Abstract: In our contribution, the new idea of parking/moving discrimination is proposed by using Three Line Scanner Imagery. The framework of our study consists of three main stages: preprocessing, vehicle detection and parking/moving detection respectively. First two stages of framework have been done in our previous work. Parking/ Moving Discrimination algorithm have been developed by using generic vehicle characteristics and some principle of photogrammetry. By using detected vehicles from our previous work, stopping/moving vehicles are able to discriminate. Moving vehicle is detected by detecting generic moving vehicle in TLS, inter-band gap. Stopping vehicle is verified by 3 dimensional viewing of Stereoscopic measurement. Finally, the conceptual framework has been done and the result will been realized soon.

Keywords: Three Line Scanner, Vehicle Monitoring, Stopping/ Moving Vehicle Discrimination.

1. Introduction

Nowadays, on-street vehicle statistic is important for traffic planning and management. There are varieties of vehicle observation methods with many types of sensors. One of them, which is robust and practical is vehicle detection by using aerial image. Compared with vehicle detection by ground-based sensors, observation by using aerial image covers on wide area not only special spot.

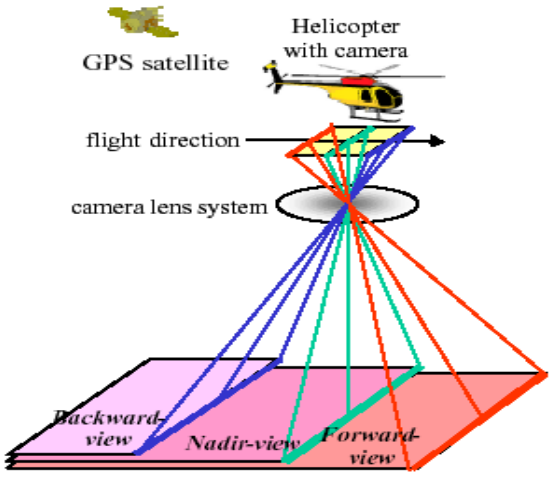

Fig.1 Three Line Scanner

Recently, Three Line Scanner, TLS as new aerial line imaging sensor have been developed and are available in civilian sectors. TLS is suitable for vehicle monitoring because, with ultra resolution, even car pillar is identifiable and with TLS as typical seamless imaging, it is easy to identify ground linear feature object such as road etc.
(See fig.1)

The reminder of this paper is organized as follows. Chapter 2 reviews existing researches with their strong and weak points. In chapter 3, the framework of our study is discussed. Chapter4 and chapter5 mention the detail of our algorithms. Finally, the chapter 6 is deduction.

2. Related Work Review

There are few works of vehicle detection by aerial image, existing in the world. Two approaches however, are categorized in terms of vehicle model: Explicit and implicit model. Tao and his group proposed the implicit model for vehicle detection and also Parameswaran fulfilled vehicle detection by neural network on implicit model. Vehicle Detections by explicit model were presented by Hinz in [2] and Chellappa in [1]. Although, both of models are merit and demerit, explicit model seems more robust. Implicit model is limited with training data set mentioned in [2]. Therefore, our vehicle monitoring by using TLS image has been developed. The algorithm is based on advantages of TLS for on-road vehicle monitoring and robustness of explicit model. The detail of our algorithm is mentioned in next chapters.

3. Framework

The framework is created on three objectives: Vehicle Detection by single nadir TLS image, Stopping/Moving Vehicle Discrimination and Parking/Signals Waiting Classification respectively. Our framework is depicted in Figure 2.

The framework consists of four main stages as below:
1. Preparation is generation of fundamental information for further processing as image segmentation etc

2. Vehicle Detection by using Sing le Nadir TLS image
3. Stopping/Moving Vehicle Discrimination by integrating multi TLS image processing
4. Parking/ Signals waiting Vehicle classification.

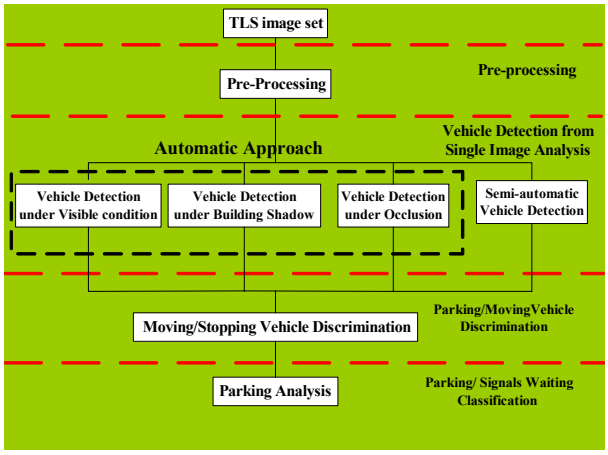

Fig. 2 Framework of our vehicle monitoring algorithm

4. Preparation and Vehicle Detection

For algorithms of two stages of framework, we have done and described in detail in [7]. Therefore, in this paper, the detail of this algorithm is mentioned briefly as below:

4.1 Preparation

Unlike human-eye, computer is not able to identify any object types. Fundamental in formations are given in the image. The most important is image region segmentation and oversegementation/noise correction. Region is the basic unit for further processing.

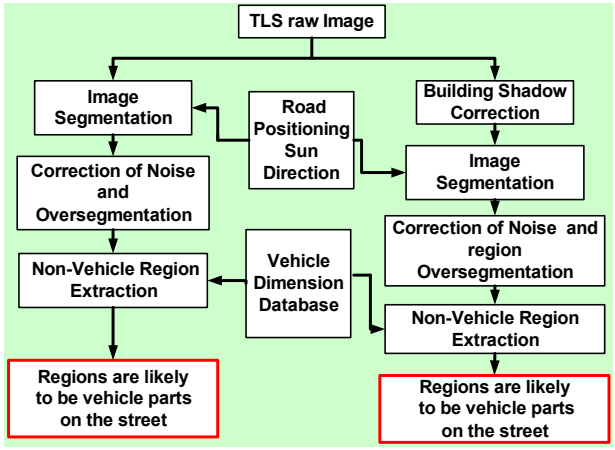

Fig3. Systematic Diagram of Preparation Stage

Moreover, non-vehicle region are removed in this stages. Only Vehicle-likely regions exist in segmented image. Also, building shadow, which is important occlusion, is delineated and corrected. The algorithm is depicted in fig.3

4.2 Vehicle Detection

In this stage, the explicit model is applied with vehicle-likely regions from previous step. Also vehicle model has been developed from generic characteristics of vehicle in TLS. The algorithm procedure start2 to detect vehicles in the image as below:

- Due of vehicle such as vehicle shadow is detected.
- Based on cue position, the Frame detector is created to detect Vehicle likely regions.
- Those detected regions are grouped to a cluster or vehicle candidate.
- Only vehicle candidate satisfied with vehicle model is detected vehicle in the model finally. (See Fig4)

The result of vehicle detection by our approach is shown in Fig5。

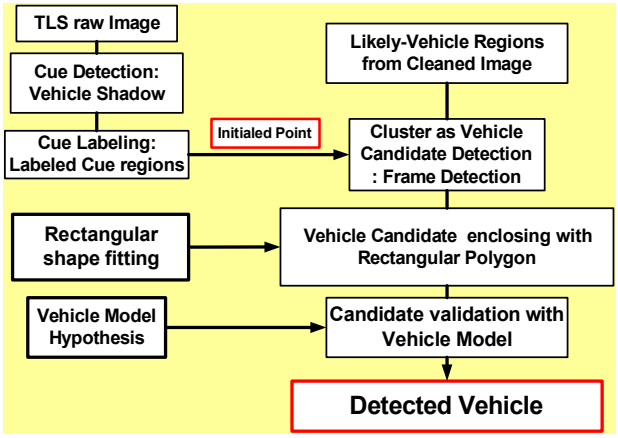

Fig4. Procedure of Vehicle Detection

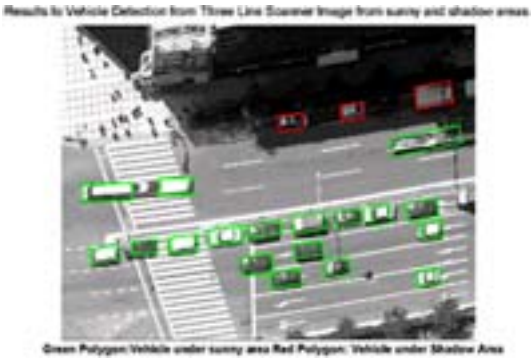

Fig 5 Results of Vehicle Detection

5. Parking/Moving Vehicle Discrimination

Theoretically, detected Vehicles from chapter 4 are able to be categorized into two classes: Moving vehicle and Stopping vehicle. It is based on some assumption as below:

- Stopping vehicle is viewed three-dimensionally by using stereoscopic measurement. (See Fig6)
- Moving vehicles is able to be tested by using Spatial-Temporal Methods because TLS imaging have lap time between two different view images.

3. Moving objects in RGB TLS image has generic characteristics. This is Inter-band Gap (See7)

Based on assumption of moving/stopping vehicle mentioned above, the algorithm of moving/stopping vehicle has been developed. (See Fig.)

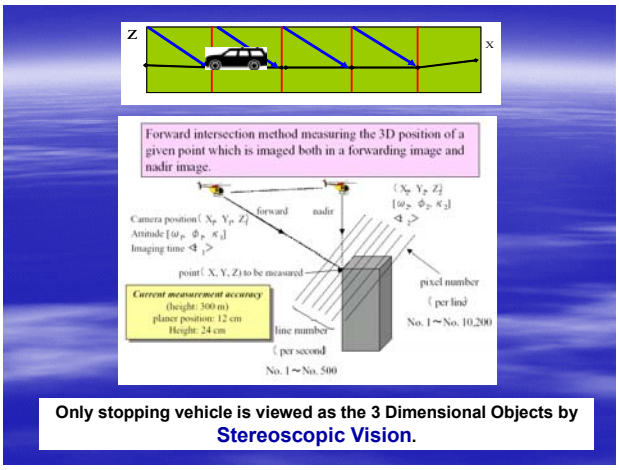

Fig6. Stereoscopic measurement and Stopping Vehicle Detection

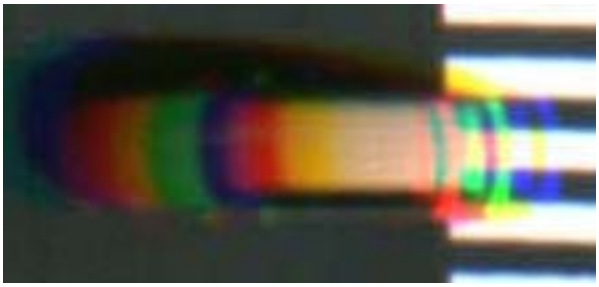

Fig 7 Moving Vehicle and Inter Band Gap

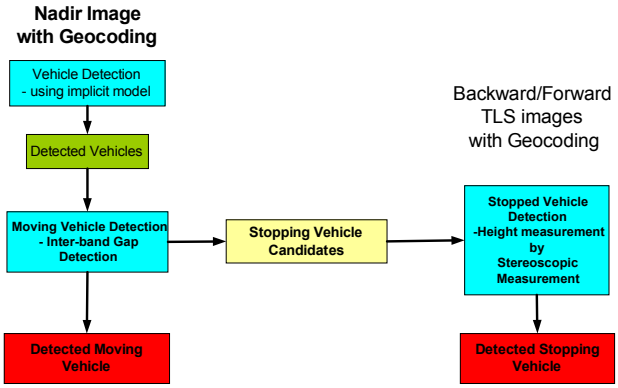

Fig8 the systematic diagram for moving/stopping vehicle discrimination

6. Conclusions

In this paper, the new algorithms are proposed for vehicle detection with promising results and moving/stopping vehicle discrimination conceptually. They are complex-reduced and new algorithm with new ultra resolution image, TLS image. Some problems, which exist in this stage, are being modified. The algorithm of stopping/ moving vehicle is being realized soon.

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