A Survey on Video-based Vehicle Behavior Analysis Algorithms

Jian Wu[1,2,3]
[1.]The Institute of Intelligent Information Processing and Application; [2.]Provincial Key Laboratory for Computer Information Processing Technology, Soochow University, Suzhou 215006, China;
[3.]Jiangsu Yihe Traffic Engineering Co., Ltd., Suzhou 215002, China
Email: szjianwu@163.com

Zhi-ming Cui[1,2,3], Jian-ming Chen[1,2,3], Guang-ming Zhang[1,2]
[1.]The Institute of Intelligent Information Processing and Application; [2.]Provincial Key Laboratory for Computer Information Processing Technology, Soochow University, Suzhou 215006, China;
[3.]Jiangsu Yihe Traffic Engineering Co., Ltd., Suzhou 215002, China
Email: szzmcui@suda.edu.cn

***Abstract*—Analysis of the Vehicle Behavior is mainly to analyze and identify the vehicles' motion pattern, and describe it by the use of natural language. It is a considerable challenge to analyze and describe the vehicles' behavior in a complex scene. This paper first hackles the development history of the intelligent transportation system and analysis of vehicles' behavior, and then conducts an in-depth analysis of current situation of vehicle behavior analysis from the video processing, video analysis and video understanding, summarizes the achieved results and the key technical problems, and prospects the future development of vehicle behavior analysis.**

***Index Terms*—vehicle behavior analysis; vehicle detection; vehicle tracking; behavior understanding**

I. INTRODUCTION

Video analysis and recognition is to make the computer achieve the understanding of what the show is or what events occurred by running certain core algorithms through specific programs to extract content information or individual movement information in the video signal information. The most critical technology in this process is analyzing the video signal by the use of computer, so that we can extract some specific events occurs or the specific behaviors of the monitored target occurred in the video scene. Video analysis and recognition technology is a computer vision technology, and it belongs to one branch of artificial intelligence research which can extract and understand the contents of the video screen through digital image processing and video signal analysis. Video analysis and recognition technology has a wide range of applications, speaking in its contented definition, actually it has been used in the transport sector, and vehicle license plate recognition technology is a typical example. There are two ways to recognize license plate, one is by the use of captured image triggered by the sense coil, and another is by the use of captured images triggered by videos. For the latter, it means to make continued analysis of images from the video camera by the use of certain core algorithms and extract and then recognize the license plate number from the video.

Vehicles can be regarded as a special object in intelligent video analysis technology, behaviors of vehicles contain prohibition state and motion state, and the detection of vehicle behaviors has important application value. Analysis of vehicle behavior is to detect vehicles in monitored scene, analyze its direction and trajectory and analyze the correctness and rationality of vehicle behaviors according to the preset rules. Analysis of vehicle behavior is mainly to analyze and identify the movement pattern of vehicles and use natural language to describe it. The behavior patterns achieve automatic detection likely through video analysis and recognition technology are listed below:

(1) Parking due to violation/failure/accidents

Parking phenomenon appears in the driveway or the no parking area is extremely dangerous event or illegal behavior easily causes traffic jams, no matter it is parking due to vehicle breakdowns or illegal parking, we need timely processing. The management needs to know accident parking in time so that traffic is restored as soon as possible.

(2) Illegal left and right turns

It is not allowed to turn left or right in some crossing, otherwise it not only easily leads to traffic congestion and easily leads to traffic accidents cause loss of life and property.

(3) Illegal lane change

In some sections, it is an illegal act if high-speed motor vehicles change their lines freely; it easily leads to traffic accidents.

(4) Violation of traffic line

In traffic regulations, violation of traffic line is a serious illegal act and should be dealt with severely.

(5) Illegal retrograde

In traffic regulations, retrograde is a very serious violation of regulations, it is not only easily to cause traffic chaos, and is easily to cause traffic accidents, and

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it should be detected in time, stopped in time and dealt with in time.

(6) Spilling objects

It is likely to cause traffic jam if moving vehicles spill objects inadvertently, especially when motor vehicles are high speed, the car in front spilling objects can easily lead to a serious car accident to the latter.

(7) Vehicle fire

Vehicle fire due to breakdown or other reasons is a very serious event; it can seriously block the traffic, there may even be the possibility of the spread of fire or explosion, it should be processed in the shortest time.

(8) Analysis of traffic congestion

Analyzing the traffic congestion on the roads or achieving optimal control of signal lights can help to ease traffic flow in time.

Vehicle Behavior Analysis has a wide range of applications and has become the research focus of security monitoring, intelligent transportation and other fields. This paper summarizes the vehicle behavior analysis algorithms current widely used based on video. It is organized as follows: Section II describes the history of video-based vehicle behavior analysis; Section III summarizes the most widely used vehicle behavior analysis algorithms based on video from the video processing, video analysis and video understanding the three levels; Section IV summarizes the existing key technical problems in video behavior analysis; Section V describes the evaluation methods of vehicle behavior analysis algorithm; Section VI summarizes this paper. The review of traffic incident detection algorithm is introduced in Literature [1,2], but not exhaustive or systematic. Currently the vehicle behavior analysis has become an independent research, it is necessary to conduct an independent, detailed and systemetic review for the behavior analysis algorithm.

II. History and Present Situation

The development of intelligent transportation systems can date back to the development and application of some new technologies of a series of traffic diversion system in Seventies and eighties in the 20th century. In 1991, the United States passed the "Surface Transportation Efficiency Act", and then IVHS research in the United States entered the operational phase of macro. In 1994, IVHS was renamed ITS in USA. After then, Europe, Japan also have joined in. After 40 years of development, United States, Europe, Japan become the three bases of the ITS. Currently, ITS study also has a large scale in other countries and regions, Such as Australia, Korea, Singapore, Hong Kong and so on. It can be said that a new ITS industry is being formed in the world and all kinds of projects are being carried out, whose scale and speed of development is staggering. The concept of ITS is gradually formed in the world, whose goal is "Protect the safety, increase efficiency, improve the environment and conservate energy". From the perspective of development of intelligent transportation systems, we count statistics of landmark events associated with intelligent transportation system occurred every year, and get Figure 1 which shows the overview of intelligent transport systems.

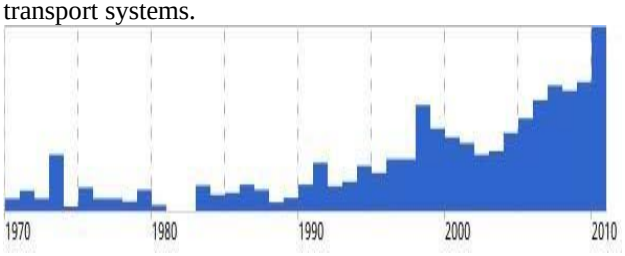

Figure 1. Development Overview of ITS

It is generally believed that a complete management system of ITS should be a combination of these various systems below: Traffic management system, public transportation systems, information service systems, surveillance systems, security systems and logistics management system. Among them, the vehicle behavior analysis is an important part in the intelligent transportation system, whose research originated in the 20th century, 70 years. Figure 2 shows the number of articles published on vehicle detection, vehicle tracking and traffic incident detection aspects in some important journals and conference from 2000 to 2010 until the first half (such as IEEE Transactions on Intelligent Transportation Systems, IEEE Transactions on Pattern Analysis and Machine Intelligence, International Journal of Computer Vision, IEEE International Conference on Intelligent Transportation Systems, IEEE Intelligent Vehicle Symposium, Computer Vision and Pattern Recognition,International Conference on Pattern Recognition , International Conference on Computer Vision, Europe Conference on Computer Vision and so on).

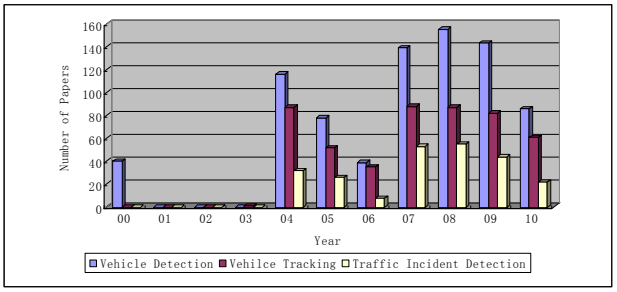

Figure 2. Relational research survey of vehicle bahavior analysis

Figure 2 shows that the number of articles on analysis of vehicle behavior in recent years has been significantly increased, which also reflects the development of researchs related to the vehicle behavior analysis. After 2004, analysis of vehicle behavior was in-depth study, and some research results were achieved. However, the current study is still focused on vehicle detection and vehicle tracking; few algorithms involve high-level understanding of complex behavior. If we applicate vehicles behavior analysis in real scenarios, there are still many serious problems.

III. Video-based Behavior Analysis

So far, many scholars have proposed a variety of algorithms of vehicle behavior analysis based on video.

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As shown in Figure 3, the process of the algorithms is more or less the same and can be divided into there steps. First is ROI extraction and vehicle detection. Second is to get the static and dynamic parameters of the vehicles and establish descriptions of the vehicles. Thirdly, we should understand and describe the behavior of the vehicles by pattern matching and state estimating.

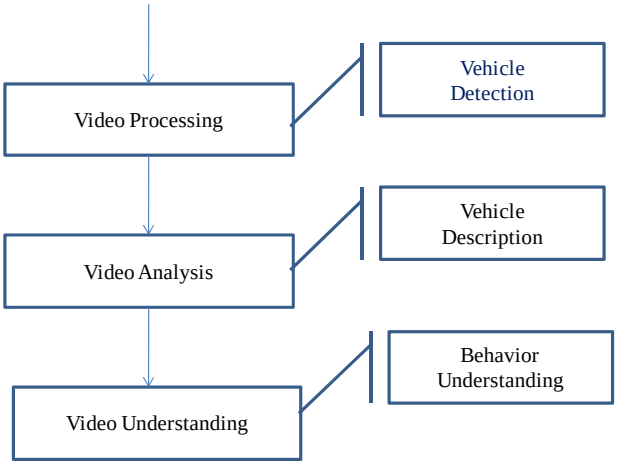

Figure 3. Hierarchy of vehicle behavior analysis

A. *Video Processing*

Vehicle detection is the core of the intelligent traffic and its purpose is to tell whether there is vehicle in the detected region. It can be attributed to the area of object detection. Moving object detection is to separating the varying region from the background of the image sequence. It is a major component of digital image processing. Effective segmentation of motion region plays a key role in the post processing, such as object segmentation and tracking. The mainly way detect the moving object is the following several methods, optical flow method [3,4], frame difference method [5-7], background subtraction method [8,9], expanding EM algorithm [10], scene change detection based on Morphology [11] and detection of energy motion algorithm [12]. Among the methods mentioned above, the first three algorithms are most commonly used.

(1) Optical flow method

Optical flow reflects the changes of the images caused by the movement in a certain time. It is a method to estimate the sport-field and merge the similar motion vector into a moving target. So calculating the optical flow is the prerequisite of the subsequent process. It mainly detects the moving area using the feature of vector flow of the moving object. Optical flow method can be divided into three categories, matching-based, frequency domain and the gradient method. The matching-based method consists of feature-based and region-based. There is some advantages of optical flow method that can be summarized in two points. First, it set the foreground moving object as the center without any priori scene information and can be used for the case of camera moving. Second, it measures the moving object based on the image pixels, for this reason it obtains accurate test results under the ideal case, pixels level or sub-pixel level. The disadvantage is that it is sensitive to noise and can't effectively deal with the issues such as target occlusion. On the other side, the high complexity of the algorithm is not conducive to a high degree of real-time applications.

(2) Frame difference method

Frame difference method is to get the pixel level difference between the two or three adjacent frames in a continuous sequence of images and extract the moving area in the image through the threshold. For example, VSAM [13] developed an algorithm that combines the adaptive background subtraction with the three frame difference, which can effectively detect the moving target from the background. Using this algorithm in the condition that the change of ambient luminance is little, we can hold that the scene is still where the pixel difference is small, while it is caused by the moving of the object where the pixel value vary widely and we can get the foreground moving object by subtracting the two images and threshold the result. For detecting moving object, frame difference method has strong adaptability for dynamic environment and is robustness to adapt the changing environment. But we can't get the entire foreground moving object, that is to say there are usually cavitations in the moving object.

(3) Background subtraction method

Background subtraction method is the most commonly used segmentation method. It is a technology that detects the moving regions using the difference of the current image and the background image. This method can detect the target accurately by subtraction when the image quality is good and the scene is stable. But the background is often more complex in reality. Be affect by so many destabilizing factors of noise, light and weather, that the simple method of reducing the background can't meet our needs. Usually, the adaptive threshold method largely eliminates the impact of light, but it is not useful for other factors. For this reason, the commonly used method is to update the background in real time by modeling of the background and get the closest background image for the current frame. Construction of dynamic background model has been being a heated thesis for the scholars domestic and foreign and among their results period average background is the simplest model, while mixture Gaussian model is one of the most popularly used model. There is lots of other dynamic background models including phone book model [14], the target centroid model [15] and the filter-based adaptive background model by Kalmann, Brandt and Kilger [16]. The background subtraction method is effective in moving target detecting when the camera is fixed and its greatest advantage is the ability to extract the entire moving target.

After the detection of moving objects, we should classify them. What we are interested in are the information of the moving vehicle, but the objects detected contain the pedestrians, bicycles, floating clouds, swinging tree branches, moving vehicles and other moving objects. To classify the moving objects is

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necessary for the further analysis of the moving objects. We separate the vehicles from the moving objects by the appearance, shape and moving statistical properties of the moving object. The methods commonly used are shape-based classification, motion-based classification and co-occurrence matrix classification.

B. Video Analysis

Basing on the video processing, video analysis will describe the target features which are detected in video processing. The data of video is dynamic and its features are dynamic in the time dimension. Take full advantage of the dynamic features of the video image and we can further improve the retrieval accuracy of the video clip. The object of detecting and description in the traffic video is the vehicles and what we primary concern is how to measure the static and dynamic features and quantify the features so as to analyze the vehicles. The features used in description are as shown in Figure 4.

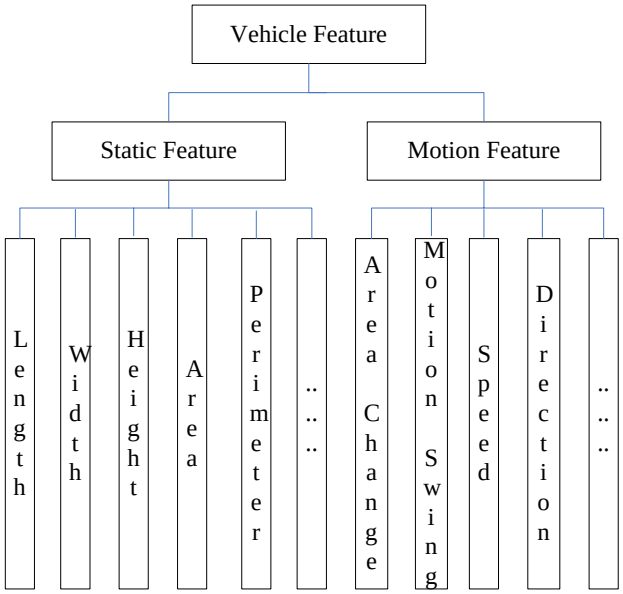

Figure 4. Features for vehicle description

The main features of the vehicles are divided into static features and dynamic features. The static features include brightness, color, texture, vehicle length, vehicle width, vehicle height, vehicle perimeter and other features while dynamic features include area change, speed, direction and other features. We have classified the moving objects and obtained the moving vehicles in vehicle processing. After the three-dimensional reconstruction and further action, to be assisted by the static information such as lane width, we can extract the some static features such as length, width, height, area of the vehicles.

For the dynamic features of the vehicles such as area change, speed, direction and other features, the main operation is tracking which belongs to the area of motion tracking. The commonly used motion tracking algorithm can be divided into several categories and we in this paper talks over region-based tracking, snake-based tracking, feature-based tracking, model-based tracking and multi-thread tracking.

(1) Region-based tracking

This algorithm is to extract the static features of the moving vehicle and match the features between the different frames, so as to track the vehicles. The most common method is sum of squared differences (SSD), kernel-based tracking algorithm [17,18] and affine image rectification algorithm [19,20], in which the most typical is mean-shift algorithm [21,22]. We can also use this algorithm to estimate the location of the target, combining with some forecasting methods such as linear prediction and Kalman prediction. It is frequently used in news video and teleconference which has little change. For example, Pahlavan use it for tracking the head and eyes. There are advantages of region-based tracking algorithm that it is intuitive, stable and accurate when the target is not under occlusion, while its disadvantage is that it is time-consuming especially when it searches globally and it results in loss of the target when there is change between the adjacent frames caused by occlusion or deformation of the target.

(2) Snake-based tracking

Proposed by Kass [23] and other scholars, snake is a algorithm with unique idea which is used in many application fields of image processing. It marks the initial contour manually at the border of the target, and defines the internal forces, external forces and constraint forces of the contour. And then make the contour moving to the interested target by minimizing the curve energy. Snake model is well suited for tracking the target with distortion, such as lips which is implemented by Kass and moving cells by Leymarie[24]. The shortcomings of Snake is that it require good initial contour and the hollow part is not available and there are solutions such as snack balloon model by Cohen[25]. The solutions for the shortcomings usually add external forces to the model.

(3) Feature-based tracking

The basic principle of the feature-based tracking is to use the information of the object's feature to identify the moving target. The general requirements for the features are that they uniquely represent the object and maintain stability even the object is moving. We assume the features as the unique stable features. Different from region-based tracking, it chooses one or several local features but not the whole vehicle as object. By contrast, the advantage of it is that even if some parts of the vehicle are under occlusion, we can track the vehicle accurately as long as there are any part is visible. However, there are shortcomings and difficulties that we should consider how to choose the unique stable features. Too little features results in high speed but wrong match, while too many features results in less efficient and low robustness.

(4) Model-based tracking

When there is a need to know the moving details of the object, we usually choose model-based tracking. We create a prior model of the moving objects first and the second is to search in the image sequence for tracking.

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There are many ways to modeling the object and the common model is based on 2D/3D or based on view, where 2D means the model is established in two-dimensional space while 3D in three-dimensional space. 3D-based model is used in many algorithms in actual practice, especially for rigid moving target. For example, ZHU realize the tracking of the vehicles and ultimately get the speed and size of the vehicle by simplifying the 3D-model in the VISATRAM system [26]. View-based model describe the object making use of the collection of the images from different perspectives, to avoid three-dimensional space modeling of the target objects and complicated computation. For example, Matsumoto establish a "View Sequence" model [27] for the road the moving object is on using this method, which has a memory function and can identify the current environment through matching the current image and model.

(5) Multi-clue tracking

There are many deficiency and shortcomings in the tracking methods described above and the multi-clue tracking method combine the above method. It integrates the various information from different source, to improve the robustness of the tracking algorithm. But a major problem is how to handle the clues and make a reasonable combination. For example, Lu [28] and other scholars combine the edge, optical flow and shading information to optimize the model for tracking and realize the tracking of the hands under the changing condition. Its advantages are that it improves the tracking results using the multiple clues, which have complementary advantages, while there are many constraints about the tracked object and the object and environment assumed become special. Therefore, good algorithm should consider the compromise of the robustness and commonality.

We talked above about the advantages and disadvantages of the various tracking algorithm. Based on tracking, we can get the dynamic information of the moving object, such as area change, speed, direction and so on. These dynamic information are abstract and multi-dimensional and get ready for the next step.

C. Video Understanding

The ultimate goal of behavior analysis is to understand the behavior. Since the seventies of twenty century, people have developed a variety of traffic incident detection algorithm, which can be divided into pattern recognition based algorithm, statistic based algorithm, traffic flow model based algorithm and artificial intelligence based algorithm. Compared to other behavior detection, the vehicle behavior detection is more difficult, because the behavior of the vehicles is more complex and it is based on video processing and video analysis. Owing to the limitation of space, we will introduce the major classical algorithm.

(1) Pattern recognition based algorithm

Pattern recognition based algorithm is also known as comparison algorithm, which compares the measured values with the threshold and trigger the alarm system when the measured value exceed the threshold. The representative is the California algorithm [29] which was born in the late sixties of twenty century. Basing on road occupancy ratio of the adjacent sampling station, it detects the event and applied to the monitor center of Los Angeles highway. It requires three input variables. The first is the absolute difference of road occupancy parameters of two adjacent sampling stations. The second is the ratio of the difference and the road occupancy parameter of the upstream sampling station. The third is the ratio of the difference and the road occupancy parameter of the downstream sampling station. When the actual values of the input variables exceed the corresponding threshold, the alarm will send event alerts.

Among the improved California algorithm, California #7 and California #8 has better efficiency. The disadvantage of California algorithm is that the inputs are all about the road occupancy parameters without consider of flow rate and speed, while the advantage is that it seldom make mistake.

(2) Statistic based algorithm

Statistic based algorithm include the standard Normal Deviation method. SDN is proposed by the Texas Transportation Institute in seventies of twenty century, which is based on the statistic and analysis. It assumes that there is traffic incident when the traffic parameters change unexpected. In this method the predicted road occupancy value of the time of T is the arithmetic mean value of the former N values and the standard normal deviation of the time of T SND(t) is based on the standard deviation of the former N actual value and predicted value. If the value of SND(t) exceed the specified threshold, there may any incident occurred. The paper [30] detect the incident combining nonparametric regression and SND algorithm and gain good results.

(3) Traffic flow based model

Traffic flow based model [31] express the traffic incident making use of the complicated traffic parameters and predict whether there is a traffic incident or not by comparing the actual parameters with the predicted parameters. The representative algorithm is called Mc Master algorithm which is proposed by Mc Master university of Canada. Basing on catastrophe theory, it established a distribution mode of the traffic flow and road occupancy ratio, which is divided into four regions corresponding to four kinds of traffic state. If the measured parameter exceed some certain threshold and is in a specific range, we can hold that there may be traffic congestion and detect the traffic incident automatically by distinguish the congestion kind. It make use of both the traffic flow and road occupancy ratio, which excelled the California algorithm. But the threshold is difficult to set and unsuitable value will affect the results.

(4) Artificial intelligence based algorithm

Fuzzy logic. It was born in sixties in the twenty century and is realized in traffic video by D Teodorovic in 1994 [32]. Making use of the fuzzy logic, in the same year Chang and Wang deal with the abnormal traffic [33], define the fuzzy set of the traffic and distinguish whether the traffic state is a event or not. Because the concept of traffic flow is important but imprecise, to

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detect the traffic incident with a fixed threshold is not well adapted to dynamic traffic state. The fuzzy logic makes up for it and has short-time performance. However, it is difficult to determine the fuzzy probability function and the detection rate and false-alarm rate will be ideal if we find the appropriate probability function.

Rough set theory. Z.Pawlak presented his classic paper Rough Sets in 1982 [34], which proclaimed the new birth of the Rough Sets. It is good at expressing the certain and uncertain knowledge, analyzing the inconsistent information and imitating analogue sorting. The paper [35] detects and sorts the traffic incident with the help of Rough Sets and improves the sorting accuracy by making use of cross-validation because the theory of Rough Sets is sensitive to the discrete attributes.

Artificial neural network algorithm. Neural network [36,37] is usually used for identifying the mode of the traffic when there is any incident. Because of the information gap, we can't obtain the accurate information of the incident and it's difficult to trace and analyze the reasons of the incident. The shortcomings of the algorithm are that there is no standard to determine the network structure and it needs a mass of training samples. It is liable to get the local minimum value and its ability to generalize the model is not strong because of its over-fitting.

Hidden Markov Model was born in about late sixties and early seventies in last century. Shunsuke Kamijo creates the traffic incident detection system based on HMM [38]. It studies the behaviors of each vehicle using HMM chain and identifies the current event using the output of tracking system. The results it identifies are collision, congestion and successful-pass. With single feature of the vehicle, this method is useful and practical in some situation. But when there are a lot of vehicles and pedestrians in the detected region, the tracking algorithm consumes too much computer source and results in system crash.

IV. Technical Difficulties

Since the 20th century, 70 and 80 years to now, behavior analysis have made great progress in the research at all levels. However, due to the complexity of the traffic scene, the vehicle behavior analysis is a very challenging research topic; errors existed in the results of each step will directly affect the analysis and description of the behavior. In order to improve the performance of behavior analysis algorithms, we need to solve many serious problems.

(1) Vehicle shadow

All monitored traffic scenes are in the outdoor, and illumination is very clear, so segmented motion regions often contain a shadow cast by vehicle. This not only leads to changes in the shape of the vehicle, but also increases the probability of the vehicles stick together. Therefore, to eliminate the shadow associated with moving objects is a key step for the extraction and tracking of vehicles. Shadow detection methods can be divided into two categories: model-based methods and feature-based approach. The problems of current algorithms: model-based approach requires prior knowledge and the computation is complex, so it is not suitable for real-time applications. Feature-based methods often have some limitations and rarely take the continuous nature of the shadow in space into account.

(2) Vehicles blocking

Block problem often appears between vehicles, which will affect the accuracy of the vehicle target detection, segmentation and positioning, and then affect the effectiveness of multi-target tracking algorithm. Therefore, it is of great significance to solve the mutual occlusion problem between vehicles in the intelligent traffic video surveillance, but it is also a more difficult problem in transport video processing to solve. In recent 10 years, scholars have put forward a number of ways to solve the problem of vehicles blocking, these methods can be basically divided into four categories: model method based on feature, model method based on three-dimensional, model method based on statistical and model method based on reasoning. However, these methods are studied for the partial occlusion and their requirement of scenario is high, so severe occlusion is difficult to deal with. Therefore, they are less practical, but also need further study.

(3) Semantic Expression of traffic accident

Traffic incident detection has become a research hotspot in the video surveillance. The researchers conducted a study on relevant issues, and have made some progress. However, because of traffic the system's strong nonlinearity, ambiguity and uncertainty, a variety of existing detection algorithms are more or less inadequate. Commonly used algorithms on the semantic expression of traffic incident can be divided into four catagories: the algorithm based on pattern recognition, the algorithm based on statistical techniques, the algorithm based on traffic flow model and the algorithm based on artificial intelligence. After the traffic exceptions occur on the highway, the affected objects are mainly vehicles driving on the line where exceptions occur, therefore, most algorithms basically has been widely used on the highway. Howere, vehicles on the urban road run on the highway in different station, the difficulty of detecting the vehicle behavior is more complex when compared to other detecting technologies.

V. Evaluation of The Algorithms

Vehicle behavior analysis is generally applied to real-time road monitoring in the fields like security surveillance, intelligent transportation and so on. Because of the requirements of real-time operation, which requires that the system can achieve real-time monitoring, we use the following three commonly used evaluations.

- Mean Time to Detect (MTD), which is defined as the average interval between the occurrence of an incident and the time when detection algorithm detects this incident.
- Detection Rate (DR), which is defined as the ratio of the number of detected traffic incidents and total number of events which reduces the traffic

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capacity in a specified period time. It is expressed as a percentage.

- False Alarm Rate (FAR), which is defined as the ratio of the number of incidents of false positives and the total number of incidents detected with the algorithm in a certain period of time. It can be expressed as a percentage or the number of false positives in every period of time.

Efficient vehicle behavior analysis must have three basic characteristics: short MTD, high DR and low FAR. However, MTD, DR and FAR are interrelated, the improvement of one performance index often results in the degradation of others. So we should have a trade-off among those performance indexes according to actual situation.

Vehicle behavior analysis can also be applied to traffic video retrieval, whose performance can be judged by its efficiency and effectiveness. In general, its efficiency can be evaluated by how much work it needs when performing a query. Its effectiveness can be measured by Recall and Precision. Recall and Precision are relative reasonable indexes in measuring search results now.

$$Recall = \frac{number\ of\ searched\ relational\ traffic\ events}{number\ of\ relational\ traffic\ events\ of\ video} * 100\% \quad (1)$$

$$Precision = \frac{number\ of\ searched\ true\ traffic\ events}{number\ of\ searched\ relational\ traffic\ events} * 100\% \quad (2)$$

Both values are between 0 and 1. If the value is closer to 1, it means the Recall / Precision is higher. The former can measure the ability to detect relevant information of the retrieval system and searchers. The latter can measure the ability to reject non-relevant information of them. Take them together, and then we get the retrieval efficiency. Experimental results show that interdependence of the opposite exists between Recall and Precision. If we improve the Recall of output, its Precision will be reduced, and vice versa.

VI. CONCLUSION

Because of its complexity of the algorithm and the diversity of target behavior, the development of the study on Video Analysis and Recognition is undeniable to have been slow. Now foreign technology is more mature, but it could not meet the full satisfaction of the users. It has only a relatively low level of intelligence and can complete the automatic detection of some simple behaviors. Nowadays, the understanding of the vehicle behavior is still in the early development stage; however, the rapid development of vehicle behavior analysis will certainly promote the further development of behavior understanding. With the continuous development of video analysis technology, its application in the intelligent transportation industry is increasingly close to be realized. It will show its importance in the field of intelligent transportation and play a growing role.

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Jian Wu was born in Nantong on the 29th April, 1979, and got master degree in the field of computer application technology from Soochow university, Suzhou city, China in 2004. The main research direction is computer vision, image processing and pattern recognition. He works as a teacher in the same college after his master graduation. Now he is pursuing the doctoral degree. He was awarded the Third Prize of 2007 Suzhou City Science and Technology Progress and the 2008-2009 Soochow University Graduate Scholarship Model.

Zhi-ming Cui was born in Shanghai on the 4th July, 1961. Professor, PhD Candidate Supervisor. The main research direction is deep web and video mining.

Jian-ming Chen was born in Suzhou on February, 1960. Associate professor, Master Supervisor. The main research direction is intelligent information processing and software engineering.

Guang-ming Zhang was born in Suzhou on the 10th Februry, 1981. PhD Candidate, his main research direction is image processing and video retrieving.

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