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Use of video data for analysis of special transport movement

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Abstract

Special transport (for example ambulances, fire trucks, police cars) can ignore rules of the road in some cases. Modern transport models simulate the movement of conventional vehicles. However usually modern models don't take into account, for example, ambulance moving onto oncoming lane. We need data about special transport moving for developing effective models. In this work we described a methodology, which can be used for obtaining data about special transport moving onto oncoming lane and road traffic from road cameras video. Methodology includes computer vision methods for vehicle moving detection. We demonstrate the work of our method in the task of analyzing the data of road cameras in St. Petersburg.

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*Keywords:*Computer Vision ; ambulance ; transport modelling ; video data analysis

1. Introduction

A great number of emergency services function in modern cities. Arrival time of ambulances or fire trucks has a great impact on the health and life of a patient. Transport modelling is an effective approach for research and optimization of special transport movement. However, modern transport models do not take into account special transport behavior such as moving onto oncoming lane or exceeding the speed limit. Thus, we need to develop transport model of special transport movement, which can imitate violation of traffic rules in some cases.

Real data on special transport movement is necessary to develop an effective emergency service model. However, it is difficult to obtain such information due to the security and anonymity issues. Moreover, special services cars

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(SSC) rarely use their special rights and move around the city like other traffic participants. Therefore, collecting data about special transport behavior is difficult.

This work describes an approach, which is based on obtaining data with the usage of open sources (open road cameras). The main advantage of this approach is data availability (for example, in St. Petersburg there are several thousands of cameras, which stream the city in Internet every day). The approach's disadvantages are small coverage of traffic network and short road part in camera's field of view.

The first part of this paper includes research actuality and review of existing approaches to special transport imitation and obtaining data about its movements. In the second part we describe proposed methodology for obtaining data on SSC movements using processing data from road cameras. The third part includes proposed tool work example with the usage of data from a camera on "Nevskiy prospect" street, Saint Petersburg. In the final part we present some conclusions and propose methodology for future studies.

2. Related Works

Special Service Car (SSC) driver use standard navigation tools, which don't take into account "special" vehicle behavior. However, difference in a few minutes of arrival can influence the health and safety of people. Tereshchenko and Zhirov in [1] write that ambulance doctor's acts can depend on predicting patient arrival time. In articles [2], [3] authors describe the dependence of intrahospital and annual mortality of patients with ACS from patients arrival to the hospital time and the start time of the operation. Wilson [4] writes about time limits, that are necessary for fire rescue operations. Thus, SSC arrival time decreasing approach (with using "improved" navigation) is actual scientific task.

Approaches to emergency service work at the disasters are described in [5]. The authors consider optimization models for resource allocation of services, location of emergency medical facilities, but don't consider SSC navigation methods. Zhang and Brown solve police patrol optimization task, for decrease police car arrival time in [6]. Authors use simple transport model, which compute arrival time as the sum of the ratio of the lengths of the roads of the shortest route and the maximum speed on them. Authors research dependence of police car arrival time from patrols locations. Ambulance navigation method is described in [7]. This method is based on weighted Dijkstra algorithm (weight – road traffic). Akay and others propose DSS for fire departments, which optimize fire truck travel time. The travel time is calculated as the ratio of the average speed of the fire truck on the road to road's length. The main disadvantage of described approaches is that they don't into account "special" SSC behavior. It can be the reason for the inaccuracy of the predicted travel time and the choice of the optimal route for SSC.

Obtaining SSC movements data is difficult task, because emergency service's work is related with personal data of people. In [8] authors predict ambulance arrival time with using GPS data from EMC Toronto. The advantage of GPS data in comparison with the data from video cameras is their coverage of the route. However, accuracy of GPS data is low (sometimes, several meters to real position), so exit to oncoming lane detection can be difficult. Moreover, GPS data don't contain information about current traffic situation, which is important for SSC "special" behavior conditions research. Traffic data in Saint Petersburg can be obtained with using navigation services such Yandex.Probki[†], but this data aren't free.

Work with video data (from road cameras) allows to get traffic data on part of the road and to track trips to the oncoming lane. There are a lot of approaches for vehicle detection and tracking in computer vision. Haar Cascades [9] is method for image recognition with using Haar wavelets. It is characterized lower accuracy that method, which is based on the intensity of the images. Coifman and other propose vehicle tracking system which use Feature-Based Approach in [10]. This approach is based on tracking the movement of key points of the object. The HOG method [11] computes occurrences of gradient orientation in localized image parts. Its advantage is high accuracy, but the method has a high computational complexity. In [12] authors use computer vision to measure the distance between the SSC and the traffic light. Region Proposal Networks method is used in [13] for vehicle tracking. In this work, we use Haar Cascades because its simple realization, low computational complexity and sufficient accuracy.

[†] https://yandex.ru/maps