Analysis and Classification of the Group Behavior of Bicyclists in Typical Urban Traffic Scenarios for AV Applications

Master‘s Thesis of Nikita Khabibulin

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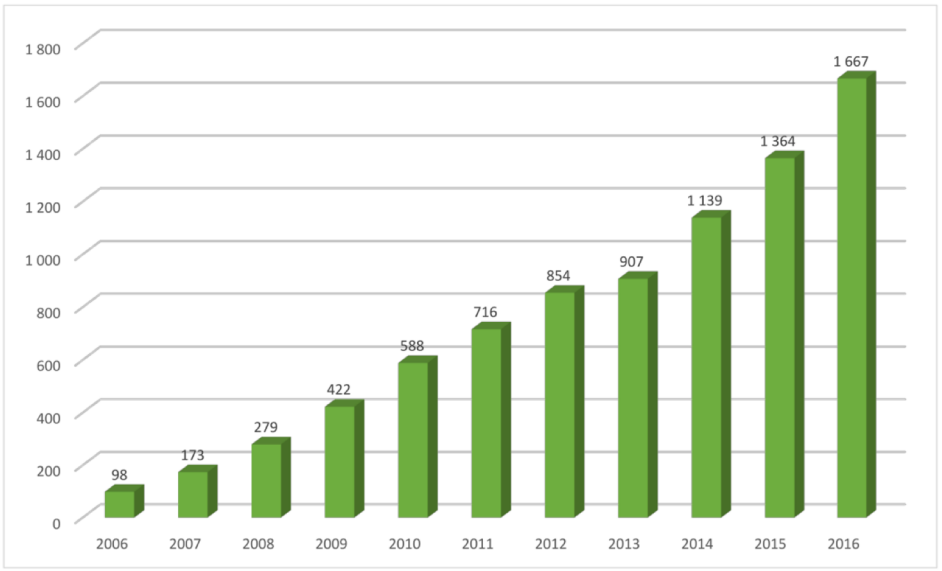


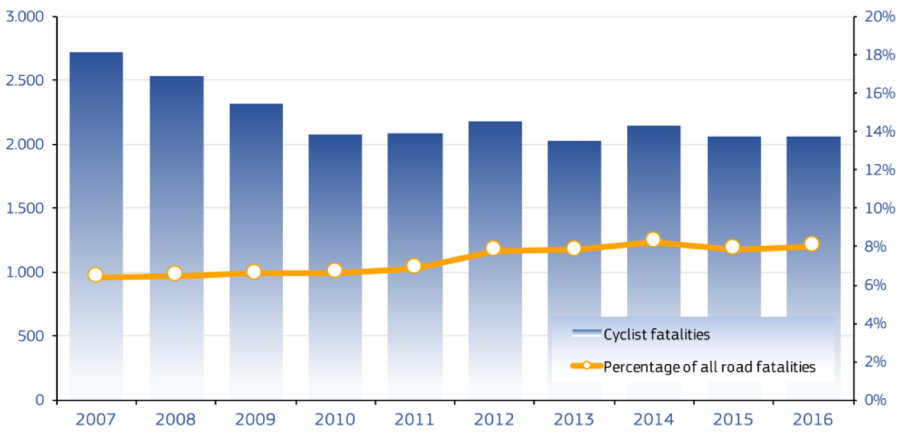
European EPAC sales (1000 units) (CONEBI, 2017)

Cycling has always been a popular mode of transport and nowadays it’s still attractive for the road users. The European bicycle sales market from year to year shows high numbers of bicycles produced and sold. The popularity of bicycles for the road users can be explained by many reasons. According to the survey, conducted by The National Heart Foundation and the Cycling Promotion Fund, the most reasonable facts to choose bike for transport were:

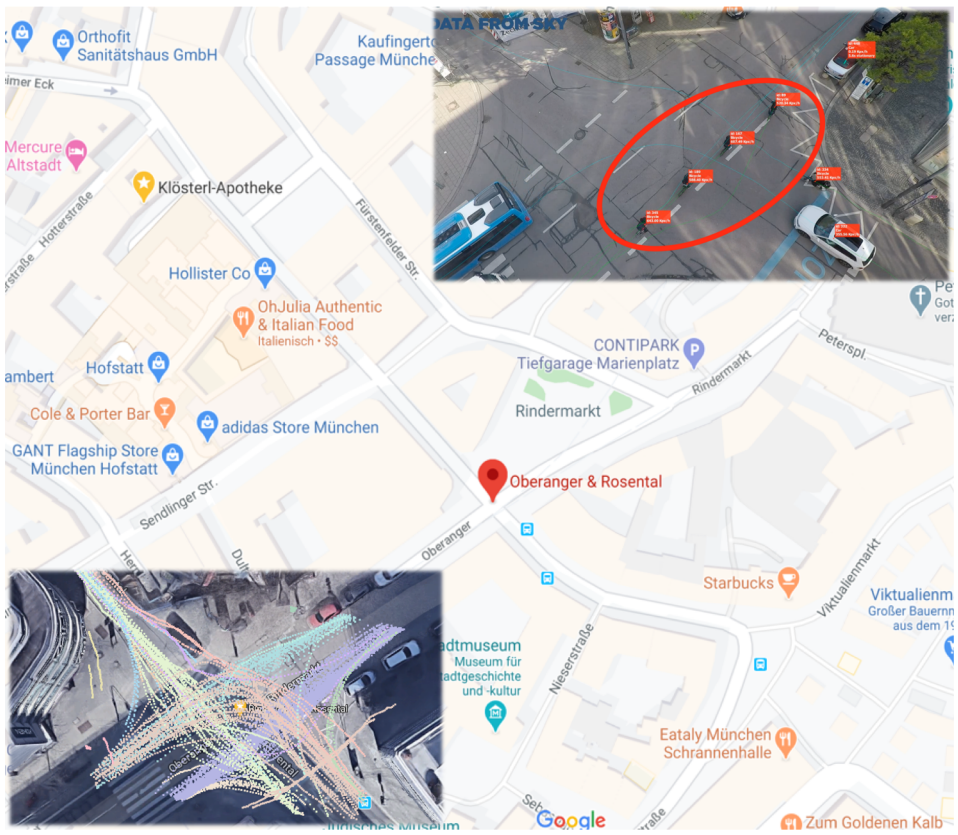
- It’s healthy and good exercise 89,9%;
- It’s economically beneficial 70,9%;
- It’s environmentally friendly 68,4%;
- It’s convenient 55,7%;
- To avoid congestion 23,4%;

Considering the above-mentioned factors, it becomes obvious that cycling will continue developing in future and the number of cyclists in the streets will grow. Moreover, the tendency of citizens to use cycling more active than private transport contributes to the overall sustainability of the cities, creating livable and friendly environment.

However, the safety of cyclist is still a big challenge for the society. As stated in the Traffic Safety Basic Facts, provided by the European Commission, the percentage of cyclist fatalities of all road users increased from 6% in 2007 to 8% in 2016. As we can see, the cyclists are among the most vulnerable road users and ensuring their safety is the primary objective for the future technologies. One of the upcoming technologies is the autonomous driving vehicles technology, which is aimed to increase the safety on the roads, improve productivity and provide more mobility. In near future self-driving cars will have to directly interact both with the single cyclists and the groups of cyclists. The correct detection of cyclists and interpretation of the detection results by autonomous vehicles is a crucial aspect for the successful operation.



Cyclist fatalities, EU, 2007-2016 (European Commission, 2018)



The proposed master thesis focuses on studying the behavior of cyclists riding in groups at the unsignalized intersection. The literature review part of the master thesis provides an overview of the state-of-the art levels of automation, detection technologies, communicational patterns between the vulnerable road users and motorized traffic and the group behavior of cyclists on the public roads. The methodological part of the master thesis includes the analysis of the behavior of cyclists at the Oberanger-Rosental intersection in Munich, Germany. In order to identify the group behavior of cyclists and classify them into groups, the following methodology was developed: firstly, the trajectories are pairwise compared with the trajectory similarity function and stored in the distance matrices. Secondly, the trajectories are classified with a standard clustering algorithm according to the spatial similarity in groups. Thirdly, the clustering within the spatial clusters is done with the help of the maximum simultaneous pairwise distance metrics to consider the simultaneous factor. The model showed relatively good results and performed correctly in identifying and classifying the cyclists from the video recordings. The understanding of the group behavior of cyclists on the public roads in an essential component for the development of the autonomous vehicles’ technology. The proposed model could be considered in the overall vehicle-group cyclists’ methodology for the autonomous vehicles’ technology.