Scalable Simulation of the Filling and Emptying of a Car Park – By the Example of a Large Audi Car Park in Ingolstadt

Master's Thesis of Muhammad Yasin
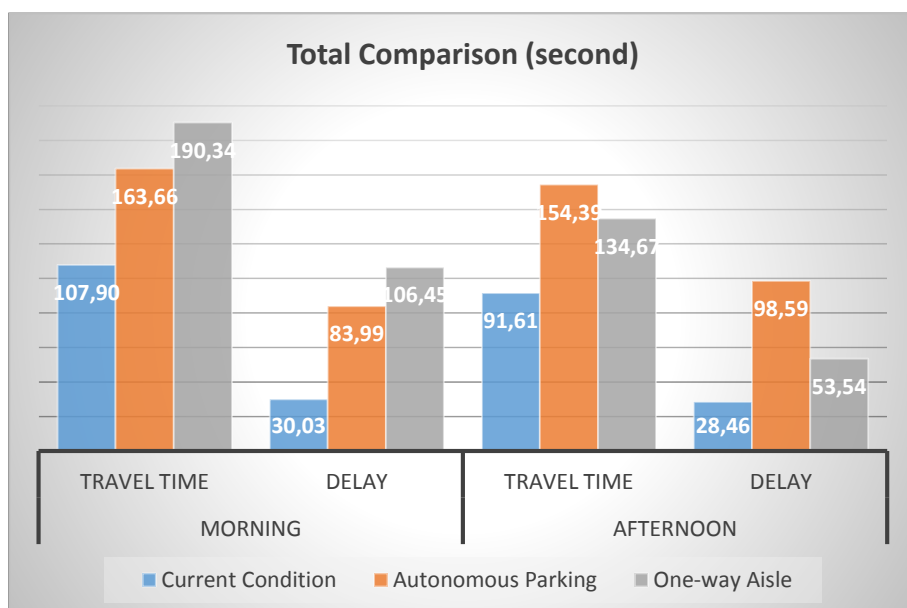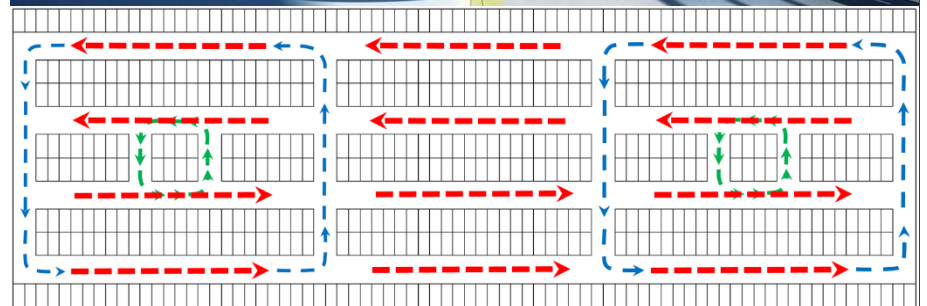
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Poor management and design of a parking garage would provoke certain problems, such as congestion and emission. Car park has particular transportation system that differs from normal urban or highway system. It demands such an intricate way for analyzing the performance and the traffic interaction inside. Addressing the problem of parking garage management is therefore essential to obtain environmental friendly and efficient performance.

The purpose of this study is to analyze traffic circulation in a car park during the filling and emptying processes, especially in times of work shift changes and to develop potential measures to the merit of efficiency. The performance evaluation was done by using micro simulation, Vissim, which could help in handling complicated traffic design and management issue.

Two proposed scenarios were developed to challenge the current system performance. Application of autonomous vehicles is introduced as the first scenario by considering the promising automotive technology development. An analyzing to the circulation system was deeply considered to come up with one-way aisle system as the second scenario. Vissim is selected as the microscopic simulator to perform the evaluation performance. It provides detailed configurations which allow the simulation model to replicate actual condition. Parking choice behavior is modelled by assigning attractiveness values to parking lots. Utility approach is used to define the attractiveness values based on observed parking behavior and condition.

Total Comparison (second)

MORNING — TRAVEL TIME: Current Condition 107,90; Autonomous Parking 163,66; One-way Aisle 190,34
MORNING — DELAY: Current Condition 30,03; Autonomous Parking 83,99; One-way Aisle 106,45
AFTERNOON — TRAVEL TIME: Current Condition 91,61; Autonomous Parking 154,39; One-way Aisle 134,67
AFTERNOON — DELAY: Current Condition 28,46; Autonomous Parking 98,59; One-way Aisle 53,54

■ Current Condition ■ Autonomous Parking ■ One-way Aisle

Despite some limitations, the simulation model was quite proficient to represent the real network for evaluation purpose. The findings of this study indicated that the prevalent condition system which employ two-way aisle of conventional parking system is still more efficient than both proposed measures, either at the filling process or emptying case. One interesting thing is noticed for the comparison performance between autonomous parking and one-way aisle system. The result show that autonomous parking system creates more efficient circulation system at the filling process compared to one-way aisle. In the emptying case, one-way aisle system however worked more effective than autonomous.

As a final point, regardless these findings show the lower performance of autonomous parking scenario in the case study, there is still huge promising technology development in this area which might improve the efficiency a car park management.

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