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Development of a workflow to analyze the mobility behavior of a university campus with trajectory data

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This work addresses the following topic from the Call for Contributions:

☐ Placemaking to integrate urban spaces and mobility
☐ Promoting sustainable mobility choices in metropolitan regions
☐ Governing responsible mobility innovations
☐ Shaping the transition towards mobility justice
☒ System analysis, design, and evaluation
☐ other: _____

Extended Abstract

Problem statement

The Bundeswehr University Campus in Munich (UniBw M) is being used as a real-life laboratory for climate-neutral and demand-oriented mobility research as part of the MORE research project. MORE is a dtec.bw funded project and is the short form for “Munich **Mo**bility **Re**search Campus” (More, 2023). This real-life laboratory uses i.a. the traffic analysis software "DataFromSky Viewer" with camera object recognition to gather traffic-related data (Adamec, 2020). The extracted data is currently used for feeding a campus traffic simulation model for optimizing an on-demand shuttle service and research on traffic-related emissions.
The problem is that the mobility behavior in the real laboratory currently needs to be discovered. Accurate, reliable, and reproducible traffic analysis is required to build accurate models and design realistic simulation scenarios (Daamen, 2015).

Research objectives

The target of this work is to investigate the mobility behavior on the campus and answer the following research questions:

- Which means of transport are most frequently used on the Universität der Bundeswehr München campus?
- Are there differences in mobility behavior between different days and times of day?

To answer these questions, a workflow for traffic analysis is developed based on the trajectories gathered from the installed cameras.

Methodological approach

The study area is home to around 3,800 students and approx—1400 employees, including 199 professors. In addition to a trimester system, UniBw M offers various facilities, such as a kindergarten, a mensa, and a sports

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support association (UniBw M Karriere, 2023). There is ample parking space for cars on the campus, and the MORE project provides a sharing service with freely usable bicycles, scooters, and cargo bikes.

On the UniBw M campus, a total of 22 traffic cameras are installed at seven recording areas, with areas of entrances (n=5) and main traffic junctions (n=17) being monitored. The analysis of this article focuses on video footage from the two cameras recording the main entrance. The view of the camera examined is shown in **Figure 1**. However, the workflow developed can be applied to any camera on the campus.

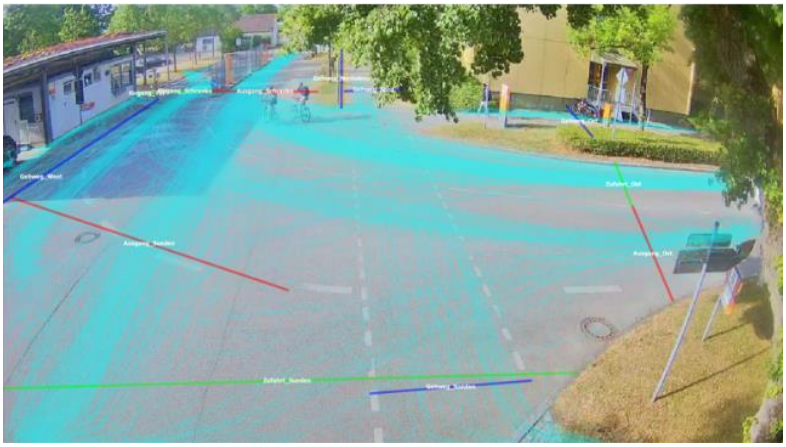

Figure 1: Camera view of the investigated area

The dataset includes video material subjected to analysis using the software "DataFromSky Viewer" (version 1.16.4; Data From Sky, 2023). The results of this analysis are output in a tracking Log file and contain classified objects and their trajectories. Trajectories are positional data of individual traffic elements, blue lines in **Figure 1**. The software uses up to 17 category classes for traffic elements (DataFromSky, 2023). This classification takes place in real-time, so there is no need to store the video footage, and privacy can be maintained. The investigation period covers 24 hours to represent one day. The data is generated continuously and can be evaluated daily. A virtual gate configuration is added to the data packets to time-stamp the classified objects by passing through these gates. A Matlab code (with "Matlab R2020b" (The MathWorks, Inc., 2020)) generates two diagrams: a Modal Split and a Traffic count. The workflow is shown in **Figure 2**.

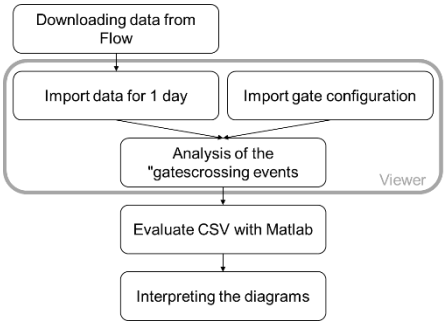

Figure 2: Workflow of data procurement

Expected results

The traffic analysis with the applied workflow results in two kinds of diagrams: modal split and traffic counts. Modal split is a method in transport statistics that shows the relative distribution of traffic volume among different modes of transport (Kirchhoff, 2002). The results of the modal split analysis are offered in a pie chart as a percentage and provide information about the frequency of the means of transport used.
Traffic counts are a time-dependent analysis of the absolute number of categorized traffic elements (Steinneyer, 2021). For this purpose, the data from each day is divided into one-hour intervals, visualized in a bar chart, in

this evaluation, for example, in **Figure 3**. Each means of transport is shown in a separate bar, and the height of a bar corresponds to its absolute number.

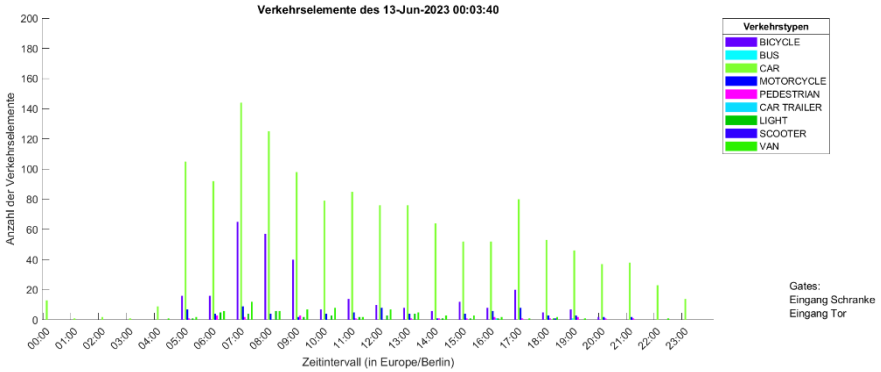

Figure 3: Workflow of data procurement

It can be assumed that the car share is the largest, followed by pedestrians and cyclists. The traffic data pattern is expected to correspond to the typical peak hours in urban areas (Hamad, 2021). However, higher motorized traffic, as in other distinct student campuses, is anticipated due to the high number of employees on the campus (Cattaneo, 2018).
Preliminary results support the above assumptions, but a comprehensive statistical analysis is planned in the following months in the scope of the MORE research project.

Literature

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