Identification and Imputation of Moving Bottlenecks in Urban Road Networks using Drone Surveillance Data and Artificial Intelligence

Call for an Interdisciplinary Project Work in the Application Subject of Traffic Engineering and Control

Background Information
In late 2018, Prof. Geroliminis from the Federal Institute of Technology in Lausanne, Switzerland, and his team carried out one of the most significant data collection efforts in the field of traffic engineering in the past decades: They used ten drones to record all vehicle movements (cars, buses, bikes, lorries) in downtown Athens for four days (https://open-traffic.epfl.ch/). This unique dataset allows us to increase our understanding of the complexity of multimodal urban traffic that can help us to improve mobility for everyone. It covers multiple days and contains traffic streams in a congested area of a 1.3 km² with more than 100 kilometers of traffic lanes, around 100 busy intersections (signalized and non-signalized), many bus stops and close to half a million vehicle trajectories (Barmpounakis & Geroliminis, 2020).

Figure 1: Covered area for drone data collection, downtown Athens (pNEUMA EPFL, 2020)

This new source of traffic data makes the analysis of the impact of a slow vehicle, also known as a moving bottleneck, on the traffic flow very interesting, since their occurrence can result in a disruption of the traffic flow and may significantly impact the traffic stream behavior around the slow-moving vehicle.
Task Description
This IDP project deals with the analysis of the above described open large-scale dataset of naturalistic vehicle trajectories, collected in the pNEUMA project of Prof. Geroliminis in 2018. It aims at the development of a neural-network-based methodology to identify the presence of moving bottlenecks from drone surveillance data in an urban traffic environment and the subsequent derivation of probability functions on the likelihood of occurrence of such a traffic situation. In detail, the fulfillment of the following tasks is expected:

- Identification of road segments with many buses or delivery vehicles that drive substantially slower than cars (and thus cause moving bottlenecks in the traffic flow)
- Development of a methodology based on neural networks that identifies from vehicle trajectory data the presence of a moving bottleneck on the road
- Classification of moving bottleneck types
- Derivation of probability functions for road stretches on the likelihood of encountering a moving bottleneck of a certain type

Requirements
- Interest in traffic data, data analytics and artificial intelligence
- Strong data analytics skills (no specific data analytics tool will be prescribed)

Accompanying Lecture
In general, the accompanying lecture can be selected in consultation with the supervisor from the entire list of courses offered by the Chair of Traffic Engineering and Control. For this IDP, the attendance to one of the following lectures is recommended:

- Traffic Flow Models (winter term)
- Traffic Data Collection and Analysis (summer term)

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References