Doctor of Business Economics

Monitoring Transport with Big Data: Analysing vehicle behavior with ANPR and GPS data

Sheida Hadavi

Promotors: prof. Mattias Guns, PhD and prof. Cathy Macharis, PhD

Abstract
The evolution of globalization has increased the importance of transport worldwide. This aspect of our daily lives is of growing relevance. It acts as 'the economy's backbone' by providing connections for people and goods. Despite all the advantages, numerous studies have also shown the major contributions of transportation to air pollution, noise nuisance, traffic accidents, congestion, and climate change. In order to preserve the livability of urban environments, the mobility system needs to evolve.

Policymakers benefit from evidence-based insights into current transport flows. Analyzing available data sources can provide such insights, by aiding us understanding urban transport, and the subsequent planning. Traditionally, methods such as traffic counts, surveys, interviews, group discussions, written questionnaires, and diaries are used to collect data on urban transport. However, digital data sources such as GPS devices, cameras and sensors are increasingly employed, which hold the potential to better understand urban transport. Subsequently, it is important to develop methods to analyze these large amounts of raw (and often noisy) data and extract information that is accessible for city planners.

In this dissertation, we introduce such methods to analyze big data sets in order to gain valuable insights for policymaking. We begin by a literature review, investigating the use of big data analytics in transport operation, and identifying the existing gaps. Thereafter, in the rest of this dissertation, we make use of two digital data sources, which provide data on the location of vehicles; namely data from On-Board Units (OBU) of heavy-good vehicles and from Automatic-Number-Plate Recognition (ANPR) cameras.

In analyzing OBU data, we introduce practical indicators for urban transport and propose a generic method to compute these indicators from large amounts of raw and noisy OBU data. We provide a case study, in which data is collected from OBUs of heavy-goods vehicles for Brussels-Capital Region in Belgium. Next, we present a methodology for analyzing raw augmented ANPR camera data. The ANPR data has the benefit that it contains not only heavy-goods vehicles but also light-goods and passenger vehicles. Therefore, we can analyze the behavior of each vehicle group separately, and compare them. The methodology is applied in a case study for the Mechelen-Willebroek district in Belgium, encompassing augmented data from 122 ANPR cameras. Lastly, we investigate computational techniques for automatically extracting patterns of vehicles trajectories from
ANPR cameras data. Moreover, we compare the patterns of different vehicle groups at various hours of the day and observe meaningful interactions.

This research starts by identifying the potential of new big data sources. Thereafter, we introduce methods to transform raw big data into knowledge to better understand mobility dynamics. We choose our objective in analyzing the data such that the driven knowledge can support local authorities in designing suitable and sustainable policies. The dissertation ends with a discussion on the importance of using the tools that we introduced in this research, as follow-up tools to evaluate the evolution of transport over time.