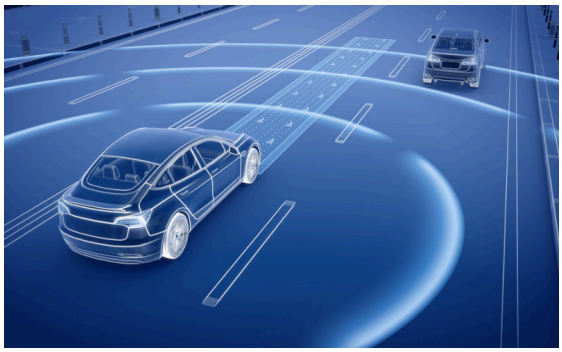
Viability of Safety Performance Indicators (SPI)



Problem description

The automotive industry is currently undergoing a shift towards automation and electrification of the vehicles. This comes under the ambition of safer and more sustainable automotive industry. As type approval authority RDW is faced with a particular challenge of striking a good balance between safety and innovation. To ensure safe deployment of Automotive Driving System (ADS) many assessment criteria are being developed and proposed. One such assessment methodology is In-Service Monitoring and Reporting. The In-Service Monitoring and Reporting (ISMR) is considered as post deployment activities to ensure safe operation of the ADS and proper reporting.

In-Service Monitoring and reporting is executed to ensure that the ADS performance is within the nominal performance of the vehicle during its operation. The manufacturers can demonstrate an effective ISMR through multiple Key performance indicator (KPI) and Safety performance indicator (SPI). KPIs aim to assure that monitoring is performed at an optimal level and addresses any issues affecting the effectiveness of the monitoring program. However, SPIs aim at monitoring the safety performance/behavioral competences over the operational lifecycle of the ADS.

Assignment

This project is aimed at researching the viability of different SPIs. SPIs can be divided into two categories: Lagging metric and Leading metric. As part of this project the researcher needs to determine the applicability of one or more SPI through a practical experiment.

This project can be divided into three phases. The first phase consists of choice of SPI for the project, wherein the researcher shall decide upon one or more SPI to investigate as part of this project. The second part of the project consists of an experiment where the researcher needs to collect the necessary data in a mixed traffic environment (virtual) and plot the performance of the ADS against the SPI chosen. The final phase entails presenting the research findings in a master's thesis.

Payment

Monthly stipend: 672.30 € (exact amount to be confirmed at the start of the project)

Research group

Transport & Planning

Thesis supervisor: Dr. ir. Haneen Farah; Dr. ir. Irene Martínez Josemaría

External supervisor: Dr. ir. Solmaz Razmi Rad; ir. Shubham Koyal (RDW)

Information

For further information on this Master topic, please contact: h.farah@tudelft.nl

Resilience of road networks

Problem description

Recent research has shown that resilience of road networks is strongly dependent on certain parameters of the network. The relation of resilience with network parameters, such as density, number of nodes and average number of lanes was investigated, and the research showed that networks with a lower density having a higher resilience. It was also found that no conclusion could be drawn about the relation between capacity and resilience. For this research random networks were drawn. However, the networks generated had very correlated parameters. This made it difficult to find which network parameters influenced the resilience the most. It is possible to design networks differently, such that the network parameters can be better distinguished. Also, the relation between network size and resilience is still an open research topic.

Assignment

- Check recent literature on resilience and resilience metrics;
- Decide which network parameters are worth further research;
- Design and execute simulations to determine the relation between certain network parameters and resilience;
- Analyse the relation between the chosen network parameters and resilience;
- Write a thesis report (and optionally a scientific paper for an international journal).

Research group

CEG - Transport & Planning

Thesis supervisor: dr.ir. Victor Knoop

Daily supervisors: dr.ir. Irene Martínez Josemaría; dr.ir. Henk Taale (Rijkswaterstaat)

Technology, Policy and Management – Multi-Actor Systems Department

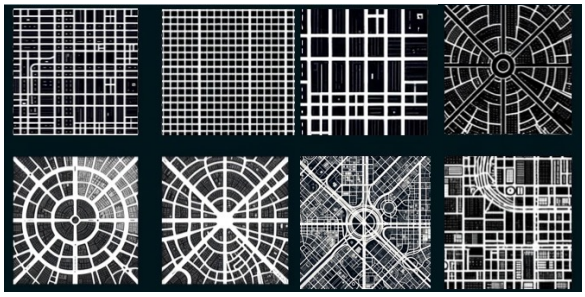
Thesis supervisor: prof.dr. Martijn Warnier

Information

This research is done in cooperation with Rijkswaterstaat, within the ITS Edulab. In ITS Edulab students analyse traffic related issues with short-term research for Rijkswaterstaat, the Dutch motorway operator. In this way, real-life, operational knowledge is connected with scientific research. ITS Edulab leads to useful, practical knowledge for Rijkswaterstaat, and interesting master projects to students.

For further information on this Master topic, please contact: h.taale@tudelft.nl

Classification of urban networks based on their topology and demand



Problem description

Cities face increasing population growth, leading to environmental problems due to congestion. Thus, there is a need for sustainable and efficient transportation systems, and the optimization of shared transportation services presents a pivotal opportunity to provide a viable alternative to private vehicles. However, the diversity in demand patterns and network topologies of different cities calls for a tailored shared mobility system rather than a universal solution for shared mobility. Finding a solution for each city is very computationally expensive and inefficient. For this reason, some researchers have aimed to classify cities and provide tailored solutions for each category. However, a systematic way to identify city categories is still elusive.

Assignment and objectives

This project aims to categorize cities into distinct typologies, considering factors such topology characteristics and demand patterns to better understand the relationship between urban form and transportation dynamics. By identifying distinct classes of urban typologies, we can tailor shared mobility systems to each class, optimizing for efficiency and sustainability.

The assignment will consist of the following:

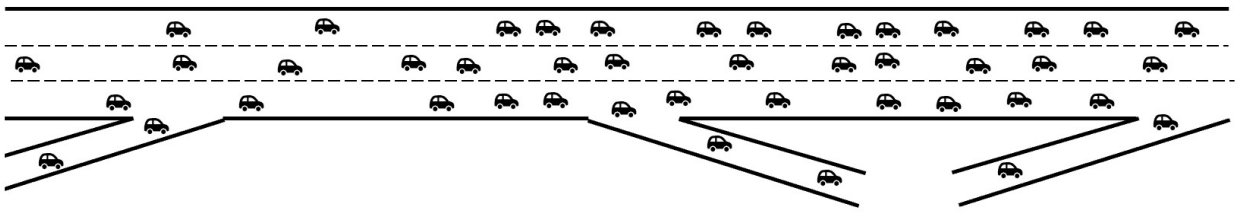
- Conducting a literature study and select some cities for the study
- Use of OpenStreetMap to analyze urban netwroks structural characteristics.
- Identify and collect relevant transportation demand patterns from multiple cities, e.g., trip distances.
- Establishing correlations between city structure and transportation demand.
- Use of clustering techniques for network classification

Research group

Transport & Planning Department
Daily supervisor (contact for information):
Dr. ir. Irene Martínez (I.MartinezJosemaria@tudelft.nl)

The project can be conducted as a final thesis project for the MSc Civil Engineering –Transport & Planning track or MSc in Transport Infrastructures and Logistics.

Modeling freeway traffic at corridors: comparison of microscopic, macroscopic, and network traffic flow models



Problem description

Multiple traffic flow models and simulation softwares have been developed to study the traffic dynamics that arise from the interaction of vehicles on the road. Traditional traffic flow theory describes the movement of vehicles as particles (Lagrangian coordinates) or as a stream of vehicles through a road (Eulerian coordinates). These traffic flow models can be referred to as vehicle flow models because they are focused on describing the flow of vehicles and are not particularly focused on the trip perspective of those vehicles, e.g., mode or route choice and other trip characteristics such as origin and/or destination. Based on the behavioral rules and on the representation, these traditional traffic flow models are usually classified into macroscopic (Eulerian coordinates and Macroscopic behavioral rules) or microscopic (Lagrangian coordinates and microscopic behavioral rules) flow models. The traffic dynamics on these models rely on local speeds, which can be calculated based on average local densities or the distance to the leading vehicle, respectively. Recently, there is an emerging modeling approach has been gaining interest in the research community due to its computational cost benefits. The main idea behind this approach is to treat a network as an undifferentiated unit, where trips are modeled in a relative space with respect to their destinations. These models are referred to as bathtub models. The trip flow dynamics at the network level are characterized by an average speed of the system that is calculated globally based on network-wide density. The existence of this network-wide speed-density relation at the network level has been proven to exist empirically both in urban networks and at freeway corridors.

Assignment

The assignment will consist of:

- Literature study on microscopic and macroscopic flow models and on bathtub models
- Develop code(s) to compare traffic dynamics for different traffic models on a freeway corridor with multiple on- and off-ramps
- Compare computational cost and accuracy between models

Background

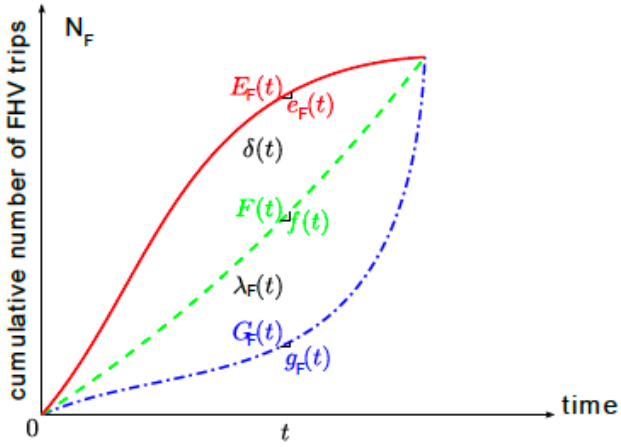
A student who has interest in traffic flow simulation and wants to elevate their programming skills.

Research group

The project can be conducted as final thesis project for MSc Civil Engineering –Transport & Planning track or MSc in Transport Infrastructures and Logistics.

Daily supervisor (contact for any information): Dr. Ir. Irene Martínez (I.MartinezJosemaria@tudelft.nl)

Fleet sizing strategies for shared automated vehicles (SAVs) under mixed mobility systems



Problem description

The urban mobility environment is changing with the development of new technologies which enable new modes of urban transportation, e.g., new shared mobility services such as Uber. Therefore, it is important to understand the impacts of these for-hire vehicles on the whole transportation system's performance and devise the corresponding system-level management schemes to improve the whole transportation system's performance.

Assignment and objectives

A recent model has been proposed to capture the trip flow dynamics of such a system with a simple compartmental model, which can be interpreted as a coupled queuing system between the waiting and the traveling trips. The study concluded that it is essential to limit the for-hire vehicles in the system to guarantee there is no traffic congestion (in the traveling compartment). However, the fleet size cap depends on the other transportation modes, particularly the number of privately owned vehicles (POVs).

This project aims to perform a systematic analysis to determine the optimal fleet size cap for these shared automated vehicles under a mixed environment with SAVs and POVs. This project will rely on a mathematical model and/or simulations (Matlab, Python, or similar).

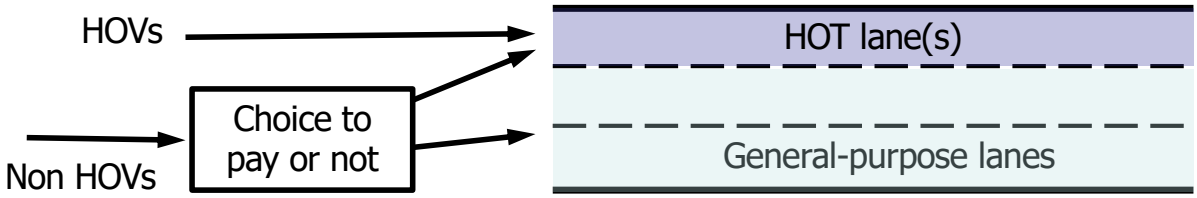
The assignment will consist of the following:
- Conducting a literature study on the fleet size of SAVs
- Analyze the total cost of travelers depending on the fleet size of SAVs
- Determine the optimal cap for SAVs under different demand scenarios

Research group

Transport & Planning Department
Daily supervisor (contact for any information): Dr. Ir. Irene Martínez (I.MartinezJosemaria@tudelft.nl)

The project can be conducted as a final thesis project for the MSc Civil Engineering –Transport & Planning track or MSc in Transport Infrastructures and Logistics.

Fair and dynamic HOT lane pricing based on expected travel time



Problem description

Single-occupancy vehicles (SOVs) are charged to use the high occupancy toll (HOT) lanes, while high-occupancy-vehicles (HOVs) can drive in them at no cost. The pricing scheme for HOT lanes has been extensively studied at local bottlenecks or at the network level through computationally expensive simulations. However, most of the dynamic pricing strategies are reactive in nature and may lead to unfair pricing. Leveraging vehicle-to-infrastructure communication, we can rely on a more personalized toll, which is not only time but also distance-dependent.

This thesis aims to develop a fair and dynamic HOT lane pricing strategy for freeway corridors with multiple bottlenecks. The proposed tolling scheme will account for the expected travel time of users based on day-to-day information or near-future demand predictions, ensuring a more equitable distribution of toll rates. The research will leverage Vickrey's bathtub model or agent-based bathtub model to evaluate the equity and efficiency of traffic control. The findings of this study will contribute to the advancement of equitable transportation policies and congestion management strategies.

Assignment

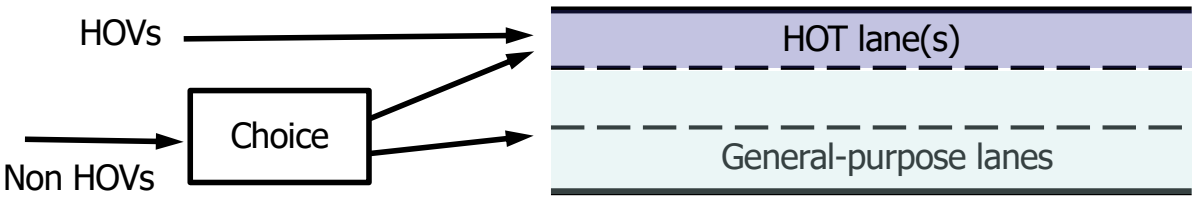
The assignment will consist of:
- Literature study of HOT lane pricing
- Introduce one or multiple dynamic tolling scheme that considers the expected travel time
- Introduce one or multiple dynamic tolling scheme that accounts for the overall expected externalities caused by each vehicle (marginal pricing)
- Simulations to evaluate the impact on efficiency and equity of the proposed strategies

Research group

The project can be conducted as final thesis project for MSc Civil Engineering –Transport & Planning track or MSc in Transport Infrastructures and Logistics.

Daily supervisor (contact for any information): Dr. Ir. Irene Martínez (I.MartinezJosemaria@tudelft.nl)

Lane choice behavior modeling on high-occupancy-toll (HOT) lanes



Problem description

Dedicated lanes for high-occupancy-vehicles (HOVs, where there are 3+ persons in a vehicle) are usually underutilized. To take advantage of the available unused capacity in these lanes, HOT lanes allow vehicles that do not meet the minimum occupancy requirement to pay a toll to travel in the underutilized lane. This management strategy improves the system performance without significantly influencing the travel time of HOVs. The operator should determine the dynamic toll for SOVs based on the demand to ensure that the HOT lane is never congested while also not being underutilized. Moreover, there is an increasing interest to make the toll collection a distance-based pricing strategy.

However, the lane choice for HOT lanes is not systematically studied in the literature. Because drivers can choose to travel in the HOT lanes only for a portion of their trip, the path alternatives have significant overlap, therefore, simple discrete choice models like the logit model can not be applied due to the correlation between alternatives. Moreover, the choice of drivers will also depend on the congestion level in the general-purpose lanes as well as on the HOT lanes, the value of time of the driver, and the his/her personal characteristics.

Assignment

This project consists in developing a stated choice experiment to develop a model for the decision of which lane to take, for how long, and when.

The assignment will consist of the following:
- Conducting a literature study of lane choice models
- Develop an experimental design in terms of variables and their levels as well as context variables
- Design a stated preference survey with alternatives and calibrate different model structures
- Analyze the results and produce meaningful insights from the research

Research group

Transport & Planning Department
Committee:
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Dr. Ir. Gonçalo Correia (g.correia@tudelft.nl)

The project can be conducted as a final thesis project for the MSc Civil Engineering – Traffic and Transport Engineering track or MSc in Transport Infrastructures and Logistics.