FRANKFURT UNIVERSITY OF APPLIED SCIENCES

ReLUT - Research Lab for Urban Transport

NEWSLETTER 01/2024

ReLUT RESEARCH LAB FOR URBAN TRANSPORT FRANKFURT UAS

Welcome!

The Research Lab for Urban Transport is an interdisciplinary team of researchers in Frankfurt, Germany working on current and future challenges of mobility. Our research focuses on the development of economic and ecological solutions for new mobility models. In addition to the disciplines of transport planning and logistics, ReLUT combines a wide range of competencies: urban planning, social science, data science (Big Data), computer science (AI), geoinformation, law, automotive engineering, and economics.

We closed out 2023 with many projects, travels, and new partnerships. In March, we celebrated our 5th anniversary of ReLUT. It is hard to imagine the research and progress we have accomplished in these five short years. We are excited to see how we grow in the next five years. The growth and impact of our team was prominent this year in our international collaborations. In September, Petra Schaefer represented ReLUT in the German Delegation team's visit to Canada. In November 2023, ReLUT team members met with a delegation from the China Academy of Transportation Science to echange ideas on promoting sustainability.

Our annual Urban Transport Conference held in March was a huge success. The theme of this year's meeting was "Shaping the future of urban mobility and logistics in times of high energy prices". If you were unable to make it, you can review the talks and last year's schedule here.

We hope you enjoy reading about all the projects our team has been working on and that our work inspires your work. We are always looking for areas of collaboration! Please reach out to us if any of our projects are of interest to you.

Best wishes for the new year!


Petra Schäfer


Tobias Hagen


Anne Lange


Dennis Knese

Faculties 1 & 3
ReLUT

Wissen durch Praxis stärkt

LieferMichel, a drone delivery service

WINGCOPTER

Gefördert durch:

Bundesministerium für Digitales und Verkehr

aufgrund eines Beschlusses des Deutschen Bundestages

Wingcopter and the Frankfurt University of Applied Sciences (Frankfurt UAS) launched the project „LieferMichel“ on October 5, 2023. The pilot project enables residents of remote districts in Michelstadt, Hesse, to have goods and groceries delivered quickly and emission-free to their homes using drones and electric cargo bikes. The drone deliveries aim to sustainably improve local supply in the region, not only for food but for different kind of daily necessities. The project is funded by the Federal Ministry for Digital and Transport (BMDV) under the „Innovative Air Mobility“ funding guideline, with a total grant of around 430,000 EUR.

Initially, the two outlying districts of Rehbach and Wuerzberg, located outside Michelstadt, will be served. Residents of these districts can order daily necessities from REWE supermarket, such as shelf-stable milk, eggs, fruits, vegetables, canned goods, and many other non-refrigerated products through the website www.liefermichel.de and have them delivered to their homes at a preferred time. Delivery packages are limited to a weight of up to 4 kilograms. Orders will be flown by the drone Wingcopter 198 to designated landing points on the outskirts of the villages. From there, they will be transported to end customers

© 2023 Riese & Müller GmbH

© 2023 Wingcopter GmbH

by e-cargo bikes. This delivery process showcases multimodal supply chains for rural regions. In addition to the city of Michelstadt and REWE, Vodafone, and Riese & Müller have joined as associated project partners.

The Frankfurt UAS will scientifically accompany the pilot project, evaluating the service from economic and ecological perspectives. The university will also handle the e-cargo bike deliveries, leveraging its expertise in last-mile logistics with cargo bikes and light electric vehicles (LEV).

Based on the experiences in Michelstadt, the goal is to develop a sustainable and scalable business model to improve local supply in other rural areas of Germany through fast, ecologically sensible, and reliable drone and cargo bike delivery of daily necessities. Despite the disappearance of smaller stores in rural areas in recent years, food delivery services that deliver orders within minutes have so far been limited to urban areas. The project partners see significant potential in expanding this service. The funding project is initially scheduled to run until the end of 2023 and will be continued in 2024, if successful.

M. Eng.
Benjamin Federmann
Research Assistant

Faculties 1 & 3
ReLUT

Wissen durch Praxis stärkt

RisiSens at the World Multidisciplinary Civil Engineering Symbposium

On September 7, 2023, our research associate, Elisabeth Lerch, represented ReLUT at the „World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium“ (WMCAUS) in Prague. The conference serves as an international networking and exchange platform for multidisciplinary research in the fields of civil engineering, architecture, urban and regional planning. Elisabeth Lerch presented our research project „Risk management of classic intersection types using automobile sensor data (RisiSens)“ in the „Session Recording and Evaluating the condition on urban cycle roads“. In RisiSens, we surveyed traffic conflicts between pedestrians, cyclists, and motor vehicles manually and with the help of automobile sensors at three selected intersection types.

© ReLUT

Based on this data, we are developing a risk management system for pedestrians and cyclists. The monitoring tool is intended to support local authorities in their preventative road safety work. Elisabeth Lerch presented the methodological approach to RisiSens at the WMCAUS with her lecture, „Analysis of Traffic Conflicts at Big Intersection Types in Urban Areas“. The project was met with great interest from the audience and a lively exchange of ideas followed her presentation. We have also summarized the methodological approach of the „RisiSens“ project in a paper. The paper, „Analysis of Traffic Conflicts at Big Intersection Types in Urban Areas,“ has been accepted for peer review and is expected to be published in 2024.

M. Eng.
Elisabeth Lerch
Research Assistant

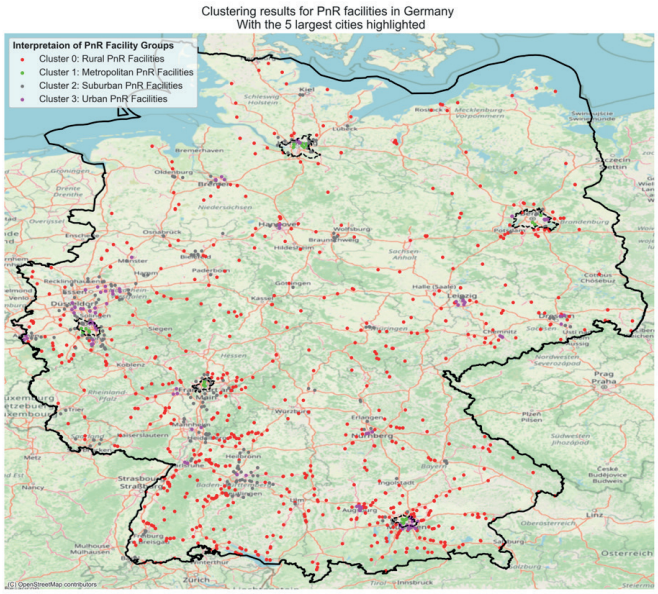
PnR2Scale - Clustering of Facilities.

Gefördert durch:
Bundesministerium für Digitales und Verkehr
aufgrund eines Beschlusses des Deutschen Bundestages
mFUND

Park-and-Ride (PnR) is a widely recognized concept that originated in the United States during the 1920s. Essentially, PnR is a service designed for motorists located at the outskirts of urban areas, providing a connection to the city center, commonly referred to as the Central Business District (CBD). Just as cities vary in size, connectivity, and other characteristics, PnR facilities exhibit diversity in their features. This diversity suggests the existence of different types of PnR facilities, all serving the same purpose but possessing distinct attributes. Consequently, it is essential to consider different policies and design features for various PnR facility types.

Previous studies have attempted to classify PnR facilities into groups based on factors such as spatial location and proximity to the city center. For instance, facilities have been categorized as remote, local, or peripheral depending on their proximity to the city center. However, these studies primarily focus on spatial considerations and often neglect other variables that influence the utilization and acceptance of PnR facilities. To close this gap, our approach enriches PnR facilities with a comprehensive set of variables, with a focus on traffic and acceptance.

By using open-source data from OSM, we are able to extract information on more than 1500 PnR facilities in Germany. These facilities are enriched with more than 200 descriptive variables, encompassing land-use details, socio-demographics, core data (such as capacity), available public transport options, road network information, and more. To identify heterogeneous groups of PnR facilities, we employ a clustering approach. Given the mixture of numerical and categorical variables, standard approaches like k-Means and DBSCAN are not suitable. Instead, we utilize k-Prototypes, an extension of the k-Means clustering algorithm capable of handling both numerical and categorical variables concurrently.



© ReLUT

Our analysis reveals four distinct groups of facilities: rural, metropolitan, suburban, and urban. This clustering not only aligns with spatial proximity-based groupings, but also introduces an additional category. To interpret these findings, we combine domain knowledge with descriptive statistics and SHAP values—a machine learning approach aiding in understanding results. Lastly, to select representative facilities for each group, we employ propensity score matching that best describes their respective characteristics. This method allows us to identify the top representative facilities for each group. The accompanying figure illustrates the clustering results for all of Germany.

M. Sc.
Jonas Hamann
Research Assistant

M. Eng.
Seray Künbet
Research Assistant

ReLUT attends 7th annual meeting of Cycling Research Board #CRBAM23

From October 25-27, 2023, Dennis Knese and Nicole Reinfeld of the ReLUT team attended the 7th Annual Meeting of the Cycling Research Board (CRBAM) in Wuppertal, Germany. Cycling researchers came together to discuss how we can overcome practical challenges with research solutions. Nicole and Dennis were involved in several workshops, lectures, panel discussions, fishbowls, excursions and deep-dive talks. The variety of different session formats and topics as well as the constructive, almost family-like atmosphere in an amazing location made the conference special.

Thanks to the organizers Heather Kaths, Cat Silva and the bicycle traffic team of the Bergische Universität Wuppertal. An overview of the program can be found here.

See you next year, when Kay Axhausen and the ETH Zürich will host the 8th Annual Meeting of CRBAM.

© ReLUT

European Transport Conference 2023

ReLUT was strongly represented at the European Transport Conference 2023 in Milan with team presenting on many topics. The European Transport Conference (ETC) is the annual conference of the Association for European Transport, which brings together participants from transport policy, practice and research from Europe and beyond. We're looking forward to the 2024 meeting in Belgium.

Nicole Reinfeld

"Use of cluster analysis to identify behaviorally homogeneous groups in several stages of the four-stage model"

Lukas Fassnacht

"Digital interface to promote climate-friendly mobility concepts in freight transport"

Siavash Saki

"Parking search time prediction in historical FCD and future trips"

Jonas Hamann

"Detection of trip purposes through automated clustered semantic trajectories"

Amir Babaei

"Using a grid approach to model the spatial distribution of air pollutants in an agent-based traffic simulation of the Rhine-Main region"

"Incorporating background traffic in MATSim for accurate simulation of mobility behavior: A case study of the Frankfurt/Main region"

Nicole Reinfeld

Chaired a session on „National Travel Surveys"

Prof. Dr. Tobias Hagen

Chaired a session on „Data for Micromobility"

ReLUT explores new methods for analyzing travel behavior

An individual's travel behavior depends on current societal factors (e.g., energy prices), the life phase of an individual (e.g., students, older adults), and trends within their own generation, or the so-called "cohort" (e.g., GenZ, Baby Boomers).

For example, young adults between 18 and 29 years used to be one of the most car-orientated groups in German society. They served as an indicator of long-term trends in travel behavior of the future (Kuhnimhof et al., 2012). For older adults, car use has continued to increase over the last 20 years (Kraftfahrt-Bundesamt, 2021). This is particularly true for women, who are approaching the level of men's car use from cohort to cohort. This can be explained by the increased participation of women in the labor market.

However, car use in the age group of young adults has declined and their daily passenger kilometers on public transport have doubled (Kuhnimhof et al., 2012). At the same time, the number of students has risen sharply (+63.3% from 2000 to 2020 or 5.0% per year (Destatis)).

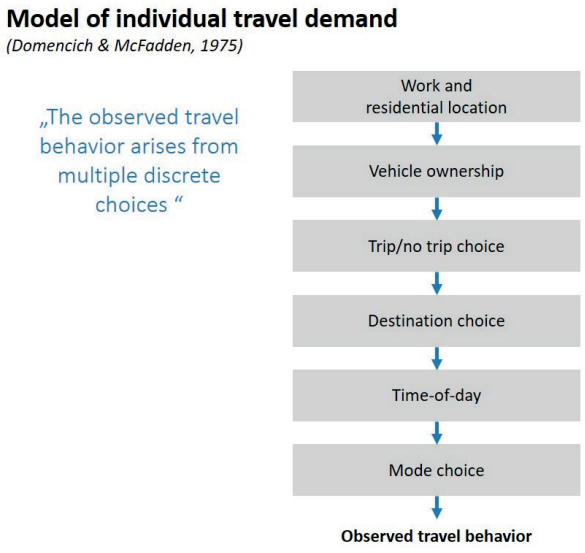


Figure 1: Model of individual travel demand. (Domencich & McFadden, 1975).
© ReLUT

This group may not have sufficient financial means to maintain a car but instead in some cases a cheap public transport ticket offered by the universities.

This raises the question of whether the change in young people's travel behavior is a result of a temporary change in life circumstances or a permanent change in behavior or ideology. If the former is the case, we can assume that young people have only „postponed" car use. If the latter is the case, we can assume a long-term commitment to use of public transport.

The aim of the „MAKoMo" project is to identify and quantify cohort effects in travel behavior. We will use innovative, quantitative methods to analyze representative survey data for Germany and the Netherlands. A comparison of cohorts such as this is common practice in medical research, and we will transfer medical cohort research methods to the analysis of mobility behavior. As the observed behavior depends on multiple interdependent choices (Fig. 1), this project will analyze the influence of work location and residential location, vehicle ownership, decision whether to travel or to stay at home (by investigating the share of immobile persons), destination choice, time-of-day, and mode choice.

We have currently completed the data acquisition process and are working on data processing and cleaning. To validate the results with qualitative methods, we will acquire a focus group with citizen participation. We plan to hold workshops with the focus group at the end of 2024 to discuss our findings and to add subjective experiences of the focus group participants.

The project is funded by the State of Hesse and HOLM funding under the „Innovations in Logistics and Mobility" measure of the Hessian Ministry of Economics, Energy, Transport and Housing. The project will continue until May 2025.

M. Sc.
Nicole Reinfeld
Research Assistant

FRANKFURT UNIVERSITY OF APPLIED SCIENCES

Exploring Urban Efficiency: An Insight into the DZwEI Project

Gefördert durch:

Bundesministerium für Digitales und Verkehr

aufgrund eines Beschlusses des Deutschen Bundestages

mFUND

„DZwEI," an acronym for „Digital twin for real-time analyzes of the effects of infrastructure measures to increase the efficiency of mobility and reduce emissions in urban areas" focuses on creating a digital twin for real-time analysis of transport infrastructure measures. This project is not just a technical endeavor, but a step towards understanding and enhancing urban mobility and emissions efficiency.

The core of DZwEI lies in addressing a significant challenge: the lack of real-time evaluation tools for local emission reduction measures, such as adjustments in parking spaces and development of bike and pedestrian paths. The primary goal is to develop a prototype technology that utilizes various data sources to assess the effects and potential side effects of these local measures in urban areas. This analysis includes a comprehensive look at traffic volume, speed, emissions, parking space availability, parking pressure, and parking search traffic (possibly extending to adjacent areas to understand traffic diversion effects).

Image generated by AI with the prompt „Digital twin city model, showasing real-time traffic and emissions analysis"

Inputs for the DZwEI project are diverse, ranging from vehicle data (including parking maneuvers and ultrasonic sensors) to Floating Car Data (FCD), traffic cameras, and manual counting. Additionally, the project integrates communal data, such as information from parking meters.

The output envisaged is a user-friendly dashboard that provides real-time analysis of various urban mobility and emission metrics. This dashboard aims to offer insights into the current traffic and parking situation, emission levels, and the impact of infrastructure measures. The project revolves around key research questions:

- How can vehicle data be calibrated using machine earning models to accurately reflect traffic and parking situations?
- What model can create a digital twin of vehicle traffic in a city area for real-time monitoring and evaluation?
- How can vehicle traffic emissions be integrated into the digital twin?
- How can the digital twin be constructed to be transferable

The DZwEI project contributes to broader urban planning and policy goals by using so far underutilized vehicle data for real-time analysis of street and parking infrastructure. This method, starting in Frankfurt, has the potential for broader application, influencing transport infrastructure provision at various governmental levels.

The DZwEI project, coordinated by ReLUT, is a collaborative effort with esteemed partners including Mercedes-Benz AG, MBition GmbH, and B2M Software GmbH. The project, which runs from October 2023 to September 2025, is funded by the Federal Ministry for Digital and Transport as part of the mFUND innovation initiative.

M. Sc.
Amir Babei
Research Assistant

Faculties 1 & 3
ReLUT

ReLUT represents with the DFG trip to Canada

From September 24 to 30, 2023, Petra Schäfer was able to take part in a DFG (Deutsche Forschungsgemeinschaft/ German Research Foundation) delegate trip to the USA and Canada. Around 40 colleagues from German universities of applied sciences made this trip with a focus in the two research fields of Smart Cities and Energy. Stops included the University of Washington in Seattle, Simon Fraser University in Vancouver, the University of British Columbia in Prince George and the University of Calgary. The trip resulted in many new contacts and perspectives. Most memorable was the reception with the German Consulate General Marc Eichhorn in Vancouver and a very warm welcome at a university in Prince George that is partly supported by the population of North British Columbia. Many foreign colleagues who have found their home in Canadian universities study there. From an academic's perspective, the Mobility Innovation Center at the University of Washington was very interesting, as it deals with topics similar to those at ReLUT. Other contacts were also made and have already continued to develop.

A follow-up meeting will take place on January 23, where the status of networking will be discussed.

PhD Eng.
Petra Schäfer
Professor for Transport Planning

© ReLUT

© ReLUT

Status:
December 2023

Picture credits:
All Portraits: Ulrike Wolf

If you would like to unsubscribe to the newsletter, please send a short email to relut@fra-uas.de

PUBLISHING INFORMATION

Frankfurt University of Applied Sciences
Fb 1 Architecture · Civil Engineering · Geomatics
Fb 3 Business and Law
Nibelungenplatz 1
60318 Frankfurt am Main
Tel. +49 (0)69 - 1533-2361
E-Mail: relut@fra-uas.de
www.relut.de
www.frankfurt-university.de

Faculties 1 & 3
ReLUT

Wissen durch Praxis stärkt