Conference Program

STRC

25th Swiss Transport Research Conference
Monte Verità / Ascona, May 14 – 16, 2025

We are delighted to welcome you to the 25th edition of the Swiss Transport Research Conference (STRC).

This milestone event continues to serve as a key forum for professionals and researchers in the fields of transportation and mobility.

STRC brings together academics, consultants, and representatives from both the public and private sectors to exchange insights, share research outcomes, and engage in meaningful dialogue on pressing transport issues.

The conference fosters collaboration and innovation through a diverse program of presentations and discussions.

This year, 65 contributions will address a wide array of topics such as Demand Modeling, Public Transportation and Shared Transport Operations, Transport Data Science and Machine Learning, Sustainable Urban Mobility Planning, Traffic Flow and Control, Logistics, and Autonomous and Intelligent Transport Systems (ITS)—among many others.

The following keynote speakers have confirmed their attendance:

- **Dr. Bilge Atasoy**, Delft University of Technology, Netherlands
- **Dr. Alexandre Torday**, Aimsun
- **Prof. Andreas Schäfer**, University College London, UK

On behalf of the STRC organizing committee, welcome!

Michel Bierlaire, Transport and Mobility Laboratory, EPFL

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Questions

For questions regarding the conference, please send us an e-mail: **strc2025@epfl.ch**
If you have any questions during the conference, please call Evangelos Paschalidis:
+41 78 248 46 69

Conference venue

Fondazione Monte Verità
Strada Collina 84
CH-6612 Ascona

46.15899987655616, 8.762859915341023

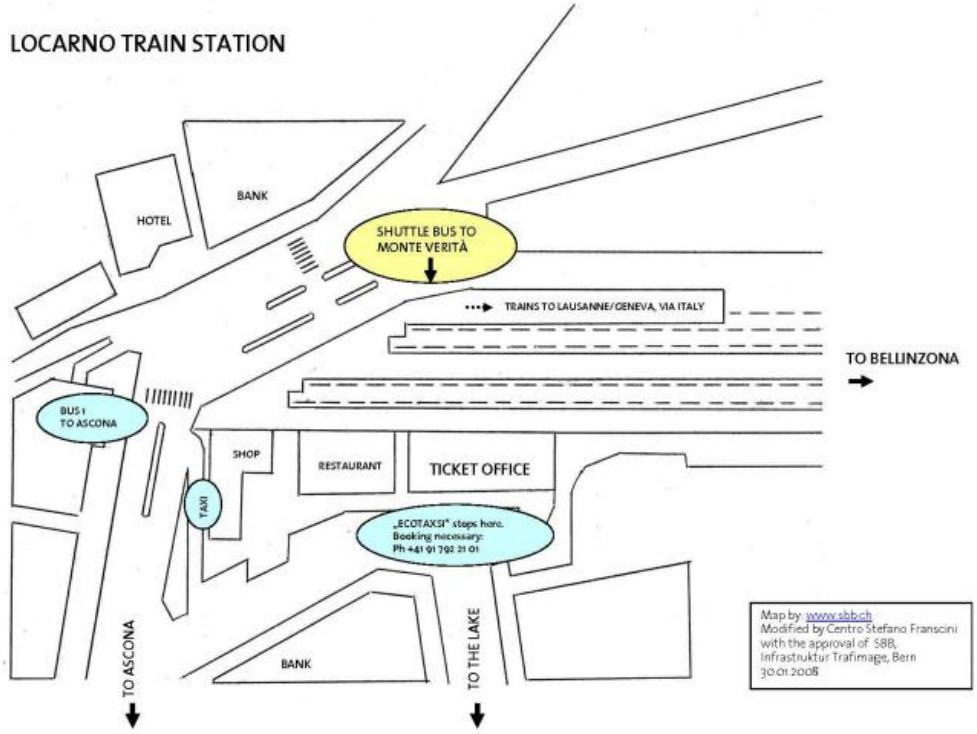
The conference venue is near the cities of Ascona and Locarno.

The auditorium is located on the ground floor. The dining room and the remaining rooms are located on the first floor, directly above the auditorium.

Arrival / Departure with shuttlebus

We recommend travelling by train to Locarno as there are only a limited number of parking spots.

On **Wednesday 14th May** there will be a shuttle service from Locarno train station to Monte Verità. The first bus departs at **11:00h** from Locarno station. We recommend attendants plan their arrival at Locarno station before **13:00h**.



Shuttle Service Schedule							
Wednesday 14th May				Friday 16th May			
From	To	Departure Time	Seats	From	To	Departure Time	Seats
Locarno Station	Monte Verità	11:00	30	Monte Verità	Locarno Station	13.15	50
		11:30	8			13.55	50
		12:00	30				
		12:40	50				
		13:00	14				

Arrival at the STRC-Conference

Your name badge can be found at the reception desk of the Monte Verita conference site.

Details on hotels

Check in is from **15:00h**, check out until **10:00h.** For those staying at La Perla (outside of Monte Verità conference venue), please check in ***after 15:00h and before 21:30h.***

Breakfast and lunch

Breakfast will be served from **07:30h** until **10:00h**, lunch starts at **12:00h** (Monte Verità conference site).

Dinner (Wednesday 14th) and Gala Dinner (Thursday 15th)

Dinner – Wednesday May 14th

Location: Grotto Baldoria (Via Sant'Omobono 9, 6612 Ascona)

Time: 19:15h

Distance on foot from Fondazione Monte Verità: 15–20min

Gala Dinner – Thursday May 15th

Location: Osteria Ticino da Ketty & Tommy (Via Muraccio 20, 6612 Ascona)

Time: 19:15h

Distance on foot from Fondazione Monte Verità: 20–25min

Both dinner locations are within walking distance from the Fondazione Monte Verità hotel. However, there will also be a shuttle service departing from Monte Verità at **19:00h** and back at **22:00h**.

Conference program

The program of the conference can also be accessed through the conference webpage: https://www.strc.ch/2025.php.

Details regarding the venue can be found: http://www.monteverita.org.

Information concerning travel times by train can be checked at: http://www.sbb.ch/

Details for conference photo

On **Thursday, May 15th at 18:30h**, we take a group photo directly on the steps in front of the building. Please be there on time so that you're sure to be in the photo.

Meeting of conference committee

The conference meeting for principal investigators (PIs) of the labs will take place on **Thursday, May 15th at 17:15h - 18:15h** in the *Eranos room* (all PIs of the organizing institutes of STRC Conference and conference staff 2025).

Factsheet for session-chairs

- The last presenter of each session is also chairing the session.
- Please arrive in the room **5 minutes before** the session and check that the projector is working.
- Please make **your computer available** for the presentations, which are passed over by the presenters either by memory stick or via email, or help the presenters to connect their computer to the projector.
- The presentation length will be 25 minutes. This has to be checked by you as a Session-Chair. The discussion round must not last longer than 5 minutes.
- Please prepare sheets of paper with times that you can hold up to tell the presenter the remaining time. We recommend 5 minutes and 2 minutes.
- When the time is up, please politely interrupt.
- For the Auditorium: Please be ready to pass the microphone around for the discussion.
- After the discussion, please immediately help the next presenter to set up their presentation. Please then start immediately with the introduction for the next presentation.
- When all the presentations in your session are finished, please put the room back the way you found it.

Factsheet for presenter

Presentation:
Please find below the instructions to present at the STRC-Conference:

- Presentation length will be 20 minutes
- Followed by 5 minutes of questions
- Please use your institution-template for your slides.

You can bring your presentation on a memory stick or use your own computer for the presentation. Or you can send your presentation to the chair via email.

Consider providing the following information in your slides:

- Title, name, affiliation
- What is the research question?
- Precise problem statement
- Overview of previous works
- Your proposed solution
- IF applicable: future steps within your project

Review:
Each session presenter **should review the paper following their own presentation** if the paper is available (information is provided in the conference program). The last person of the session reviews the paper of the first presentation of the session.

Please find the papers of your sessions in your *session-folder* that you have received via email before the conference.

Based on your review, you are invited to pose the first questions in the Q&A session of the corresponding paper to facilitate a smooth discussion.

If you have not uploaded your paper or want to provide a more recent version, please upload it individually into the *session-folder* or contact your reviewer.

Please note: The papers are not publicly available until the final submission after the conference. Therefore, please ensure confidentiality regarding the draft versions of the papers.

Final Paper:
The organizing committee will publish on the STRC-Homepage the latest version of your submitted paper. If you have a more recent version that you would like to upload, please upload: STRC 2025| Submission form or contact the organizing committee.

If you **do not** wish your paper to be uploaded on the STRC-Homepage please contact the organizing committee.

Participants of STRC 2025 conference

Name	Surname	Lab / Institution
Mohamed	Abdelfattah	EPFL-VITA
Alex	Alahi	EPFL-VITA
Georg	Anagnostopoulos	EPFL-LUTS
Zahra	Ansarilari	ETH-IVT-TS
Bilge	Atasoy	TU Delft
Kay	Axhausen	ETH-IVT-VPL
Lukas	Ballo	ETH-IKG
Chevallier	Benjamin	HEIG-VD, HES-SO
Yasamin	Borhani	EPFL-VITA
Elisabeth	Brugger	ETH-IVT-TS
Ran	Chen	EPFL-LUTS
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Thomas	Hettinger	SBB
Beat	Hintermann	UNIBAS-WWZ
Ye	Hong	ETH-IKG
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Xuhang	Liu	EPFL-HOMES
Jan	Lordieck	ETH-IVT-TS
Po-Chien	Luan	EPFL-VITA
Xinyu	Ma	EPFL-HOMES

Name	Surname	Lab / Institution
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de Lapparent	Matthieu	HEIG-VD, HES-SO
Jonas	Meli	ETH-IVT-TMP
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Kaouther	Messaoud	EPFL-VITA
Lucas	Meyer de Freitas	ETH-IVT-VPL
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Nina	Wiedemann	ETH-IKG
Weijiang	Xiong	EPFL-LUTS
Zhenyu	Yang	EPFL-LUTS
David	Zani	ETH-IBI-IM
Mohammadali	Zayandehroodi	ETH-IVT-SVT
Kenan	Zhang	EPFL-HOMES
Tong	Zhang	EPFL-IVRL
Pengbo	Zhu	EPFL-LUTS

Keynote speakers

Dr. Bilge Atasoy

"Adaptive transportation systems with holistic representation of supply and demand"

Bilge Atasoy is an associate professor in Delft University of Technology and working towards adaptive transport and logistics systems. Her research lies at the intersection of operations research, behavioral modeling and learning algorithms.

She is the recipient of ERC Starting Grant and runs other national and international projects. Prior to joining TU Delft, Bilge was a research scientist at the Intelligent Transportation Systems Lab at MIT where she managed projects on real-time optimization as well as choice-based optimization for various transport systems. Bilge received her PhD from EPFL as part of the Transport and Mobility Lab and prior to that she studied at Bogazici University, Türkiye.

Dr. Alexandre Torday

"From theory to practice: How research can (and should) support practical business needs"

Alex Torday is a civil engineer graduated from the Swiss Federal Institute of Technology where he also completed his PhD. As part of his past research activities, he also developed strong links with Tokyo University where he spent 6 months as invited researcher. From 2005 to 2022, he led the Aimsun Professional Services activities worldwide. He also managed the Asia-Pacific branch of Aimsun, based in Sydney, from 2012 to 2020. Since 2022, Alex is Aimsun's CEO, and moved back to the company headquarters in Barcelona, Spain.

Prof. Andreas W. Schäfer

"Decarbonising aviation"

Andreas W. Schäfer is a Professor of Energy and Transport at the School of Environment, Energy and Resources, University College London, where he directs the Air Transportation Systems Laboratory. His research covers the demand for and supply characteristics of energy and transportation systems along with their integration.

Schedule overview

Wednesday, May 14th

12:00 –14:00	Registration and sandwich Lunch		
14:00-14:10	Welcome (Auditorium)		
14:10 - 15:10	Keynote 1: Dr. Bilge Atasoy (Auditorium)		
15:10 - 15:40	Coffee Break - Check-in		
	Session 1A:	**Session 1B:**	**Session 1C:**
	Auditorium	**Sala Balint**	**Sala Eranos**
15:40 - 16:05	Y. Tak	B. Chevallier	J. Linke
16:05 - 16:30	Y. Hong	J. Roth	G. Anagnostopou-los
16:30 - 16:55	Y. Haghighi	C. Rames	L. Ballo
16:55 - 17:05	Short Break		
	Session 2A:	**Session 2B:**	**Session 2C:**
	Auditorium	**Sala Balint**	**Sala Eranos**
17:05 - 17:30	Z. Yang	B. Tomarchio	P.C. Luan
17:30 - 17:55	T. Zhang	Y. Gao	L. Sun
17:55 - 18:20	B. Hinter-mann	V. Klasovitá	M. Fernando
19:15	Dinner		

Thursday, May 15th

07:30 - 09:00	Breakfast		
09:00 - 10:00	Keynote 2: Dr. Alexandre Torday (Auditorium)		
10:00 - 10:30	Coffee Break		
	Session 3A:	**Session 3B:**	**Session 3C:**
	Auditorium	**Sala Balint**	**Sala Eranos**
10:30 - 10:55	M. Maljkovic	R. Hos-seininejad	K. Schimohr
10:55 - 11:20	L. Schwab	A. V. Preto	E. Brugger
11:20 - 11:45	I. Kaddoura	S. Papini	A. Reiffer
12:00 - 13:30	Lunch		
	Session 4A:	**Session 4B:**	**Session 4C:**
	Auditorium	**Sala Balint**	**Sala Eranos**
13:30 - 13:55	M. Kukic	N. Wiedemann	D. Zani
13:55 - 14:20	B. Gramsch-Calvo	N. Ortelli	M. Za-yandehroodi
14:20 - 14:45	M. Wang	P. Ilinov	L. Feng
14:45 - 15:10	K. Riehl	P. Zhu	L. Meyer de Freitas
15:10 - 15:40	Coffee-Break		
	Session 5A:	**Session 5B:**	**Session 5C:**
	Auditorium	**Sala Balint**	**Sala Eranos**
15:40 - 16:05	J. Shan	N. Rezvany	J. Lordieck
16:05 - 16:30	M. Pham-Truffert	R. Chen	P. Vogler
16:30 - 16:55	S. El-Baklish	K. Messaoud	T. Haering
17:15 - 18:15	Committee meeting (Eranos)		
18:30	Photo (at stairway)		
19:15	Gala Dinner		

Friday, May 16th

07:30 - 09:00	Breakfast		
	Session 6A:	**Session 6B:**	**Session 6C:**
	Auditorium	**Sala Balint**	**Sala Eranos**
09:00 - 09:25	J.M. Hen-choz	M. He	M. Hassan
09:25 - 09:50	D. Guggis-berg	Y.C. Ni	M. Seger
09:50 - 10:15	B. Schmid	W. Xiong	J. Meli
10:15 - 10:35	Coffee-Break		
	Session 7A:	**Session 7B:**	**Session 7C:**
	Auditorium	**Sala Balint**	**Sala Eranos**
10:35 - 11:00	X. Liu	Z. An-sarilari	F. Fouchs
11:00 - 11:25	Y. Borhani	X. Ma	M. Abdelfattah
11:25 - 11:50	A. Elvarsson	C. Chen	
11:50 - 12:00	Short Break		
12:00 - 13:00	Keynote 3: Prof.Andreas Schäfer (Auditorium)		
13:00	Closing of the Conference (Auditorium)		

Sessions 1: Wednesday, May 14th 2025

Chair	Yasaman Haghighi (EPFL-VITA)	**Session 1A**		
Room	Auditorium			
No.	**Start**	**End**	**Speaker**	**Title**
1.1	15:40	16:05	Yura Tak (EPFL-LUTS)	Moving Drone-Based Trajectory Extraction Through Referential Drone Map
1.2	16:05	16:30	Ye Hong (ETH-IKG)	Causal Inference for Interpretable and Robust Deep Learning in Mobility Analysis
1.3	16:30	16:55	Yasaman Haghighi (EPFL-VITA)	Scene-Aware Human Motion Generation
Chair	Clément Rames (EPFL-LASUR)	**Session 1B**		
Room	Sala Balint			
No.	**Start**	**End**	**Speaker**	**Title**
1.4	15:40	16:05	Benjamin Chevallier (HEIG-VD, HES-SO)	A decision-support system for brownfield rehabilitation: Optimizing material usage and transport for sustainable urban redevelopment
1.5	16:05	16:30	Jakob Roth (UNIBAS-WWZ)	Mode Choice for Leisure Travel in Europe: Simulating Future Transport Policies
1.6	16:30	16:55	Clément Rames (EPFL-LASUR)	The interaction between motility, accessibility and modal choice
Chair	Lukas Ballo (ETH-IKG)	**Session 1C**		
Room	Sala Eranos			
No.	**Start**	**End**	**Speaker**	**Title**
1.7	15:40	16:05	Jannis Linke (IMO-HSG)	Employers' Potential to Drive Greener Transport: Examining Swiss Employees' Willingness to Subscribe to Employer-Subsidized Sustainable Mobility Solutions
1.8	16:05	16:30	Georg Anagnostopoulos (EPFL-LUTS)	Propagation of perturbations in far-from-equilibrium multispecies traffic systems: a simulation approach
1.9	16:30	16:55	Lukas Ballo (ETH-IKG)	Mobility utopias for realists: Generative design of topologically consistent transport system scenarios in existing cities

Sessions 1 - abstracts

Session 1A

Yura Tak

Moving Drone-Based Trajectory Extraction Through Referential Drone Map

Yura Tak (EPFL-LUTS), Robert Fonod (EPFL-LUTS), Nikolas Geroliminis (EPFL-LUTS)

A critical challenge in large-scale traffic monitoring from aerial imagery is maintaining a consistent spatial referential across multiple video frames, particularly when a drone moves and captures different viewpoints of a scene. In this research, we present a novel framework that leverages automated image stitching techniques to construct a unified, high-resolution "drone map" from carefully selected frames. Our approach begins by evaluating candidate frames for their quality and suitability based on criteria such as frame sharpness and the number of reliable keypoint matches. The selected frames are then seamlessly stitched together to form a common, stable referential coordinate system that spans the entirety of the observed region. With the drone map established, individual frames are aligned to this global reference, allowing accurate transposition of detected vehicle positions and identities from each frame onto the unified map. This process enables consistent vehicle tracking across the entire duration of the video, despite drone motion and varying viewpoints. As a result, we can extract precise vehicle trajectories and conduct robust traffic flow analyses over a large spatial area without the complexities introduced by frame-to-frame coordinate shifts. The proposed methodology advances the use of drones as mobile traffic monitoring platforms, offering improved accuracy, scalability, and continuity in vehicular movement analysis.

Ye Hong

Causal Inference for Interpretable and Robust Deep Learning in Mobility Analysis

Ye Hong (ETH-IKG), Martin Raubal (ETH-IKG)

Deep learning (DL) networks are increasingly utilized in mobility analysis and predictive modeling, yet their intricate internal workings hinder interpretability and complicate robustness assessments, limiting real-world deployment. Recent studies identified causal inference as a promising method for evaluating DL robustness, as it enables the extraction of interpretable and actionable insights. This study introduces a causal intervention framework to assess how mobility-related factors influence DL networks for next-location prediction. We employ mechanistic mobility models to simulate location visit sequences and control behavioral dynamics through targeted interventions in data generation. The modified sequences are analyzed using standardized mobility metrics and processed through pre-trained DL networks to quantify performance variations. Performance deviations highlight three key behavioral factors: (1) sequential patterns in location transitions, (2) individual tendencies for spatial exploration, and (3) heterogeneity in location preferences at both the population and individual levels. We publicly released a modular, opensource Python framework that includes formal data specifications, mobility models for synthetic dataset generation, benchmark DL architectures, and evaluation protocols. These insights contribute to the practical implementation of mobility prediction systems, while the framework establishes a foundation for integrating causal inference to improve DL interpretability and robustness in mobility applications.

Yasaman Haghighi

Scene-Aware Human Motion Generation

Yasaman Haghighi (EPFL-VITA), Alexandre Alahi (EPFL-VITA)

We present a new approach for enhancing spatial controllability in diffusion-based human motion generation. Although diffusion-based models generate realistic human motions under unconditional and text-conditioned settings, they often struggle with spatial conditions. Effective spatial control in motion generation involves ensuring specific joints passthrough designated key points, enabling control over the position of any joint throughout the generated sequence. Additionally, spatial control should allow for realistic scene interaction, ensuring generated motions avoid penetrating obstacles within the environment. We propose tackling the challenges of spatially conditioned motion generation by employing inference guidance during the denoising steps of diffusion models. The guidance updates the motion based on a loss function that measures adherence to spatial constraints. However, strong guidance can compromise motion realism, while insufficient guidance may not satisfy spatial conditions. Our method, addresses these challenges with an uncertainty-aware guidance approach that dynamically adjusts guidance intensity based on noise levels at each denoising step. Our approach is plug-and-play, can integrate with any conditional or unconditional motion generation model to enhance spatial controllability, offering broad applicability and versatility. By combining uncertainty-aware guidance with refined loss functions, our method achieves state-of-the-art performance in spatial controllability and scene navigation, achieving an effective balance between realism and spatial precision.

Session 1B

Benjamin Chevallier

A decision-support system for brownfield rehabilitation: Optimizing material usage and transport for sustainable urban redevelopment

Selin Ataç (HEIG-VD, HES-SO), Benjamin Chevallier (HEIG-VD, HES-SO), Matthieu de Lapparent (HEIG-VD, HES-SO)

The valorization of brownfields presents a significant challenge in urban redevelopment, as decisions in this domain involve a trade-off between environmental sustainability and financial feasibility. Our study, focusing on three sites in Switzerland, introduces a comprehensive decision-support system (DSS) that integrates operations research methodologies to optimize the rehabilitation process of such sites. Within this DSS, we identify key cost components related to material transport and rehabilitation expenses, including routing, vehicle usage, tools, materials, storage, transformation/repackaging, and recycling costs. Our DSS finds the most efficient strategy while considering (i) spatial constraints, i.e., the locations of brownfield sites, storage sites, recycling centers, transformation/repackaging facilities, and construction sites; (ii) technical constraints, i.e., facility and vehicle capacities and material-related restrictions; and (iii) financial constraints, i.e., budget limitations. By developing a mixed-integer linear programming model, we aim to provide the optimal assignment of materials between sites and the vehicle routing of material transport. The results of this research are planned to be integrated into a brownfield rehabilitation framework that benefits from circular economy practices in construction, proposing incentives to promote sustainability.

Jakob Roth

Mode Choice for Leisure Travel in Europe: Simulating Future Transport Policies

Jakob Roth (UNIBAS-WWZ), Laura Schwab (UNIBAS-WWZ), Beat Hintermann (UNIBAS-WWZ)

The European travel sector is experiencing a transformation driven by increased climate awareness and policy measures aimed at reducing emissions. This study examines how Swiss travelers respond to these developments, using a stated preference choice experiment including the modes train, night train, car, and airplane. We calculate price elasticities and find a significant willingness-to-pay (WTP) of CHF 9.38 for sustainable aviation fuel (SAF), while the (lower) WTP for carbon offsetting remains insignificant. Based on the estimated coefficients, we evaluate the impacts of four policy scenarios: a flight tax (30 CHF), a subsidy for night trains (20 CHF), a SAF blending quota (50%), and a realistic market outlook for 2030 including a mixture of policies. These proposed policies are compared to the first-best Pigovian tax. After assessing demand shifts, changes in consumer surplus, and welfare effects including external costs, we find that subsidizing night train prices, the flight ticket levy, and the 2030 scenario increase welfare, while a 50% SAF mandate reduces it.

Clément Rames

The interaction between motility, accessibility and modal choice

Clément Rames (EPFL-LaSUR), Eloi Bernier (EPFL-LaSUR), Jules Grandvillemin (EPFL-LaSUR), Florian Masse (EPFL-LaSUR), Guillaume Drevon (EPFL-LaSUR), Philippe Gerber (LISER, Luxemburg), Vincent Kaufmann (EPFL-LaSUR)

While built environment characteristics, in particular transport infrastructure, play a pivotal role in modal practices (Ewing & Cervero, 2010, Van Acker et al., 2007), individual attributes, for instance travel dispositions and aptitudes, are equally decisive in the choice of modes of transport (Kaufmann, 2011). In this paper, we leverage a large panel survey dataset (n=10,202) covering the Greater Geneva region (straddling Switzerland and France) conducted in 2022. We pose three hypotheses. The first is that motility and accessibility both influence modal practices in specific ways. The second is that motility, defined as the potential to be mobile, varies as a function of the accessibility of one's environment. Finally, we hypothesize that motility has a compensatory dimension for deficiencies in accessibility. In order to test these, we adopt a Structural Equation Modeling (SEM) approach (Hoyle, 2014). We construct three latent variables – Motility, Accessibility and Mode Choice – which are first tested individually with Confirmatory Factor Analysis. The complex relationship between these three aspects is then evaluated with a SEM model. The model converges, with appropriate indicators of fit, and shows that motility is strongly connected with alternative mode choice, to a greater extent than accessibility. Results also show that individuals living in more accessible environments tend to possess higher motility, countering our third hypothesis.

Session 1C

Jannis Linke

Employers' Potential to Drive Greener Transport: Examining Swiss Employees' Willingness to Subscribe to Employer-Subsidized Sustainable Mobility Solutions

Jannis Linke (IMO-HSG), Luisa Stöhr (IMO-HSG)

Work-related travel accounts for 28% of daily distances travelled in Switzerland, contributing, for example, to rising emissions and urban space constraints. As an emerging trend, employers, including Roche and Google, are offering mobility solutions to attract talent and meet emission reporting requirements. While these cases highlight the potential for fostering the uptake of sustainable mobility solutions, research on general employee demand for employer-subsidized mobility offers remains limited. This study examines employees' willingness to subscribe to employer-subsidized sustainable mobility products, including electric car leasing, company bike leasing, GA travelcards, local fare network travelcards, car-sharing, micromobility sharing, and mobility budgets. Data from n = 1,112 employees in Switzerland were collected via an online survey using quota sampling in October 2024. Respondents evaluated detailed product scenarios, considering functionality and personal costs. The analysis will use multiple linear regression to identify how factors such as sociodemographics, current commuting modes and general interest in products influence employees' willingness to subscribe to employer subsidized mobility products. This study contributes to understanding the potential of employer-subsidized mobility options from an employee demand perspective, serving as one building block for promoting sustainable mobility.

Georg Anagnostopoulos

Propagation of perturbations in far-from-equilibrium multispecies traffic systems: a simulation approach

Georg Anagnostopoulos (EPFL-LUTS), Nikolas Geroliminis (EPFL-LUTS)

A fundamental question in transportation, and more specifically in traffic flow theory, concerns the issue of delays. To this day, this has been the center of a heated philosophical debate, mainly between physicists and traffic engineers. The latter argue that delays are caused by discrete disruptions in the system, such as accidents, whereas the former claim that stochastic processes in continuous time can generate unreasonably large jams, similar to the butterfly effect. In this paper, we investigate a combination of both arguments and their combined effect on a multispecies system using nonequilibrium simulations.

Lukas Ballo

Urban utopias for realists: An automated generation and testing of urban mobility visions

Lukas Ballo (ETH-IKG), Raphael Eder (UC San Diego), Ayda Grisiute (ETH-IKG), Nina Wiedemann (ETH-IKG), Kay W. Axhausen (ETH-IVT-VPL), Martin Raubal (ETH-IKG)

Urban planning faces systemic challenges such as climate change, urbanization, and demographic changes that require bold, integrated responses. However, traditional land use and transport planning processes are fragmented and not suitable for the transformations needed. This paper suggests to overcome this blockade by adopting a "deep planning" approach that spans across the traditional silos. It introduces an approach that combines large language models (LLMs) with a network-level urban design tool SNMan, to enable rapid generation of disruptive yet realistic urban scenarios—a process we term "structured ideation". A proof-of-concept in Lucerne, Switzerland, demonstrates how the LLM converts natural language inputs into fundamentally redesigned yet consistent traffic networks using SNMan. We suggest reinforcement learning to improve the scenario generation process. The "deep planning" approach unifies creative ideation with real-world consistency, enabling cities to move beyond incrementalism and develop visionary yet actionable plans. While centered on urban design, this method introduced in this paper is also applicable to many other complex systems with or without spatial components.

Sessions 2: Wednesday, May 14th 2025

Chair	Beat Hintermann (UNIBAS-WWZ)	**Session 2A**		
Room	Auditorium			
No.	**Start**	**End**	**Speaker**	**Title**
2.1	17:05	17:30	Zhenyu Yang (EPFL-LUTS)	Reverse ADL-Vickrey: Inferring morning commuting preferences based on congestion and choice data
2.2	17:30	17:55	Tong Zhang (EPFL-HOMES)	Multi-modal Transportation Network Design Integrating UAM Mode: An Activity Capacity-based Approach
2.3	17:55	18:20	Beat Hintermann (UNIBAS-WWZ)	Transport Pricing to Promote E-biking and Reduce Externalities: In-sights from a GPS-Tracked Experiment
Chair	Viera Klasovitá (ETH-IVT-TS)	**Session 2B**		
Room	Sala Balint			
No.	**Start**	**End**	**Speaker**	**Title**
2.4	17:05	17:30	Barbara Tomarchio (EPFL-TRANSP-OR)	Content dependent vehicle routing problem with intermediate facilities
2.5	17:30	17:55	Yang Gao (EPFL – VITA)	OmniTraj: Pre-Training on Heterogeneous Data for Adaptive and Zero-Shot Human Trajectory Prediction
2.6	17:55	18:20	Viera Klasovitá (ETH-IVT-TS)	Stochastic Programming for the Line Planning Problem with Uncertain Passenger Demand
Chair	Malithi Fernando (ETH-IVT-TMP)	**Session 2C**		
Room	Sala Eranos			
No.	**Start**	**End**	**Speaker**	**Title**
2.7	17:05	17:30	Po-Chien Luan (EPFL-VITA)	Unified Human Localization and Trajectory Prediction with Monocular Vision
2.8	17:30	17:55	Linghang Sun (ETH-IVT-SVT)	Unveiling the effect of real-world supply-side disruption on urban traffic networks
2.9	17:55	18:20	Malithi Fernando (ETH-IVT-TMP)	The evolution of shopping behaviour: A comparative study of three European countries

Sessions 2 - abstracts

Session 2A

Zhenyu Yang

Reverse ADL-Vickrey: Inferring morning commuting preferences based on congestion and choice data

Zhenyu Yang (EPFL-LUTS), Pietro Giardina (EPFL-LUTS), Andre de Palma (CY Cergy Paris Université) Nikolas Geroliminis (EPFL-LUTS)

We aim to infer travelers' scheduling preferences from their observed arrival times, given an exogenous traffic congestion pattern. To do this, we employ a structural model that characterizes how users balance congestion costs against the penalties for arriving early or late relative to an ideal time. In this framework, each traveler selects an arrival time that minimizes their overall trip cost by considering the within-day congestion pattern along with their individual scheduling preferences. By incorporating the distribution of these preferences across the population, we can estimate the likelihood of arrivals occurring at specific times. Using real-world data, we then apply the maximum likelihood estimation (MLE) method to determine the parameters of the distribution of scheduling preferences. Our numerical results demonstrate the effectiveness of the proposed method.

Tong Zhang

Multi-modal Transportation Network Design Integrating UAM Mode: An Activity Capacity-based Approach

Tong Zhang (SEU, China, EPFL-HOMES), Dawei Li (SEU, China), Chongqi He (SEU, China), Kenan Zhang (EPFL-HOMES)

Given the limited number of electric Vertical Take-off and Landing (eVTOL) airports and their restricted coverage, air-ground coordination is crucial for achieving seamless multi-modal travel through strategies like transportation capacity matching and timetable synchronization. Developing a multi-modal network design method that integrates Urban Air Mobility (UAM) is increasingly urgent. While traffic network capacity is a commonly used optimization objective in network design, existing methods often fall short in areas such as analyzing activity-oriented travel demand, incorporating land-use information, and supporting design requirements from the activity perspective, such as maximizing the capacity to accommodate activity flow, to prevent the traffic network from impeding urban vitality enhancement. To address these gaps, this paper introduces the Activity Capacity-based Multi-modal Network Design Problem (AC-MNDP) model, which can deliver the network design scheme that maximizes the capacity to accommodate activity flow and the corresponding distribution of demands and flows. The model is structured into a three-layer programming approach: the upper-level model considers network design under investment constraints, the middle-level model focuses on maximizing activity capacity within land-use and activity structure constraints, and the lower-level model is a Multi-modal Activity-Travel Assignment model (MATA). A Sensitivity Analysis-Based algorithm (SAB) is developed to solve the model. Numerical case studies validate the model's ability to generate multi-modal network design schemes under varying investment constraints, comparing activity capacity-based with traffic network capacity-based design methods, and offering insights from a sensitivity analysis of UAM travel costs and capacity thresholds.

Beat Hintermann

Transport Pricing to Promote E-biking and Reduce Externalities: Insights from a GPS-Tracked Experiment

Jakob Roth (UNIBAS-WWZ), Laura Schwab (UNIBAS-WWZ), Beat Hintermann (UNIBAS-WWZ), Thomas Götschi (UOregon), Adrian Meister (ETH-IVT), Lucas Meyer de Freitas (ETH-IVT-VPL), Kay W. Axhausen (ETH-IVT-VPL)

This study presents results from a randomized controlled trial involving 1,085 participants in Switzerland that have access to an E-bike, a car, and public transport. The participants' transport choices are monitored by means of a GPS-based tracking app. The treatment consists in a monetary incentive that approximates the main external costs and benefits associated with transport in the spirit of a Pigovian tax. This tax reduces transport-related external costs by 6.9 %, which corresponds to 78 Swiss francs per person and year (currently equivalent to 94 US dollars). The main underlying mechanism is a mode shift away from driving towards E-biking, public transport and walking. The results are primarily driven by individuals who own an S-pedelec with support up to 45 km/h, rather than users of the more common E-bikes that provide support up to 25 km/h. The pricing also induces a travel shift towards less congested time windows.

Session 2B

Barbara Tomarchio

Content dependent vehicle routing problem with intermediate facilities

Barbara Tomarchio (HES-SO, EPFL-TRANSP-OR), Sacha Varone (HES-SO), Léa Ricard (EPFL-TRANSP-OR), Michel Bierlaire (EPFL-TRANSP-OR)

We introduce and study a new variant of the vehicle routing problem (VRP) that integrates content considerations into the routing solution. This new problem arises from a real-world application involving the collection of containers which may contain different proportions of desired and undesired materials. If the content verifies specific conditions, the vehicle collecting the containers can be taken to a designated facility for further processing; otherwise, it must be taken to an alternative facility. We extend the traditional vehicle routing problem with intermediate facilities (VRP-IF) by proposing first a fundamental model wherein all containers with a content not satisfying specific conditions are directed to the alternative facility, while all the containers satisfying them are brought to the designated processing facility. We also propose a unified model enhanced with valid inequalities in which vehicles can accommodate containers with a content satisfying or not the conditions on a single route. Specific constraints are added in this model, in particular to ensure that vehicles unload at an alternative facility when its contents consist of a quantity of undesirable materials that exceeds the acceptance threshold. In addition, the different costs associated with unloading at the two different facilities are integrated into the objective function. We present computational results on self-generated small instances and show that our model produced solutions costing on average 14% less than the benchmark. Finally, the results also indicate that the addition of the valid inequalities to the unified model significantly reduces the computational time.

Yang Gao

OmniTraj: Pre-Training on Heterogeneous Data for Adaptive and Zero-Shot Human Trajectory Prediction

Yang Gao (EPFL-VITA), Po-Chien Luan (EPFL-VITA), Kaouther Messaoud (EPFL-VITA), Lan Feng (EPFL-VITA), Alexandre Alahi (EPFL-VITA)

Predicting human trajectory is essential for safety-critical applications such as autonomous driving and robotic navigation. However, existing models are typically designed to learn motion patterns within a fixed temporal horizon and frame rate within a single dataset and input modality, limiting their ability to generalize across different scenarios with different frame setups. To address this challenge, we extend a unified data framework by integrating diverse datasets with varying modalities and frame structures. We then introduce Omni-Traj, a transformer-based model with multimodal, multi-setup pre-training, enabling strong generalization across different temporal configurations. Extensive experiments show that our approach achieves state-of-the-art zero-shot generalization, reducing ADE by over 70% compared to the best prior method while also achieving state-of-the-art performances on the NBA, JTA, WorldPose, and ETH-UCY datasets after fine-tuning. Furthermore, we provide an in-depth analysis demonstrating the benefits of both multi-modal learning and multi-setup learning in human trajectory prediction. Our data, model, and code will be released upon publication.

Viera Klasovitá

Stochastic Programming for the Line Planning Problem with Uncertain Passenger Demand

Viera Klasovitá (ETH-IVT-TS), Florian Fuchs (ETH-IVT-TS), Francesco Corman (ETH-IVT-TS)

In this paper, we investigate the use of stochastic programming with a recourse action for line planning in public transport systems, specifically addressing the uncertainty in passenger demand. We compare the performance of the integer L-shaped method with a standard solver, focusing on runtime, optimality gaps, and the quality of solutions. Our results indicate that, while the L-shaped method has a large optimality gap and extended runtime, it often achieves similar or even better results compared to the solver and finds good solutions quickly. The analysis of different demand scenarios reveals varying second-stage costs that follow expected patterns. Furthermore, the computed value of stochastic solution (VSS) and the expected value of perfect information (EVPI) are promising, demonstrating the significant benefits of incorporating uncertainty into the line planning process. These findings underscore the importance of developing stochastic models that can effectively handle variability in passenger demand, ultimately improving decision-making and the overall performance of public transport systems.

Session 2C

Po-Chien Luan

Unified Human Localization and Trajectory Prediction with Monocular Vision

Po-Chien Luan (EPFL-VITA), Yang Gao (EPFL-VITA), Céline Demonsant (EPFL-VITA), Alexandre Alahi (EPFL-VITA)

Conventional human trajectory prediction models typically rely on clean, curated data, neglecting the accumulated errors from upstream tasks—a limitation that restricts their effectiveness in real-world robotic applications. To overcome this challenge, we present UniHuman, a Transformer-based framework that jointly addresses perception and prediction using only a monocular camera. UniHuman employs a spatial-temporal attention mechanism to reconstruct SMPL representations for each detected human in the 3D plane. Specifically, the spatial attention module enhances 3D localization accuracy, while the temporal attention module ensures smooth trajectory predictions. Experimental results demonstrate that UniHuman not only achieves precise human localization and future trajectory prediction but also shows that accurate trajectory prediction can significantly improve tracking performance.

Linghang Sun

Unveiling the effect of real-world supply-side disruption on urban traffic networks

Linghang Sun (ETH-IVT-SVT), Michail A. Makridis (ETH-IVT-SVT), Anastasios Kouvelas (ETH-IVT-SVT)

Many established traffic control strategies such as perimeter control and dynamic pricing rely on traffic models like Macroscopic Fundamental Diagram (MFD), following a static well-defined function form. However, traffic networks in the real world are subject to frequent disruptions that may easily violate the assumption of a constant MFD. Based on the historical records of road construction works over the past few years in the city of Zurich, we unveil the negative effects of such disruptions on the modeling of urban traffic networks. By applying a recently proposed infrastructure potential indicator to describe the variations of MFDs under disruption, a clear decline in the infrastructure potential can be observed, followed by a gradual recovery over time. In addition, by considering several features relevant to each instance of disruptions, such as the area of construction, traffic class of the affected roads, and speed limit, we tested several algorithms, including a simple linear regression, random forest, and 1D CNN to predict the effect of a road construction work. However, due to the current limited data availability, the linear regression shows a certain degree of prediction capability while the more advanced 1D-CNN fails to do so.

Malithi Fernando

The evolution of shopping behaviour: A comparative study of three European countries

Malithi Fernando (ETH-IVT-TMP), Dipanjan Nag (NTNU), Abel Kebede Reda (Gustav Eiffel University), Anna Reiffer (ETH-IVT-TMP), Laetitia Dablanc (IFSTTAR), Trude Tørset (NTNU), Giulio Mattioli (TU Dortmund), Eva Heinen (ETH-IVT-TMP)

This study examines shopping-related travel behaviour patterns across Switzerland, Germany, and Norway, using comparative national travel survey data to analyse trends from the early 2000s through the period shortly after the Covid-19 pandemic. By stratifying the analysis by gender, age, household type, income, and urbanization level, we explore how societal trends and national policy priorities have influenced mobility choices. The data show that, over time, shopping trips have declined as a share of total trips in Germany and Norway, but increased in Switzerland. However, some of these shifts may reflect changes in survey methodology, rather than solely behavioural changes due to online shopping, for example. While women have traditionally reported higher shopping trip rates, in Switzerland, a convergence between genders is observed over time. In Germany and Switzerland, mode shares for driving are similar between trip purposes across all social groups while in Norway, some social groups drive more for shopping trips. Shopping trip rates appear largely independent of household income, household type, and urbanization level, while distances can vary. These findings highlight the complex nature of shopping-related travel and the circumstances in which travel behaviour aligns or differs across three national contexts.

Sessions 3: Thursday, May 15th 2025

Sessions 3				
Chair	Ihab Kaddoura (SBB)	**Session 3A**		
Room	Auditorium			
No.	**Start**	**End**	**Speaker**	**Title**
3.1	10:30	10:55	Marko Maljkovic (EPFL-LUTS)	Deep Recurrent Q-Learning for Multi-Agent Traffic Patrolling
3.2	10:55	11:20	Laura Schwab (UNIBAS-WWZ)	Sustainable Commuting at Roche: Exploring Mode Choice and Corporate Policy Impacts
3.3	11:20	11:45	Ihab Kaddoura (SBB)	Quantifying Future Mobility: Scenario-Based Analysis with Agent-Based Modeling
Chair	Sebastiano Papini (ETH-D-MTEC-CAE)	**Session 3B**		
No.	Sala Balint			
Präsentation	**Start**	**End**	**Speaker**	**Title**
3.4	10:30	10:55	Reyhaneh Hosseininejad (EPFL-VITA)	Representing Multimodality in Human Pose Forecasting
3.5	10:55	11:20	Anne-Valérie Preto (EPFL-TRANSP-OR)	Differentiation of Modal Preferences in Public Transportation
3.6	11:20	11:45	Sebastiano Papini (ETH-D-MTEC-CAE)	Mapping Cycling-Specific Infrastructure Using Object Detection on Remotely Sensed Images
Chair	Anna Reiffer (ETH-IVT-TMP)	**Session 3C**		
Room	Sala Eranos			
No.	**Start**	**End**	**Speaker**	**Title**
3.7	10:30	10:55	Katja Schimohr (ETH-IVT-TMP)	Household shopping trips: exploring travel patterns and links to the built environment
3.8	10:55	11:20	Elisabeth Brugger (ETH-IVT-TS)	Understanding relations of objectives in railway timetabling
3.9	11:20	11:45	Anna Reiffer (ETH-IVT-TMP)	Understanding Barriers to Active Lifestyles: Analyses of Active Travel and Exercise in Multiweek Time Use and Travel Diary Data

Sessions 3 - abstracts

Session 3A

Marko Maljkovic

Deep Recurrent Q-Learning for Multi-Agent Traffic Patrolling

Marko Maljkovic (EPFL-LUTS), Nikolas Geroliminis (EPFL-LUTS)

Efficient traffic monitoring is crucial for managing urban transportation networks, especially under congested and dynamically changing traffic conditions. Drones offer a scalable and cost-effective alternative to fixed sensor networks; however, deploying fleets of low-cost drones for traffic monitoring poses challenges in adaptability, scalability, and real-time operation. To address these issues, we propose a learning-based framework for decentralized traffic monitoring with drone swarms, targeting the uneven and unpredictable distribution of monitoring needs across urban areas. Our approach introduces a semi-decentralized reinforcement learning model, which trains a single Q-function using the collective experience of the swarm. This model supports full scalability, flexible deployment, and, when hardware allows, the online adaptation of each drone's action-selection mechanism. We first train and evaluate the model in a synthetic traffic environment, followed by a case study using real traffic data from Shenzhen, China, to validate its performance and demonstrate its potential for real-world applications in complex urban monitoring tasks.

Laura Schwab

Sustainable Commuting at Roche: Exploring Mode Choice and Corporate Policy Impacts

Laura Schwab (UNIBAS-WWZ)

Many large corporations, including Roche, aim to encourage sustainable commuting behaviors to enhance employer attractiveness, improve corporate reputation, comply with Scope 3 emissions reporting, and reduce external costs. This study analyzes commuting patterns using advanced discrete choice models for car, public transport and bicycle modes. Using a panel dataset of 12,000 Roche employees in Switzerland, with repeated observations from September 2023 to May 2024, mixed multinomial logit models estimate preference parameters and identify heterogeneity across sociodemographic groups. The results indicate that cross-border commuters, shift workers, women, and employees over 45 are more likely to commute by car, while those with higher education levels are less inclined to do so. The study also simulates policy scenarios, including location- and time-dependent parking fees and public transport subsidies, to assess their impact on mode choice. The findings identify target groups most likely to adjust their commuting behavior, enabling the design of tailored interventions. This research offers practical insights to help companies achieve their sustainability goals while mitigating the significant environmental impact of employee commuting.

Ihab Kaddoura

Quantifying Future Mobility: Scenario-Based Analysis with Agent-Based Modeling

Thomas Hettinger (SBB), Ihab Kaddoura (SBB), Annick Noll (SBB), Merlin Unterfinger (SBB), Joschka Bischoff (SBB)

By 2050, Switzerland's mobility landscape will face increasing travel demand, requiring more efficient and flexible transportation solutions. Switzerland's integral clock-face timetable has long been the backbone of public transport. This study examines new concepts for future mobility, including the replacement of the integral clock-face timetable with a metro-like system featuring more frequent, faster, and more flexible services. Using an advanced agentbased modeling framework, we quantify the impact of such transformations by capturing individual mobility behavior and system-wide effects. Multiple scenarios are investigated, examining how changes in the train schedule, stop pattern, first/last-mile connectivity and regulatory measures influence modal shift, travel times, and overall public transport system performance. The findings indicate that the new railway concept and the regulatory measures each, on their own, raise the modal share of public transport. When combined, they yield the largest increase in public transport usage. A detailed investigation of the new railway concept reveals that most simulated passengers benefit from the new schedule. However, trade-offs remain, and some travelers experience longer travel times. Our findings highlight the importance of agent-based simulations and scenario analysis in navigating the complexities of future transport planning.

Session 3B

Reyhaneh Hosseininejad

Representing Multimodality in Human Pose Forecasting

Reyhaneh Hosseininejad (EPFL-VITA), Megh Shukla (EPFL-VITA), Saeed Saadatnejad (EPFL-VITA), Mathieu Salzmann (EPFL-CVLAB), Alexandre Alahi (EPFL-VITA)

Human pose forecasting is inherently multimodal, as different future poses can emerge from the same initial motion. We first introduce MotionMap, a heatmap-based representation to capture this multimodality by modeling spatial distributions over possible future poses, where different local maxima correspond to distinct motion modes. This approach enables efficient sampling of diverse predictions and provides a measure of confidence for each possible motion outcome. We extend MotionMap beyond local pose forecasting to also predict multimodal global trajectories, capturing how different pose sequences lead to diverse motion paths through space. By modeling the relationship between local motion and global movement, our approach ensures that predicted trajectories remain coherent while preserving multimodality. We introduce an enhanced representation that efficiently captures trajectory distributions without excessive sampling, allowing for uncertainty quantification and controllability over the predicted motion. Through extensive evaluations on large-scale 3D motion datasets, we demonstrate the effectiveness of our method in producing diverse and structured global motion forecasts, advancing human motion prediction for applications in autonomous systems, virtual environments, and human-robot interaction.

Anne-Valérie Preto

Differentiation of Modal Preferences in Public Transportation

Anne-Valérie Preto (EPFL-TRANSP-OR), Antonin Danalet (SBB), Joschka Bischoff (SBB), Negar Rezvany (EPFL-TRANSP-OR), Fabian Torres (EPFL-TRANSP-OR), Michel Bierlaire (EPFL-TRANSP-OR)

Rail and light-rail is often preferred over bus due to their higher level of service and better readability. This rail or light-rail bonus indicates a user preference for rail-based systems even when service levels are comparable. However, quantifying this preference remains challenging. Stated and revealed preference (SP/RP) surveys struggle to capture the complexity of this behavior. Additionally, constant recalibration of alternative-specific constants (ASCs) is necessary for accurate modeling.
We address these challenges by using observed count data to differentiate public transport modes in Lausanne, Switzerland. The calibration and validation of constants for different modes ensures the model accurately captures modal preferences in SIMBA MOBi, the activity-based, agent-based demand model of the Swiss Federal Railways. The refined model was tested with Lausanne and Zürich data. The results confirm a preference for light rail over buses. The enhanced model accurately predicts passenger demand and mode preferences, capturing competition between bus and light rail. It demonstrates its potential to estimate the impact of new transit infrastructure.

Sebastiano Papini

Mapping Cycling-Specific Infrastructure Using Object Detection on Remotely Sensed Images

Sebastiano Papini (ETH-D-MTEC-CAE), David Zani (ETH-IBI-IM)

The new Cycle Route Act (2020) aims to significantly expand Swiss cycling infrastructure within a decade. However, in stark contrast to this policy agenda, from a research perspective the lack of comprehensive data on cycling infrastructure is a significant barrier, particularly for studying the impact of infrastructure modifications on a junction-specific granularity (e.g. on induced cycling demand or crash risks). Existing data suffers from at least one of the following deficiencies: (1) fragmentation along administrative borders, (2) purely link-oriented data without information on junctions, (3) missing information on historical infrastructure changes, and (4) inadequate categorization from a road design perspective. The contribution of this paper is therefore threefold. First, a object detection method is utilized on aerial imagery to generate a dataset that addresses all four previously mentioned issues. For this purpose, we train a YOLOv8 (You Only Look Once, version 8) model, a common deep learning architecture for object detection, to detect 18 different cycling-specific infrastructure features. Second, it is demonstrated that the method is valid by comparing a subset of the resulting data set to an external communal level data set. Third, the overall historical development of cycling-specific infrastructure in the ten largest Swiss agglomerations is discussed.

Session 3C

Katja Schimohr

Household shopping trips: exploring travel patterns and links to the built environment

Katja Schimohr (ETH-IVT-TMP), Giulio Mattioli (TU Dortmund), Eva Heinen (ETH-IVT-TMP)

Shopping is one of the most common trip purposes. Shopping also holds significant potential for active mode use as trip distances tend to be (or could be) short. However, the relationship between shopping behavior and built environment characteristics has received limited research attention so far. Shopping, as a maintenance task, is usually distributed within households. Therefore, this study aims to identify different shopping behavior typologies at the household level and investigates factors associated with these patterns. Using trip data from the 2022 German Mobility Panel, a nationwide and representative 7-day travel diary survey, we conduct a cluster analysis. Key variables to capture transport-related aspects of shopping behavior include mode choice, trip distance, trip frequency, and trip chaining. The analysis reveals six distinct household shopping patterns: No shopping trips, car-shoppers, frequent shoppers, active travelers, shopping after work and few long shopping trips. A multinomial regression analysis is performed to identify the individual, household, and spatial determinants of cluster membership. While few sociodemographic factors are related to cluster membership, the residential location is found to be strongly related to the probability of belonging to the active traveler cluster.

Elisabeth Brugger

Understanding SBBs Timetabling KPIs

Elisabeth Brugger (ETH-IVT-TS), Paola Pellegrini (Université Gustave Eiffel), Francesco Corman (ETH-IVT-TS)

Timetabling is an essential task of railway systems. Under the pressure of increasing demand for railway networks, academia has worked in these last decades on the modeling and solving of this task. To be truthful to reality, models must consider the interests of the involved stakeholders and account for technical conditions. Satisfying these different interests leads to several contradictory objectives. The weighted sum of the objectives is a common way to cope with a multi-objective problem. However, extensive studies on weight choice are lacking in the railway literature. The Swiss National Railway (SBB) has confirmed its interest in a deeper understanding of its objectives and their weights in the objective function. This paper studies the Pearson correlation between the objectives. Over a hundred scenarios are generated from three SBB corridors. The results show that no linear correlation is consistent over multiple corridors. Further research to understand the objectives' higher-order interactions and the weight choice is envisaged.

Anna S. Reiffer

Understanding Barriers to Active Lifestyles: Analyses of Active Travel and Exercise in Multiweek Time Use and Travel Diary Data

Anna S. Reiffer (ETH-IVT-TMP), Eva Heinen (ETH-IVT-TMP)

Meeting physical activity guidelines requires individuals to reallocate time from other daily activities—a process shaped by behavioral preferences and structural constraints. This paper uses a Multiple Discrete Continuous Extreme Value (MDCEV) model to simulate how individuals reallocate their time use when meeting the WHO recommendation of 150 minutes of exercise per week. Drawing on multi-week time-use data from Switzerland, the model estimates baseline utilities and satiation effects for a range of activities. Simulation results reveal that exercise time is primarily reallocated from working, unpaid work, and eating and cooking, while leisure remains relatively protected. Importantly, time trade-offs vary across population subgroups: individuals with higher income and education demonstrate greater flexibility to reallocate time, while parents of young children show more constrained adjustments. These findings underscore that while increasing exercise is behaviorally feasible, it is not uniformly accessible. Structural supports—such as flexible work arrangements, mobility infrastructure, and childcare—are essential to enable equitable time reallocations toward health-promoting behaviors. The MDCEV-based simulation approach offers a framework to quantify such trade-offs and to design more effective, context-aware physical activity interventions.

Sessions 4: Thursday, May 15th 2025

Sessions 4				
Chair	Kevin Riehl (ETH-IVT-SVT)	**Session 4A**		
Room	Auditorium			
No.	**Start**	**End**	**Speaker**	**Title**
4.1	13:30	13:55	Marija Kukic (EPFL-TRANSP-OR)	Simulation Framework for Longitudinal Synthetic Population Generation
4.2	13:55	14:20	Benjamin Gramsch-Calvo (ETH-IVT)	Going the Extra Mile: Estimating the Willingness to Travel to Meet With Friends Using a Joint Destination Choice Model
4.3	14:20	14:45	Minru Wang (EPFL-LUTS)	Profit maximization for Pickup and Delivery Problem with Time Windows using drones and scheduled lines
4.4	14:45	15:10	Kevin Riehl (ETH-IVT-SVT)	Oriented Object Detection For Aerial Vehicle Trajectory Extraction
Chair	Pengbo Zhu (EPFL-LUTS)	**Session 4B**		
Room	Sala Balint			
No.	**Start**	**End**	**Speaker**	**Title**
4.5	13:30	13:55	Nina Wiedemann (ETH-IKG)	Bridging prediction and optimization in on-demand transportation systems with Optimal Transport
4.6	13:55	14:20	Nicola Ortelli (TPG)	Mode-specific multimodal transfer penalties: insights from a stated-preference experiment in Geneva
4.7	14:20	14:45	Pavel Ilinov (EPFL-TRANSP-OR)	Keep it Simple: Addressing Rare Events in Data Synthesis Using Beta Divergence
4.8	14:45	15:10	Pengbo Zhu (EPFL-LUTS)	Incremental Detour Planning for Partially-occupied Ride-pooling Vehicles
Chair	Lucas Meyer de Freitas (ETH-IVT-VPL)	**Session 4C**		
Room	Sala Eranos			
No.	**Start**	**End**	**Speaker**	**Title**
4.9	13:30	13:55	David Zani (ETH-IBI-IM)	Creating network-wide overviews of infrastructure costs and crash risk in early planning stages
4.10	13:55	14:20	Mohammadali Zayandehroodi (ETH-IVT-SVT)	Evaluating Safety Countermeasures at Highway-Railway Grade Crossings: A Review
4.11	14:20	14:45	Lan Feng (EPFL-VITA)	TAROT: Targeted Data Selection via Optimal Transport
4.12	14:45	15:10	Lucas Meyer de Freitas (ETH-IVT-VPL)	Exploring the substitution potential from car trips towards bikes and e-bikes through radical policies: First results

Sessions 4 - abstracts

Session 4A

Marija Kukic

Simulation Framework for Longitudinal Synthetic Population Generation

Marija Kukic (EPFL–TRANSP–OR), Michel Bierlaire (EPFL–TRANSP–OR)

This paper introduces a novel framework for generating longitudinal synthetic populations that track individuals over time, addressing limitations of traditional snapshot-based synthetic population methods. We propose a Gibbs sampler-based approach that combines models and cross-sectional data to generate universal, time-independent variables, which enable the consistent derivation of time-specific synthetic populations at any point in time. A key advantage of this framework is that any changes to the universal dataset are automatically reflected in derived datasets, allowing for efficient scenario testing. The methodology is demonstrated using Swiss Mobility and Transport Microcensus data, by simulating the impacts of hypothetical events such as pandemics. This approach ensures temporal consistency, captures individual-level dynamics, and reduces the computational burden of regenerating populations, showcasing its potential for activity-based modeling and long-term policy analysis when real longitudinal data is unavailable.

Benjamin Gramsch-Calvo

Going the Extra Mile: Estimating the Willingness to Travel to Meet With Friends Using a Joint Destination Choice Model

Benjamin Gramsch-Calvo (ETH-IVT), Koki Okamura (The University of Tokyo), Kiyoshi Takami (The University of Tokyo), Yuki Oyama (The University of Tokyo), Makoto Chikaraishi (Hiroshima University), Kay W. Axhausen (ETH-IVT-VPL), Giancarlos Parady (The University of Tokyo)

Most leisure activities are carried out jointly with friends or family; therefore, the decision on where to travel is highly dependent on the spatio-temporal constraints of all members of the group. Using data from Tokyo, Japan, this study is the first to develop a joint destination choice model that explicitly integrates such constraints based on revealed preferences of all members. Such a model allows for the derivation of a new measure to quantify how much individuals are willing to travel to reduce other members' travel time; in other words, the travel time a person is "willing to pay" to participate in the social activity. Our estimates suggest that, in the context of eating-out activities (the most frequent joint activity type in Tokyo), individuals are on average willing to travel one additional minute to reduce other members' harmonic mean travel time by 0.39 minutes. However, this statistic is dependent on the differences between travel times of group members, such that the larger the difference between an individual and the rest of the group's travel time, the less that individual is willing to sacrifice for the rest of the group. Results also show that the group-level model outperforms a model that considers individual-level decisions only, especially in terms of estimated travel distances, due to individual-level models being biased towards individual locations irrespective of other members. Such group-level models might better explain the agglomeration of activities in cities.

Minru Wang

Profit maximization for Pickup and Delivery Problem with Time Windows using drones and scheduled lines

Minru Wang (EPFL-LUTS), Nikolas Geroliminis (EPFL-LUTS)

On-demand drone delivery can efficiently transport packages in an urban environment without contributing to road congestion. When a package's journey is partially carried out on a scheduled bus line, the delivery service provider can reduce service costs by exploiting underutilized capacity on ground vehicles, and prevent excessive drone disturbance in urban areas. While some customers are willing to pay a fixed fee to receive their package as soon as possible, other customers do not have any time window preference. In this work, we examine how a delivery platform can optimize the combined drone and bus delivery segments to maximize its profit.

Kevin Riehl

Oriented Object Detection For Aerial Vehicle Trajectory Extraction

Kevin Riehl (ETH-IVT-SVT), Shaimaa El-Baklish (ETH-IVT-SVT), Anastasios Kouvelas (ETH-IVT-SVT), Michail Makridis (ETH-IVT-SVT)

Vehicle trajectories offer valuable insights for a wide range of road transportation applications and research fields. A growing branch of literature explores vehicle trajectory extraction from aerial videos, where object detection using neural networks is an important component. Horizontal bounding box object detection struggles to differentiate well between rotated vehicles, especially when dealing with complex backgrounds or densely packed vehicles. In this work, we demonstrate how oriented object detection and the use of angular, directional information can be used to significantly improve the quality of extracted trajectories. The benchmark of 18 object detection models on a real world video dataset shows, that oriented object detection achieves 0.20m (15%) better internal, and 0.75m (20%) better platoon consistency; REDET and S2A from the openmmlab family count amongst the best performing detection models. Additionally, the analysis of synthetic trajectories with different levels of noise and coverage highlights, that improvements with angular information can be achieved when positional noise is high, coverage is low. At the presence of very noisy angular information however, these improvements diminish.

Session 4B

Nina Wiedemann

Bridging prediction and optimization in on-demand transportation systems with Optimal Transport

Nina Wiedemann (ETH-IKG), Théo Uscidda (CREST – ENSAE), Martin Raubal (ETH – D-BAUG)

Predictions for on-demand transportation services are oftentimes motivated by the possibility to enhance operational efficiency. For example, bike-sharing demand prediction aids in relocation planning. However, the prediction accuracy is usually evaluated with standard

metrics such as the root-mean-squared-error (RMSE), which fall short in assessing the value of predictions for downstream tasks. Since standard metrics treat spatial locations independently, they disregard the costs stemming from the spatial displacement of the predicted demand, such as relocation costs. We put forward Optimal Transport (OT) as a spatial evaluation metric and loss function to bridge the gap between prediction and optimization in transport applications. The proposed framework, GeOT, evaluates prediction models by quantifying the transport costs associated with their prediction errors. Through case studies on bike sharing data, we show that 1) OT better captures spatial costs than existing metrics, 2) OT enhances comparability across spatial and temporal scales, and 3) using OT as a loss function effectively reduces spatial costs. The method is broadly applicable to spatiotemporal prediction tasks, and we provide an open-source Python package for seamless adoption. (https://github.com/mie-lab/geospatialOT)

Nicola Ortelli

Mode-specific multimodal transfer penalties: insights from a stated-preference experiment in Geneva

Nicola Ortelli (TPG), Elisa Maria Tirindelli (TPG, EPFL-LASUR), Daniel J. Reck (TPG, EPFL-LASUR)

Besides additional walking and waiting times, transfers in multimodal urban transportation networks involve an additional penalty associated with the inconvenience of interrupting one's trip. This value, referred to as pure transfer penalty (PTP), has received an increasing amount of attention in the recent literature (e.g., Garcia-Martinez et al., 2018; Jara-Diaz et al., 2022; Yap et al., 2024) due to its importance in the design of efficient transit, as well as in the development of realistic agent-based simulation models and transportation system digital twins. In this study, we present an analysis of the data obtained from a stated-preference binary route-choice survey conducted in Geneva, Switzerland, in 2024, aimed at evaluating the intermodal PTPs associated with a variety of transport-mode pairs, including emerging modes such as bike-sharing. We develop a series of logit models under distinct assumptions, incorporating socioeconomic characteristics and random panel effects to account for observed and unobserved heterogeneity among respondents. The obtained values of PTP are compared with existing literature to assess their consistency and relevance. These are the first PTP estimates for trips that involve emerging modes, as well as the first mode-specific PTP estimates for Geneva and, to the best of the authors' knowledge, for Switzerland.

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Pavel Ilinov

Keep it Simple: Addressing Rare Events in Data Synthesis Using Beta Divergence

Pavel Ilinov (EPFL-TRANSP-OR), Michel Bierlaire (EPFL-TRANSP-OR)

The iterative proportional fitting (IPF) algorithm remains one of the most widely used tools for generating synthetic data. In this paper, we address the "zero problem" inherent to IPF. Recognizing that IPF solves a well-defined convex problem with affine constraints, we modify the objective by introducing Beta divergence, which generalizes the original problem as a special case. This approach effectively mitigates the zero problem and improves the performance of synthetic data generation.

Pengbo Zhu

Incremental Detour Planning for Partially-occupied Ride-pooling Vehicles

Pengbo Zhu (EPFL-LUTS), Giancarlo Ferrari-Trecate (DECODE - EPFL), Nikolas Geroliminis (EPFL-LUTS)

Ride-pooling services, such as UberPool and Lyft Shared Saver, enable a single vehicle to serve multiple customers within one shared trip. Efficient path-planning algorithms are crucial for improving the performance of such systems. For partially occupied vehicles with available capacity, we introduce a mixed-integer linear programming formulation for sequential ride-pooling vehicle path planning to optimize the pooling revenue for each ride. A novel trip-specific pool-matching model is proposed considering probabilistic passenger pickup opportunities. We validate its efficacy using a simulator based on the real road network of Shenzhen, China. Simulation results demonstrate that our proposed method significantly enhances service quality by answering more ride requests and reducing passenger waiting time.

Session 4C

David Zani

Creating network-wide overviews of infrastructure costs and crash risk in early planning stages

David Zani (ETH-IBI-IM), Bryan T. Adey (ETH-IBI-IM)

Many cities aim to transition their mobility systems toward more sustainable and safer active modes, such as cycling. This involves modifying road space to improve safety and attractiveness for cyclists. However, gaining an overview of the costs and benefits of such modifications is challenging due to limited spatially explicit data about road infrastructure. These data are labour-intensive to collect across entire urban networks. Decision makers rely on such data for evidence-based planning, especially in early planning stages. This paper aims to address part of this challenge. The paper presents an approach that provides a preliminary network-wide overview of existing road space, road space modification costs, and crash risk. Using Zurich City as an example, the approach combines: (1) a machine learning model to analyse aerial images and generate a spatial overview of road space; (2)

cost estimates for infrastructure modifications based on this overview; and (3) crash risk changes associated with the proposed modifications. The approach offers planners and decision-makers an overview to quickly assess potential trade-offs and benefits of road network transitions, considering costs, safety, and available road space. By providing this overview early in the planning process, the approach promotes sustainable and evidence-based mobility development in urban areas.

Mohammadali Zayandehroodi

Evaluating Safety Countermeasures at Highway-Railway Grade Crossings: A Review

Mohammadali Zayandehroodi (IUST, ETH-IVT-SVT), Barat Mojaradib (IUST), Morteza Bagheri (IUST), Anastasios Kouvelas (ETH-IVT-SVT)

Crash Modification Factors (CMFs) are key metrics used to quantify the effectiveness of safety countermeasures in reducing crashes and prioritizing safety improvements. The primary methods for estimating CMFs include Observational Before-After (BA) studies and the cross-sectional approach, both of which have inherent limitations, such as data requirements. While the BA method accounts for regression-to-the-mean (RTM) bias, the cross-sectional method is often more applicable when BA studies are impractical. Recent advancements in machine learning (ML) have enhanced CMF estimation by providing more accurate statistics. For instance, ML-based clustering can reveal the true impact of countermeasures across different sites, highlighting variations in effectiveness that are masked by traditional methods. In comparison, the BA method tends to underestimate benefits when accounting for changes in traffic. By integrating ML techniques with statistical methods, the augmented approach provides more reliable and precise estimates of countermeasure effectiveness, accounting for heterogeneity across segments. This synthesis of ML and traditional safety analysis methods offers a more comprehensive understanding of safety countermeasures, enabling transportation safety experts to make more informed decisions about which countermeasures are most appropriate for different sites.

Lan Feng

TAROT: Targeted Data Selection via Optimal Transport

Lan Feng (EPFL-LUTS), Fan Nie (Stanford University), Yuejiang Liu (Stanford University), Alexandre Alahi (EPFL-LUTS)

We propose TAROT, a Targeted data selection framework grounded in Optimal Transport theory. Previous targeted data selection methods primarily use influencebased greedy heuristics to enhance domain-specific performance. These methods perform well on limited, unimodal data (i.e., data following a single pattern) but become less effective as target data increases in complexity. Specifically, in multimodal distributions, these heuristics fail to account for multiple inherent patterns, leading to suboptimal data selection. This work identifies two primary factors contributing to this limitation: (i) the disproportionate impact of dominant feature components in high-dimensional influence estimation, and (ii) the restrictive linear additive assumptions inherent in greedy selection strategies. To address these challenges, TAROT incorporates whitened feature distance to mitigate dominant feature bias, offering a more reliable measure of data influence. Building on this, TAROT uses

whitened feature distance to quantify and minimize the optimal transport distance between the selected data and target domains. Notably, this minimization also facilitates the estimation of optimal selection ratios. We evaluate TAROT across multiple tasks, including semantic segmentation, motion prediction, and instruction tuning. Results consistently show that TAROT outperforms state-of-the-art methods, highlighting its versatility across various deep learning tasks. Code is available at https://github.com/vita-epfl/TAROT.

Lucas Meyer de Freitas

Exploring the substitution potential from car trips towards bikes and e-bikes through radical policies: First results

Lucas Meyer de Freitas (ETH-IVT-VPL), Shlomo Bekhor (Technion - Israel Institute of Technology), Kay W. Axhausen (ETH-IVT-VPL)

This study applies MNL and Integrated Choice and Latent Variable (ICLV) models to study the modeshift potentials from cars towards bikes and e-bikes. The results reveal improved model fit of the ICLV. A structural model construct with a random latent variable captures the variance differences between Revealed Preference (RP) and Stated Preference (SP) models. This model also shows that car ownership, particularly the type of car, is the most influential factor for attitudes towards mode-choice and policy preferences, offering deeper insights into transport policy preferences and the willingness to shift away from cars compared to pure sociodemographic factors. The latent variable strongly influences preferences for cycling policies, such as expanding bike networks at the expense of parking. Furthermore, we present a novel cycling infrastructure share interaction term which captures existing cycling infrastructure information at a trip level and successfully incorporate it in the estimation of our models.

Sessions 5: Thursday, May 15th 2025

Sessions 5				
Chair	Shaimaa El-Baklish (ETH-IVT-SVT)	**Session 5A**		
Room	Auditorium			
No.	**Start**	**End**	**Speaker**	**Title**
5.1	15:40	16:05	Jing Shan (ETH-D-MTEC)	Responding to Supply Chain Disruptions with Coopetition in the Intercontinental Freight Network
5.2	16:05	16:30	Myriam Pham-Truffert (Universität Bern-CDE, UZH- DSI)	Public perception of the role of electric and automated vehicles in urban transport system transformation
5.3	16:30	16:55	Shaimaa El-Baklish (ETH-IVT-SVT)	Koopman Mode Decomposition for Short-term Traffic Prediction
Chair	Kaouther Messaoud (EPFL-VITA)	**Session 5B**		
Room	Sala Balint			
No.	**Start**	**End**	**Speaker**	**Title**
5.4	15:40	16:05	Negar Rezvany (EPFL-TRANSP-OR)	Integrating housing and transport interactions: A strategic dynamic approach
5.5	16:05	16:30	Ran Chen (EPFL-LUTS)	Equilibrium Analysis of Vehicle Allocation in Competitive Multi-Regional Ride-Hailing Markets
5.6	16:30	16:55	Kaouther Messaoud (EPFL-VITA)	DualMECTraj: Dual-Level Motion–Environment Correspondence for Unified Trajectory Planning
Chair	Tom Haering (EPFL-TRANSP-OR)	**Session 5C**		
Room	Sala Eranos			
No.	**Start**	**End**	**Speaker**	**Title**
5.7	15:40	16:05	Jan Lordieck (ETH-IVT-TS)	Platform Crowding Prediction Considering Network Effects
5.8	16:05	16:30	Prunelle Vogler (EPFL-TRANSP-OR)	An Event-based modeling approach for the Mutliagents Daily Scheduling Problem
5.9	16:30	16:55	Tom Haering (EPFL-TRANSP-OR)	BHAMSLE: A Breakpoint Heuristic Algorithm for Maximum Simulated Likelihood Estimation of Advanced Discrete Choice Models

Sessions 5 - abstracts

Session 5A

Jing Shan

Responding to Supply Chain Disruptions with Coopetition in the Intercontinental Freight Network

Jing Shan (ETH-D-MTEC), Stephan Wagner (ETH-D-MTEC)

Driven by factors such as geopolitical conflicts, natural disasters, pandemics, or accidents, global shipping routes and supply chains are increasingly disrupted. Coopetition among different transport modes helps mitigate these disruptions by providing alternative modes as backup options. Intercontinental Eurasian rail freight has emerged as a vital alternative to maritime shipping, playing a crucial role in mitigating the risks associated with disruptions in maritime transport. However, existing research typically examines each transport mode independently. This paper lays the groundwork for advancing research in intercontinental multimodal freight transport by introducing the Intercontinental Multimodal Scheduled Service Network Design (IM-SSND) model to analyze Eurasian freight flows. The model captures the coopetition among transport modes that both compete and cooperate to serve the supply chain. In doing so, it enhances supply chain resilience amid geopolitical disruptions. Our findings show that the Red Sea crisis triggers a significant mode shift from maritime shipping to intercontinental rail, especially for time-sensitive goods. The findings also reveal that the existing Eurasian rail freight network cannot fully absorb the delays caused by the crisis, indicating that the capacity of the rail network needs to be expanded. In addition, train length significantly influences network profit; while longer trains also improve operational efficiency, they may also result in increased unused residual capacity (unoccupied booking spaces on train services). These findings highlight that the IM-SSND model serves as both a strategic and operational planning tool, enabling policymakers and logistics providers to better respond to disruptions in intercontinental multimodal freight transport.

Myriam Pham-Truffert

Public perception of the role of electric and automated vehicles in urban transport system transformation

Myriam Pham-Truffert (Universität Bern-CDE, UZH- DSI), Mario Angst (UZH- DSI), Maria J. Santos (UZH- GEO)

Future urban transport mobility is likely to include more Electric Vehicles (EV) and Automated Vehicles (AV). In this study, we ask "How do citizens perceive that EV and AV would influence urban transport systems?" Our survey data (n = 1172) comprises full answers from citizens living in the five largest Swiss agglomerations and randomly assigned to control and experimental groups. We collected Likert scale assessments of positive or negative interactions between four objectives of urban transport systems (transport infrastructure, road safety, transport affordability, and climate-friendliness) from the perspective of different transport modes (bikes, cars, and public transport). The treatment groups were prompted to answer the questions imagining either living in a world where (1) all gasoline-powered vehicles would have been replaced by EV, or where (2) all vehicles would have become self-driving vehicles (full driving automation). We statistically test for differences between assessments from the

control and specific treatment groups in terms of aggregate perceived effects on climate-friendliness and safety objectives. We find that for effects on climate friendliness, citizens perceive i) a high potential for electrification of cars but (ii) do not see much potential improvement in the automation of public transport. In terms of safety effects of automation of car driving, citizens are uncertain.

Shaimaa K. El-Baklish

Koopman Mode Decomposition for Short-term Traffic Prediction

Shaimaa K. El-Baklish (ETH-IVT-SVT), Michail A. Makridis (ETH-IVT-SVT), Anastasios Kouvelas (ETH-IVT-SVT)

Traffic flow data exhibits temporal and spatial correlations and a dynamic sequential structure; therby making short-term prediction challenging. This study explores the application of the Koopman operator for traffic prediction, which transforms a nonlinear system into a linear one in an infinite-dimensional space. The data-driven nature of Koopman mode decomposition (KMD) enables it to effectively capture these spatio-temporal correlations, making it well-suited for traffic prediction. Specifically, we incorporate known spatio-temporal inter-dependencies in traffic flow to develop a physics-informed modeling pipeline. A comparison between KMD and its linear counterpart, dynamic mode decomposition (DMD), demonstrates that KMD yields more accurate predictions and handles a wider range of traffic scenarios. Future research focuses on improving the robustness of KMD by addressing challenges related to missing and noisy data, further enhancing its applicability in real-world traffic prediction.

Session 5B

Negar Rezvany

Integrating housing and transport interactions: A strategic dynamic approach

Negar Rezvany (EPFL-TRANSP-OR), Frédéric Docquier (LISER, Luxemburg), Tim Hillel (UCL, UK), Michel Bierlaire (EPFL-TRANSP-OR)

Urban areas face challenges like traffic congestion and resident relocation, underscoring the need for tools to manage the complex relationship between transport and land-use. Land-use Transport Interaction (LUTI) models explore these interrelations. In traditional approaches, transitions between future states are often overlooked. Capturing time lags between urban processes—such as travel mode changes (fast), residential relocation (medium), and infrastructure developments (slow)- is particularly challenging. We propose a dynamic simulation model over a multi-year horizon, explicitly capturing feedbacks between transport and land-use within a unique framework. Our approach is based on the principles of System Dynamics, which is well-suited for modelling complex systems but remains underutilised in LUTI research. Model application is showcased by an illustrative example, simulating residents' travel and residential location choice behaviour in a region. The framework can evaluate various policies, offering valuable insights for transport and urban planning.

Ran Chen

Equilibrium Analysis of Vehicle Allocation in Competitive Multi-Regional Ride Hailing Markets

Ran Chen (EPFL-LUTS), Nicolas Geroliminis (EPFL-LUTS)

This study presents a comprehensive model to analyze ride-hailing markets where multiple companies strategically allocate their vehicle fleets across various regions to maximize pro its. We formulate the problem as a classical multi-player, non-cooperative game with co pling constraints on the actions of each company. Despite the non-convex nature of the constraints, which preclude guarantees of a unique Nash equilibrium, we propose an iterative algorithm to compute equilibria and analyze the region of convergence. Utilizing this algorithm, we conduct a numerical study illustrating the model in a duopoly market comprising two regions with distinct demand profiles.

Kaouther Messaoud

DualMECTraj: Dual-Level Motion–Environment Correspondence for Unified Trajectory Planning

Kaouther Messaoud (EPFL-VITA), Jiale Fan (EPFL-VITA), and Alexandre Alahi (EPFL-VITA)

Effective trajectory planning for autonomous driving requires accurately capturing the correspondence between dynamic agent trajectories and static environmental structures, such as lanes. Recent methods utilizing Motion–Environment Correspondence (MEC) have primarily employed simplified representations or treated MEC as separate from trajectory prediction or planning tasks. In this work, we propose DualMECTraj, a hierarchical transformer-based framework that unifies MEC with trajectory planning. Our method first employs contrastive pre-training along with the planning objectives—enhanced by Fast Adaptive Multitask Optimization (FAMO) Liu et al. (2023)—to align agent motion with detailed lane semantics. Building on this, our guidance-level MEC extracts explicit lane guidance tokens via a dedicated mapping mechanism, enabling integrated planning for immediate maneuvers and longer-term trajectory generation. Comprehensive evaluations on the nuPlan benchmark demonstrate that DualMECTraj significantly improves critical metrics, including drivable area compliance, and overall closed-loop planning effectiveness, surpassing state-of-the-art learning based methods.

Session 5C

Jan Lordieck (ETH-IVT-TS)

Informing Platform Crowding Prediction with Variable Relationships obtained from Convergent Cross Mapping

Jan Lordieck (ETH-IVT-TS), Riccardo Fiorista (MIT – Urban Mobility Lab), Francesco Corman (ETH-IVT-TS), Anson Stewart (MIT – Urban Mobility Lab)

The dissonance between demand and supply in the urban railway context, often perceived as crowding, has detrimental effects on safety, operational efficiency, and customer experience. Its accurate short-term prediction is critical to enable implementation of response techniques. Previously, prediction frameworks relied solely on solitary data without considering network

effects. In this work, we present an Empirical Dynamic Modeling (EDM) approach using Convergent Cross-Mapping (CCM), to extract causal relationships of platform occupancy between platforms in the rail network of the Washington Metro Area Transit Authority (WMATA). We show, that platform occupancies indeed causally influence each other with varying time lags. Particularly low occupancy platforms, benefit from the inclusion of lagged occupancy information of causally influencing platforms in a LightGBM prediction model.

Prunelle Vogler

An Event-based modeling approach for the Mutliagents Daily Scheduling Problem

Prunelle Vogler (EPFL-TRANSP-OR), Frédéric Meunier (ENPC- CERMICS), Michel Bierlaire (EPFL-TRANSP-OR)

This paper proposes a new formulation of the Daily Scheduling Problem for a group of agents. This involves planning the activities and trips of a group of agents over a day, which can then be used as the basis for activity-based models to forecast transport demand. The agents belong to the same social group, e.g. a family, and therefore maximize the sum of their utilities. This problem is designed to be as flexible as possible: some activities are mandatory for some agents, others require a certain group of people to be performed, several locations are possible for an activity, and some activities have a maximum capacity. The event-based modeling that we introduce enables to model this problem as a minimum cost flow problem with additional constraints, notably for temporal consistency. We present various applications of this model. We compare the performance of this model with previous models of this problem.

Tom Haering

BHAMSLE: A Breakpoint Heuristic Algorithm for Maximum Simulated Likelihood Estimation of Advanced Discrete Choice Models

Tom Haering (EPFL-TRANSP-OR), Michel Bierlaire (EPFL-TRANSP-OR)

Maximum simulated likelihood estimation (MSLE) is inherently complex due to the presence of multiple local maxima, which hinder standard optimization methods. One solution is to reformulate MSLE as a mixed-integer linear program (MILP), enabling the use of combinatorial techniques to obtain globally optimal solutions. However, this approach introduces two difficulties: (1) the reliance on simulation-based approximation, which is unavoidable when dealing with continuous mixtures and does not pose a fundamental limitation, and (2) the computational intractability of large-scale instances. To address the latter, we adapt the Breakpoint Heuristic Algorithm (BHA), originally developed for choice-based pricing, which has proven effective in solving similar MILPs with high accuracy and reduced computational time. The resulting method, the BHA for MSLE (or BHAMSLE for short), exploits the problem's combinatorial structure by identifying decision-making breakpoints in a coordinate descent framework. Numerical experiments show that BHAMSLE significantly outperforms state-of-the-art global optimization methods that do not exploit this structure. Our approach delivers strong initialization points for estimation, yielding higher log-likelihoods, more stable and interpretable estimates, and improved recovery of latent segments, even in models with mixed parameters and restricted choice sets.

Sessions 6: Friday, May 16th 2025

Sessions 6				
Chair	Basil Schmid (ARE)	**Session 6A**		
Room	Auditorium			
No.	**Start**	**End**	**Speaker**	**Title**
6.1	09:00	09:25	Jean-Michel Henchoz (FEDRO)	Potential and importance for R&D of a National Access Point for transport data: Status and Expected developments
6.2	09:25	09:50	Davi Guggisberg (SBB)	Integrating Machine Learning and MATSim for High-Granularity Passenger Load Predictions at SBB
6.3	09:50	10:15	Basil Schmid (ARE)	Stated preference survey 2025 on mode, route and departure time choices
Chair	Weijiang Xiong (EPFL-LUTS)	**Session 6B**		
Room	Sala Balint			
No.	**Start**	**End**	**Speaker**	**Title**
6.4	09:00	09:25	Mingjia He (ETH-IDSC)	Iterative VCG-based Mechanism Fosters Cooperation in Multi-Regional Network Design
6.5	09:25	09:50	Ying-Chuan Ni (ETH-IVT-SVT)	Congestion-aware optimization of urban road space allocation for cars and bicycles
6.6	09:50	10:15	Weijiang Xiong (EPFL-LUTS)	Multimodal Probabilistic Urban Traffic Forecasting
Chair	Jonas Meli (ETH-IVT-TMP)	**Session 6C**		
Room	Sala Eranos			
No.	**Start**	**End**	**Speaker**	**Title**
6.7	09:00	09:25	Mariam Hassan (EPFL-VITA)	GEM: A Generalizable Ego-Vision Multimodal World Model for Fine-Grained Ego-Motion, Object Dynamics, and Scene Composition Control
6.8	09:25	09:50	Marcel Seger (University of Oxford)	Taking charge: Measuring electric vehicle users' propensity to adopt smart charging processes at the workplace
6.9	09:50	10:15	Jonas Meli (ETH-IVT-TMP)	Spatial and Social Differences in Perceived Railway Station Accessibility in Switzerland

Session 6 - abstracts

Session 6A

Jean-Michel Henchoz

Potential and importance for R&D of a National Access Point for transport data Status and Expected developments

Jean-Michel Henchoz (FEDRO)

Introduction

R&D in transport need quality data. This is a lasting issue in the transportation field that has found only partial solutions. FEDRO has set-up since couple years a road traffic data platform where not only the data from the national network (i.e. Motorways and some key passes) but potentially all relevant data form the various road operators or private stakeholders in the road sector. At the same time, the Federal Office of Public Transport (OFT/BAV) is leading the federal initiative to build a general National Access Point for transport data called MODI. A legal base proposal is also in preparation to give a frame-work for setting up the needed infrastructure, collecting and storing data.

Presentation Content

This presentation is not directly an R&D activity, but aims to discuss the importance of quality data and the current efforts of the federal administration to gather real-time and historical data of various quality to support internal activities as well as research in the domain.

The presentation aims at:

1. Bringing the attention of the R&D community on the current efforts to generate quality and accessible data in the field of transport.
2. Discuss the current developments at the federal level.
3. Inform on initiatives at cantonal or agglomeration level.
4. Propose an analysis of the needed future development to enrich data for the specific needs of R&D.

Links & Documents

The current "Swiss National Access Point"
Open data platform mobility Switzerland – Open data platform for customer information on Swiss public transport

The Road Traffic Data Platform (FEDRO)
Aktuelle Daten-Plattform für den Strassenverkehr in der Schweiz

The MODI initivative (BAV
Data for an efficient mobility system - FOT

NAPCORE (EU Project)
NAPCORE | National Access Point Coordination Organisation for Europe

ITS Directive & Delegated Acts
ITS Directive and Action Plan - European Commission

Davi Guggisberg

Integrating Machine Learning and MATSim for High-Granularity Passenger Load Predictions at SBB

Davi Guggisberg (SBB), Marcus Riedi (SBB), Livio Kaeslin (SBB), Denis Métrailler (SBB), Marcel Rieser (SBB), Patrick Bützberger (SBB)

Swiss Federal Railways (SBB) has traditionally relied on annual average weekday and weekend Origin-Destination (OD) matrices, paired with representative timetables, to plan major service changes. While this approach has proven successful for strategic planning, new operational and planning requirements demand more granular, accurate, and frequent passenger load forecasts. To address this, two major challenges emerged: the limited availability of passenger counts, and the manual effort required to model and run numerous scenarios. We tackled these challenges by developing a Machine Learning (ML) model that infers missing passenger counts, which in turn are fed into our existing OD matrix estimation method to produce OD matrices for specific periods of the year, capturing seasonal demand variations. Additionally, we automated our transport assignment workflows by transitioning from desktop-based software and manual, labor-intensive processes to a fully automated cloud-based enterprise analytics platform. To this end, we extended MATSim's agent-based routing capabilities into a macroscopic transport assignment tool, allowing for efficient and automated assignment runs in the cloud. As a result, SBB can now reliably produce daily, accurate timetable passenger load forecasts, meeting evolving business needs, including short-term planning and responsiveness to seasonal or event-based demand fluctuations.

Basil Schmid

Stated preference survey 2025 on mode, route and departure time choices

Basil Schmid (ARE), Nicole Mathys (ARE), Mathilde Ruyssen (STRATEC), Sylvie Gayda (STRATEC), Nicolas Moreau (STRATEC), Pauline Quittelier (STRATEC), Marco Kouwenhoven (Significance), Jeroen Muller (Significance), Rodrigo Tapia (Significance), Michel Bierlaire (EPFL–TRANSP–OR),

The Stated Preference (SP) survey 2025 incorporates several improvements compared to the 2021 survey, such as higher realism in the calculation of revealed preference (RP) travel costs and simplified departure time choice experiments, focusing on a respondent's current travel mode. The selection process for the RP reference trip has been updated, enhancing the representativeness of the trips. Certain attributes have been removed, allowing for a simplified structure where all respondents are shown the same set of attributes. The layout of the SP questionnaire has been redesigned to improve clarity and user experience. Furthermore, the combination of SP experiments and types has been extended, enabling a more tailored assignment of individual questionnaires. The SP experimental designs themselves have been refined. Finally, qualitative questions related to mode choice have been included, offering additional relevant behavioural insights.

Session 6B

Mingjia He

Iterative VCG-based Mechanism Fosters Cooperation in Multi-Regional Network Design

Mingjia He (ETH-IDSC), Yannik Werner (ETH-IDSC), Andrea Censi (ETH-IDSC), Emilio Frazzoli (ETH-IDSC), and Gioele Zardini (MIT LIDS)

Transportation network design often involves multiple stakeholders with diverse priorities. We consider a system with a hierarchical multi-agent structure, featuring self-optimized subnetwork operators at the lower level and a central organization at the upper level. Independent regional planning can lead to inefficiencies due to the lack of coordination, hindering interregional travel and cross-border infrastructure development, while centralized methods may struggle to align local interests and can be impractical to implement. To support decision-making for such a system, we introduce an iterative VCG-based mechanism for multi-regional network design that fosters cooperation among subnetwork operators. By leveraging the Vickrey-Clarke-Groves (VCG) mechanism, the framework determines collective investment decisions and the necessary payments from both operators and the central organization to achieve efficient outcomes. A case study on the European Railway System validates the effectiveness of the proposed method, demonstrating significant improvements in overall network performance through enhanced cross-region cooperation.

Ying-Chuan Ni

Congestion-aware optimization of urban road space allocation for cars and bicycles

Ying-Chuan Ni (ETH-IVT-SVT), Adyasha Mohapatra (ETH-IVT-SVT), Michail A. Makridis (ETH-IVT-SVT), Anastasios Kouvelas (ETH-IVT-SVT)

Re-allocating urban road space to bicycles has been considered an effective way to enhance cycling modal share. However, this kind of transport policy often receives strong criticism from the public because of the concern related to severe traffic congestion caused by the reduction of car road space. In view of this problem, this work proposes a simulation-based optimization framework to determine the road space allocation scheme between cars and bicycles for road links in an urban network based on network traffic performance. In the framework, possible lane configurations are first designed for various road categories with different widths. Besides car traffic, bicycle traffic flow considering its distinct non-lane-based dynamics is also considered to avoid congestion on the bike lane network. Given the travel demand pattern, the algorithm aims to maximize the average route-mean speeds experienced by road users in both traffic modes. A case study is conducted for a small-size network with heavy traffic demand. The results show that the optimal allocation schemes successfully mitigate the negative impact on bi-modal network traffic flow. In addition, the amount of road space allocated to bicycles can be increased as the decrease of car modal share. The proposed framework is particularly crucial for a congested network with limited road space to foster a sustainable urban transport system.

Weijiang Xiong

Multimodal Probabilistic Urban Traffic Forecasting

Weijiang Xiong (EPFL-LUTS), Nikolas Geroliminis (EPFL-LUTS)

Urban traffic forecasting occupies a crucial role in modern Intelligent Transporation System, because the predicted information is an essential ground for traffic management and control. Therefore, the focus of many research works has been predicting a most likely value of the future traffic. However, a point prediction alone can not support good decision making, because urban traffic can evolve into different states from the same starting condition, as a result of its inherent uncertainties and dynamics. In this work, we propose a multi-modal probabilistic traffic forecasting method for an urban transporation sytem, where the model predicts a Gaussian Mixture Distribution for the future traffic. We show that the predictive distribution captures the uncertainties of urban traffic dynamics, and its Bayesian average provides a close estimate of the future traffic. Besides, the Bayesian prediction part can be learned from data in parallel with a classic regression model, and thus making the uncertainty prediction an added value. We hope our method can provide more solid grounds for traffic management and control in modern urban cities.

Session 6C

Mariam Hassan

GEM: A Generalizable Ego-Vision Multimodal World Model for Fine-Grained Ego-Motion, Object Dynamics, and Scene Composition Control

Mariam Hassan (EPFL-VITA), Alexandre Alahi (EPFL-VITA)

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We present GEM, a Generalizable Ego-vision Multimodal world model that predicts future frames using a reference frame, sparse features, human poses, and ego-trajectories. Hence, our model has precise control over object dynamics, ego-agent motion and human poses. GEM generates paired RGB and depth outputs for richer spatial understanding. We introduce autoregressive noise schedules to enable stable long-horizon generations. Our dataset is comprised of 4000+ hours of multimodal data across domains like autonomous driving, egocentric human activities, and drone flights. Pseudo-labels are used to get depth maps, ego-trajectories, and human poses. We use a comprehensive evaluation framework, including a new Control of Object Manipulation (COM) metric, to assess controllability. Experiments show GEM excels at generating diverse, controllable scenarios and temporal consistency over long generations. Code, models, and datasets are fully open-sourced.

Marcel Seger

Taking charge: Measuring electric vehicle users' propensity to adopt smart charging processes at the workplace

Marcel Seger (University of Oxford, EPFL-TRANSP-OR), Christian Brand (University of Oxford), Charlie Wilson (IIASA)

Transitioning to electrified mobility requires extensive EV charging infrastructure, particularly at workplaces where 25% of UK car-based travel occurred in 2022 for commuting purposes. Regulatory pressure is driving firms to invest in on-site workplace chargers. Advanced smart charging algorithms are then needed to coordinate power flows to adhere to capacity limits. These power flows can differ substantially subject to the choice of decision objective, ranging from lowering overall peak demand, minimising total costs or emitted carbon emissions. While the workplace as single decision agent tends to prioritise lower peaks, this can come at the risk of overwriting employees' preferences for lowest overall charging costs. To this end, digital service providers, such as Monta or ev.energy, promise to address these coordination problems by building a digital platform, taking into account employees' and workplace operators' preferences equally. While EV commuters' general preferences for smart charging have been studied extensively in the past, we lack empirical understanding of the influence of peoples' digital skills and competencies, access to (digital) infrastructure and levels of trust as mediators for predicting their willingness to adopt smart EV workplace charging technologies. Our work addresses this gap in the literature by computing a large-scale discrete choice experiment with EV workplace commuters in the UK using a hybrid choice model. We find that people with high levels of digital skills and trust towards digital technology providers are significantly more likely to accept smart charging strategies that favour CO2-minimal charging. Our results demonstrate that charging infrastructure planning needs to go hand-in-hand with user-centric factors, highlighting that users' adoption of smart charging strategies is dependent on mediators such as digital skills and high levels of trust.

Jonas Meli (ETH-IVT-TMP)

Spatial and Social Differences in Perceived Railway Station Accessibility in Switzerland

Jonas Meli (ETH-IVT-TMP), Katja Schimohr (ETH-IVT-TMP), Lea Stapper (ETH-D-GESS), Alessio Levis (ETH-D-GESS), Florian Lichtin (ETH-D-GESS), Stefan Wehrli (ETH-D-GESS), Thomas Bernauer (ETH-CIS), Eva Heinen (ETH-IVT-TMP)

Railway supply is often planned based on calculated accessibility, which can differ substantially from perceived accessibility. Little is known about the perceived accessibility of railway stations and how it differs for different spatial and societal groups. However, in order to promote rail as a means of transportation, it is important to better understand the perceived accessibility of train stations and to incorporate this into planning. We show that having access to cars, bikes, and a public transportation subscription significantly affect perceived station accessibility by foot and public transportation. Overall, measuring railway station accessibility solely based on the station connection quality and the walking distance will lead to an inaccurate measure of the quality.

Sessions 7: Friday, May 16th 2025

Sessions 7				
Chair	Arnór Elvarsson (ETH-IBI-IM)	**Session 7A**		
Room	Auditorium			
No.	**Start**	**End**	**Speaker**	**Title**
7.1	10:35	11:00	Xuhang Liu (EPFL-HOMES)	Population Markov Potential Game: An Alternative Framework for Markovian Traffic Assignment
7.2	11:00	11:25	Yasamin Borhani (EPFL-VITA)	PoseDriver: A Unified Approach to Multi-Class Skeleton Detection for Autonomous Driving
7.3	11:25	11:50	Arnór Elvarsson (ETH-IBI-IM)	Why have societies not built more cycling lanes? Initial findings for more efficient cycling infrastructure planning processes in Canton Zürich
Chair	Can Chen (EPFL-LUTS)	**Session 7B**		
Room	Sala Balint			
No.	**Start**	**End**	**Speaker**	**Title**
7.4	10:35	11:00	Zahra Ansarilari (ETH-IVT-TS)	The Impact of Bike Integration as an Access/Egress Mode in Transit Network Design: Insights from a Zürich Subnetwork
7.5	11:00	11:25	Xinyu Ma (EPFL-HOMES)	A tri-level model for the strategic game between the mobility-as-a-service (MaaS) platform and on-demand operators
7.6	11:25	11:50	Can Chen (EPFL-LUTS)	A perimeter control-route guidance framework of urban networks with priorities
Chair	Mohamed Abdelfattah (EPFL-VITA)	**Session 7C**		
Room	Sala Eranos			
No.	**Start**	**End**	**Speaker**	**Title**
7.7	10:35	11:00	Florian Fuchs (ETH-IVT-TS)	Hybrid Optimization for the DISPLIB 2025 competition: Logic-Based Benders and Mixed-Integer Programming for Railway Dispatching
7.8	11:00	11:25	Mohamed Abdelfattah (EPFL-VITA)	OSKAR: Omnimodal Self-supervised Knowledge Alignment and Representation
7.9	11:25	11:50		

Session 7 - abstracts

Session 7A

Xuhang Liu

Population Markov Potential Game: An Alternative Framework for Markovian Traffic Assignment

Xuhang Liu (EPFL-HOMES), Kenan Zhang (EPFL-HOMES)

The Traffic Assignment Problem (TAP) predicts traffic flows on a given road network and demand profile, based on the equilibrium concept from game theory, where no driver has an incentive to change their route. TAP models are typically categorized as static or dynamic models, and deterministic or stochastic models. This study introduces a novel dynamic and stochastic TAP model, in which each vehicle's routing decision follows a Markov decision process (MDP). Traffic dynamics are Markovian, and stochastic routing behaviors are captured by a state-dependent policy. Existing Markovian TAP models focus on route choice as sequential link decisions within the MDP framework, with predefined policies (e.g., multinomial logit) and deterministic state transitions. In contrast, the proposed model removes these constraints, providing greater modeling flexibility. The model, termed the Population Markov Potential Game (PMPG), integrates concepts from population games, potential games, and Markov games. It considers the Markov potential game over a large population of agents and offers a robust framework with efficient solution methods. PMPG shows flexibility and practical usefulness for various transportation applications. Through an example of ride-hailing vehicles, we demonstrate that the PMPG framework enables us to achieve equilibrium solutions using the projected policy gradient method.

Yasamin Borhani

PoseDriver: A Unified Approach to Multi-Class Skeleton Detection for Autonomous Driving

Yasamin Borhani (EPFL-VITA), Taylor Mordan (MobiLysis), Javad Khoramdel (Tarbiat Modares University), Yihan Wang (EPFL-VITA), Reyhaneh Hosseininejad (EPFL-VITA), Alexandre Alahi (EPFL-VITA)

Object skeletons offer a concise representation of structural information, capturing essential aspects of posture and orientation that are crucial for autonomous driving applications. However, a unified architecture that simultaneously handles multiple instances and categories using only the input image remains elusive. In this paper, we introduce PoseDriver, a unified framework for bottom-up multi-category skeleton detection tailored to common objects in driving scenarios. We model each category as a distinct task to systematically address the challenges of multi-task learning. Specifically, we propose a novel approach for lane detection based on skeleton representations, achieving state-of-the-art performance on the OpenLane dataset. Moreover, we present a new dataset for bicycle skeleton detection and assess the transferability of our framework to novel categories. Experimental results validate the effectiveness of the proposed approach.

Arnór Elvarsson

Why have societies not built more cycling lanes? Initial findings for more efficient cycling infrastructure planning processes in Canton Zürich

Arnór Elvarsson (ETH-IBI-IM), David Zani (ETH-IBI-IM), Bryan Adey (ETH-IBI-IM)

Policy-makers shape cycling infrastructure planning processes so that planners can best meet societal needs (e.g., safe travel without delay) and policy objectives (e.g., reaching net zero and increasing the percentage of total trips made by cycling). These processes work best when they are both effective and efficient. This may not be the case in Switzerland, as planned cycling infrastructure is often completed later than desired, meaning that it may not be addressing societal needs as effectively as possible, and the drawn-out process is also most likely not as efficient as possible. Change may be required if the canton of Zurich is to complete its 602 kilometre cycling network plan by 2043, especially seeing that some projects e.g., the 50 million CHF Limmattal cycling highway, are already delayed. To point the way forward on modifying the cycling infrastructure planning process, this paper assesses the current planning process and suggests improvements. The paper is structured into three parts. First, the Canton Zurich planning process is explained. Second, challenges to completing the network plan by 2043 with the current process are identified using planning examples. Third, potential process improvements including a timely mandate for planners, an early-stage network overview of costs, and early, consistent consensus building facilitating efficient processes are proposed.

Session 7B

Zahra Ansarilari

The Impact of Bike Integration as an Access/Egress Mode in Transit Network Design: Insights from a Zürich Subnetwork

William Andersson (ETH-IVT-TS), Florian Fuchs (ETH-IVT-TS), Zahra Ansarilari (ETH-IVT-TS), Oleksandr Halipchak (ETH-IVT), Francesco Corman (ETH-IVT-TS)

While most transit network design studies overlook the role of biking as a mode of access and egress, those that do incorporate biking often limit their analyses to idealized grid networks with uniform demand distribution. This study addresses these gaps by integrating bikes into the transit network design of a realistic urban setting, using a detailed MATSim dataset for a Zürich subnetwork. We develop a mixed-integer model that minimizes passenger travel times—including access, egress, in-vehicle, and transfer times—as well as operating costs. By systematically adjusting bike-eligible demand percentages and the maximum biking distance limit, this study evaluates the impact of biking on passenger routes, travel times, and operational features of the network, including the configuration of lines, frequency, and the number of buses, trolleybuses, and trams. Preliminary findings indicate that bike integration significantly reduces both passenger travel times and operational costs, highlighting the critical need to integrate biking into transit network design problem.

Xinyu Ma

A tri-level model for the strategic game between the mobility-as-a-service (MaaS) platform and on-demand operators

Xinyu Ma (EPFL-HOMES), Kenan Zhang (EPFL-HOMES), Rui Yao (EPFL-HOMES)

This paper studies a multi-modal mobility system with a mobility-as-a-service (MaaS) platform, transportation network companies (TNCs), and mass transit (MT). The MaaS platform competes with TNCs and MT for travelers meanwhile cooperating with them to serve multi-modal trips. A tri-level model is formulated to capture the complex interactions among the stakeholders, where the MaaS platform designs service at the upper level, TNCs optimize their strategies at the middle level, and travelers make service choices following a nested logit (NL) model at the lower level. Numerical results show that a profit-maximizing MaaS platform can hardly survive in a market with excessive service capacity, whereas it becomes more appealing to long-distance travelers when travel time is prioritized over cost. On the other hand, when demand is high but insensitive to travel time, the MaaS platform may dominate the market by consolidating all service capacities of TNCs.

Can Chen

A perimeter control-route guidance framework of urban networks with priorities

Can Chen (EPFL-LUTS), Nikolas Geroliminis (EPFL-LUTS)

Recent efforts have been devoted to integrating perimeter control and regional route guidance (PCRG) to improve traffic efficiency in multi-region macroscopic fundamental diagram (MFD) based networks. However, few existing studies have explored an optimal strategy for an MFD-based system to maximize passenger trip completion with mixed traffic of vehicles carrying different numbers of passengers. The main objective of this paper is to develop an optimal PCRG framework to maximize the passenger trip completion of large-scale MFD-based urban traffic systems, where priority is provided for more efficient modes of transport. In the proposed control framework, vehicles carrying more than one passenger are prioritized (named prioritized vehicles (PVs)) over those carrying only one (named non-prioritized vehicles (NPVs)). Trip completion of PVs can yield more system benefits than NPVs. Hence, for some regions (e.g., the central business district) in the network, we assume a spatial distribution between trip priorities such that PVs exclusively utilize dedicated lanes to transport passengers, and NPVs share the remaining network. In the other regions, we assume a mixed traffic operation of PVs and NPVs. To the authors' best knowledge, this work is the first time to investigate the mixed-separated network representation and its optimal PCRG scheme to maximize passenger trip completion for the whole network.

Session 7C

Florian Fuchs

Hybrid Optimization for the DISPLIB 2025 competition: Logic-Based Benders and Mixed-Integer Programming for Railway Dispatching

Florian Fuchs (ETH-IVT-TS), Thomas Dubach (ETH-IVT-TS), Jan Lordieck (ETH-IVT-TS), Francesco Corman (ETH-IVT-TS) , Martin Iradi Bernardo (ETH-IVT)

We present a hybrid optimization approach for the DISPLIB 2025 competition in real-time train dispatching. Our continuous-time method combines a Logic-Based Benders Decomposition (LBBD) procedure and a Mixed-Integer Programming (MIP) model-solving approach. These two complementary methods tackle the problem from two perspectives: The LBBD discovers and separates conflicts between trains, only adding the constraints required dynamically. Alternatively, the MIP-based approach relaxes the model and iteratively converges to a conflict-free and optimal solution while maintaining tractability. Both approaches incorporate various preprocessing and aggregation techniques that enable us to solve 61 of the 112 competition instances to optimality. Our results show the benefits of the two complementary approaches where, depending on the network topology, each approach can solve instances alone, but also work together to improve convergence by combining their bounds.

Mohamed Abdelfattah

OSKAR: Omnimodal Self-supervised Knowledge Alignment and Representation

Mohamed Abdelfattah (EPFL-VITA), Kauther Messaoud (EPFL-VITA), Alexandre Alahi (EPFL-VITA)

We present Oskar, the first mult-imodal foundation model based on latent feature prediction. Unlike generative or contrastive methods, it avoids overfitting to unnecessary details (e.g., pixels), and does not require negative pairs or large memory banks. We propose a novel pretraining strategy: given masked tokens from multiple modalities, predict a subset of missing tokens per modality, supervised by momentum-updated uni-modal teachers. This design efficiently uses model capacity to learn high-level features while retaining modality-specific information. Key innovations include: (1) compute efficiency via nonoverlapping masking, (2) person disambiguation through bounding box embeddings, and (3) balanced multi-modal sampling using a Dirichlet strategy to prevent tokenrich modalities (e.g., video) from dominating. Without loss of generality, we instantiate Oskar on video, skeleton, and text modalities. Extensive experimental results show that Oskar's unified pretrained encoder outperforms specialized models of similar size in action recognition (rgb, skeleton, frozen, low-shot) and localization, video-text retrieval, video question answering, and video captioning.

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