Conference Program

STRC

24th Swiss Transport Research Conference
Monte Verità / Ascona, May 15 – 17, 2024

It is our pleasure to welcome you to the *Swiss Transport Research Conference* STRC

Now reaching the 24th edition, the conference brings together various experts in the domain of transportation and mobility studies.

The conference will provide a platform for Swiss academics, consultants and industry and governmental professionals to present and discuss various studies and research findings in the broad fields of transport research.

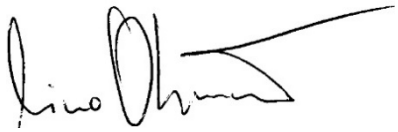
This gathering of scholars and practitioners will be a great opportunity to share knowledge and to reinforce cooperation.

This year, 66 presentations will cover a multiplicity of topics, including: traffic monitoring, modeling and control, automated and connected transport systems, demand modeling, logistics, land use data, public transport operations and infrastructure, big data for transport and mobility, pedestrian modeling, among many others.

The following keynote speakers have confirmed their attendance:

- **Prof. Dr. Becky Loo**, University of Hong Kong & Jiangxi Normal University, China
- **Prof. Dr. Bert van Wee**, Delft University of Technology, Netherlands
- **Prof. Dr. Travis Waller**, Technical University of Dresden, Germany

On behalf of the STRC organizing committee, welcome !



Prof. Dr. Timo Ohnmacht

Institute of Tourism and Mobility ITM
Lucerne University of Applied Sciences and Arts

Prof. Dr. Alex Erath

School of Architecture, Civil Engineering and Geomatics

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Questions

For questions regarding the conference, please send us an e-mail: **strc@hslu.ch**
If you have any questions during the conference, please call Timo Ohnmacht:
+41 77 408 53 93

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.

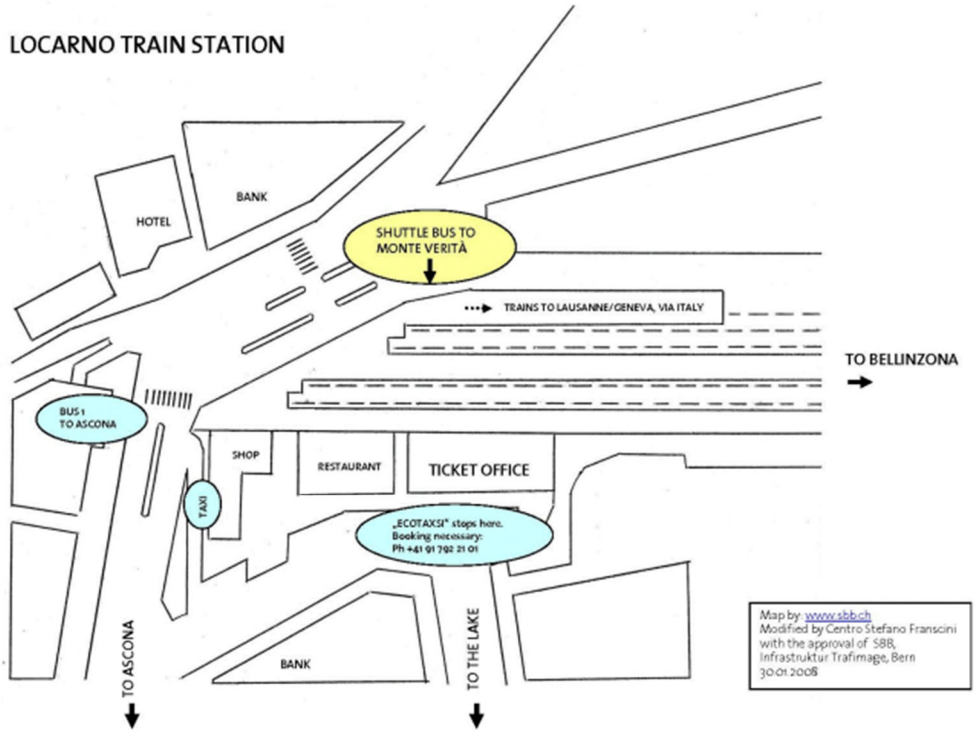
The auditorium is located on the ground floor. The dining room and the remaining rooms are located on the first floor, directly above the auditorium.

Arrival / Departure with shuttlebus

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

On **Wednesday 15th 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**. The shuttlebus at **11:30h** is Monte Verità's and has a large Monte Verità logo sticker on the sides. Please see following map.

On **Friday 17th May** there will be also shuttle services from Monte Verità to Locarno starting at **12:30h**.



Shuttle Service Schedule							
Wednesday 15th May				Friday 17th May			
From	To	Departure Time	Seats	From	To	Departure Time	Seats
Locarno Station	Monte Verità	11:00	30	Monte Verità	Locarno Station	12:30	50
		11:30	8			13:10	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 20:30h.***

Breakfast and lunch

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

Dinner (Wednesday 15th) and Gala Dinner (Thursday 16th)

Dinner on Wednesday is at Monte Verità, starting at **19:00h.**

On **Thursday 16th May**, our Gala Dinner is at **Ristorante Grotto Broggini (Via S. Materno 18, 6616 Losone)**, starting at **19:30h**.

We warmly recommend reaching the Grotto on foot, it's a leisurely 15 min. strawl from Monte Verita along a nice footpath through the woods. However, there will also be a shuttle service departing from Monte Verità from **19:00h** and back from Grotto Broggini from **22:00h**.

Conference program

The program of the conference can also be accessed through the conference webpage: https://www.strc.ch/2024.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/

CO_2-neutral conference

Transport-related emissions account for more 40% of all CO_2-emissions in Switzerland, excluding international air traffic. We take our shared responsibility towards future generations seriously. Following the concept of avoiding, reducing and compensating through carbon capture and storage, we try to keep our CO_2 footprint as low as possible and offset the remaining amount of about 21 t CO_2 (0.24 t CO_2 per participant) through the restoration of the peat bog "Ahlenmoor" near Cuxhaven, Germany. To limit global warming to 1.5°C, the maximum amount of CO_2 that can be generated by a single person in Switzerland in a year is 0.47 t CO_2 (Robiou du Pont & Nicholls, 2023).

Social program

Monte Verità has a rich history in bringing curious and open-minded people together. We organised a small social program on **Wednesday evening** to give participants various opportunities to experience why Monte Verità is a place of extraordinary cultural significance.

1) Social program: Guided tour

A guided tour of Monte Verità in English is scheduled for **Wednesday, May 15th**, at **18:10h**. Due to limited capacity, only 20 people can participate in this tour of about 60 minutes. Please register at the conference desk on a list (*first come, first served*).

2) Social program: Visit of the Casa Anatta Museum

If you are unable to take part in the guided tour on **Wednesday, May 15th**, you can alternatively visit the **Casa Anatta Museum**, which is exceptionally **open until 19:00h** for conference participants only.

The museum is home to the permanent exhibition "MONTE VERITÀ. Le mammelle della verità", curated by Harald Szeemann in 1978. The exhibition includes a wealth of materials linked to the history of Monte Verità. On the ground floor, the new exhibition "Le verità di una montagna" by Andreas Schwab serves as an introduction to the permanent exhibition. It features screens, audio stations, and multimedia presentations to help visitors delve deeper into Szeemann's permanent exhibit.

3) Social program: Screening of the Movie "Monte Verità - Der Rausch der Freiheit"

The Swiss film "Monte Verità - Der Rausch der Freiheit" tells the story of a courageous woman who, tormented by inner turmoil, finds her own way. The historical drama, which is set on Monte Verità and its surroundings and is based on true events, raises the - still timely - question of how much self-determination a woman is allowed to have in her life without being criticized by society. The movie is set in 1906, a time of upheaval where fears and hopes characterize society. The first dropouts - including the young Hermann Hesse - seek their paradise and find it in the south of Switzerland, on Monte Verità. The reformers not only shed their clothes, but also the mental corset that threatened to suffocate society. The young mother Hanna Leitner is also drawn to Ascona in Ticino to escape her bourgeois role. Torn between feelings of guilt towards the family she has left behind and the fascination of a self-determined life, Hanna not only discovers her passion for the art of photography, but also finds her own voice in the midst of idyllic nature.

The movie starts on **Wednesday, May 15th** at **21:00h**. The film "Monte Verità - Der Rausch der Freiheit" will be shown in German with French subtitles in the auditorium.

Details for conference photo

On **Thursday, May 16th at 18:50h**, 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 16th at 13:30h - 14:30h** in the *van der Heydt room* (all PIs of the organizing institutes of STRC Conference and conference staff 2024).

Factsheet for session-chairs

- 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.
- Please open the session on time by explaining the session name, the title of the first presentation and the name of the presenter.
- The presentation length will be 15 minutes. This has to be checked by you as a Session-Chair.
- 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 interrupt carefully.
- The discussion round must not last longer than 5 minutes.
- 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 15 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.

Each presentation should contain on every slide the name of the presenter.
This allows someone entering the room late or early to know the session's status.

Consider providing the following information in your slides:

- Title, name, affiliation
- What is the problem?
- 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 his or her 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.

Please send your review to the authors after 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:
Please upload your final paper after the conference again on the STRC-Homepage. Deadlines will follow after the conference. Please follow the link for upload: STRC 2024| Submission form

Please note: If the organizing committee does not receive a new paper, they will publish the first submitted paper on the STRC-Homepage, unless you tell the organizers not to do so.

Participants of STRC 2024 conference

Name	Surname	Lab / Institution
Mohamed	**Abdelfattah**	EPFL-VITA
Alexander	**Alahi**	EPFL-VITA
Georg	**Anagnostopoulos**	EPFL-LUTS
Raphael	**Ancel**	UVEK ARE
Selin	**Ataç**	HEIG-VD, HES-SO
Kay	**Axhausen**	ETH-IVT-VPL
Lukas	**Ballo**	ETH-IVT-VPL
Noah	**Balthasar**	HSLU
Candice	**Baud**	EPFL-TRANSP-OR
Shlomo	**Bekhor**	ETH
Kevin	**Blättler**	HSLU
Yasamin	**Borhani**	EPFL-VITA
Matthias	**Bruening**	UNISG
Elisabeth	**Brugger**	ETH-IVT-TS
Charles	**Corbière**	EPFL-VITA
Francesco	**Corman**	ETH-IVT-TS
Cloe	**Cortes Balcells**	EPFL-TRANSP-OR
Antonin	**Danalet**	SBB
Mariana	**De Almeida Costa**	ETH-IVT-TS
Matthieu	**de Lapparent**	HEIG-VD, HES-SO
Shaimaa	**ElBaklish**	ETH-IVT-SVT
Catherine	**Elliot**	ETH-IVT-VPL
Arnor	**Elvarsson**	ETH
Alexander	**Erath**	FHNW
Hossein	**Farahani**	EPFL-HOMES
Lynn	**Fayed**	EPFL-LUTS
Florian	**Fuchs**	ETH-IVT-TS
Siyu	**Gao**	VU (NL)
Yang	**Gao**	EPFL-VITA
Nikolas	**Geroliminis**	EPFL-LUTS
Tom	**Haering**	EPFL-TRANSP-OR
Yasaman	**Haghighi**	EPFL-VITA
Livio	**Hardegger**	FHNW
Daniel	**Heimgartner**	ETH-IVT-VPL
Eva	**Heinen**	TU Dortmund
Thomas	**Hettinger**	SBB
Raphael	**Hoerler**	ZHAW
Ye	**Hong**	ETH
Reyhaneh	**Hosseininejad**	EPFL-VITA
Sohyeong	**Kim**	EPFL-LUTS
Viera	**Klasovitá**	ETH-IVT-TS
Anastasios	**Kouvelas**	ETH-IVT-SVT
Marija	**Kukic**	EPFL-TRANSP-OR
Becky	**Loo**	HKU

Jan	**Lordieck**	ETH-IVT-TS
Po-Chien	**Luan**	EPFL-VITA
Marko	**Maljkovic**	EPFL-LUTS
Fabrice	**Marggi**	ETH
Bernardo	**Martin-Iradi**	ETH-IVT-TS
Adrian	**Meister**	ETH-IVT-VPL
Kaouther	**Messaoud**	EPFL-VITA
Bierlaire	**Michel**	EPFL-TRANSP-OR
Nicholas	**Molyneaux**	DGMR
Corrado	**Muratori**	ZHAW
Ying-Chuan	**Ni**	ETH-IVT-SVT
Michael	**Nold**	ETH-IVT-TS
Timo	**Ohnmacht**	HSLU
Nicola	**Ortelli**	HEIG-VD
Evangelos	**Paschalidis**	EPFL-TRANSP-OR
Ahmad	**Rahimi**	EPFL-VITA
Chen	**Ran**	EPFL-LUTS
Negar	**Rezvany**	EPFL-TRANSP-OR
Léa	**Ricard**	EPFL-TRANSP-OR
Kevin	**Riehl**	ETH-IVT-SVT
Saeed	**Saadatnejad**	EPFL-VITA
Dorothea	**Schaffner**	FHNW
Basil	**Schmid**	UVEK-ARE
Megh	**Shukla**	EPFL-VITA
Thomas	**Spanninger**	ETH-IVT-TS
Silvio	**Sticher**	HSLU
Michael	**Stiebe**	HSLU
Linghang	**Sun**	ETH-IVT-SVT
Yura	**Tak**	EPFL-LUTS
Fabian	**Torres**	EPFL-TRANSP-OR
Jacob	**Trepat Borecka**	ETH-IVT-TS
Bastien	**Van Delft**	EPFL-VITA
Michael	**van Eggermond**	FHNW
Bert	**van Wee**	DELFT
Widar	**von Arx**	HSLU
Thao	**Vu Thi**	HSLU
Travis	**Waller**	TU Dresden
Hannes	**Wallimann**	HSLU
David	**Walter**	Stadt Luzern
Minru	**Wang**	EPFL-LUTS
Weijiang	**Xiong**	EPFL-LUTS
Zhenyu (Tim)	**Yang**	EPFL-LUTS
Rui	**Yao**	EPFL-HOMES
Silvan	**Zeier**	ETH
Yifan	**Zhang**	ETH-IVT-SVT
Kenan	**Zhang**	EPFL-HOMES
Pengbo	**Zhu**	EPFL-LUTS

Keynote speakers

Prof. Dr. Becky Loo

"A Paradigm Shift in Transportation"

Becky P.Y. Loo is Professor of Geography at the University of Hong Kong, and Chair Professor of Jiangxi Normal University. She is a Fellow of the Academy of Social Sciences, United Kingdom. Becky also holds an Honourary Professorship at University College London (UCL) and Beijing Jiaotong University. Her core research interests are i) transit, walkability and urban form; ii) road safety and spatial analysis; iii) sustainability and transport decarbonization; and iv) smart cities.

Becky is Founding Co-Editor-in-Chief of Travel Behaviour and Society and Associate Editor of the Journal of Transport Geography. Her research papers are advancing the state-of-the-art in transport geography and her papers are often published in top-ranking journals with impact beyond her discipline. She is committed to fostering people-oriented and place-based interdisciplinary research. Her outstanding contributions to the local community have been recognized by the Hong Kong Special Administrative Region (HKSAR) Government with the conferment of the Justice of Peace (JP) title.

Prof. Dr. Bert van Wee

"Controversial policies: growing support after implementation"

Bert van Wee is professor in Transport Policy at Delft University of Technology, the Netherlands, faculty Technology, Policy and Management (since 2003). His main interests are in long-term developments in transport, in particular in the areas of accessibility, land-use transport interaction, (evaluation of) large infrastructure projects, the environment, safety, policy analyses and ethics.

His research interests are in transport policy relevant issues, such as environmental impacts, accessibility, evaluation of policies, plans, and infrastructure projects, land-use and transport interaction, transport and ethics, and the role of technology in the transport system and related policy relevant effects.

Prof. Dr. Travis Waller

"How We Move into the Future: Automated Transport Planning that Leverages Pervasive Data and Evolutionary Algorithms for Humancentric Mobility"

Steven "Travis" Waller is the Lighthouse Professor and Chair of Transport Modelling and Simulation at the Technical University of Dresden, Germany, as well as a Professor at the Australian National University (ANU). Until his relocation to Germany in March 2022 he was Head of the School of Civil and Environmental Engineering at UNSW Sydney with previous roles at UNSW including Deputy Dean of Research (Faculty of Engineering), Founding and Executive Director of the Research Centre for Integrated Transport Innovation (rCITI) and the Advisian Chair of Transport Innovation. He began his tenure-track career at the University of Illinois at Urbana-Champaign in 2001 and, subsequently, at the University of Texas at Austin (where he was promoted to Associate Professor with tenure in 2007 and full Professor in 2011).

Travis explores the modelling and simulation of complex transportation networks with particular emphasis of emerging technology and the inclusion of social values. Particular applications have emphasized inherent system characteristics (e.g., dynamic assignment, adaptive equilibrium, strategic equilibrium), ethical quantification (e.g., environmental justice, equity, resilience) and emerging technology for planning tools (e.g., automation, decision-support). Across the aforementioned and related areas, he has published more than 200 peer-reviewed scientific journal papers, supervised 43 completed PhD students and conducted over 60 funded research projects for 40 global sponsors.

Schedule overview

Wednesday, May 15th

12:00 –14:30	Registration and Sandwich Lunch		
14:30-14:40	Welcome (Auditorium)		
	Session 1A: Auditorium	**Session 1B: Sala Balint**	**Session 1C: Sala Eranos**
14:40 - 15:00	D. Heimgartner	S. Ataç	W. von Arx
15:00 - 15:20	C. Elliot	A. Meister	M. Stiebe
15:20 - 15:40	H. Wallimann		L. Ballo
15:40 - 16:10	Coffee-Break		
	Session 2A: Auditorium	**Session 2B: Sala Balint**	**Session 2C: Sala Eranos**
16:10 - 16:30	A. Elvarsson	P. Zhu	B. Van Delft
16:30 - 16:50	F. Marggi	C. Corbière	P. Luan
16:50 - 17:10	B. Schmid	T. Haering	R. Hosseininejad
17:45 - 19:00	Guided Tour through Monte Verità or Museum Casa Anatta		
19:15	Dinner		
21:00	Movie screening		

Thursday, May 16th

07:30 - 08:30	Breakfast		
08:30 - 09:30	Keynote 1: Prof. B. Loo (Auditorium)		
09:30 - 09:40	Break		
	Session 3A: Auditorium	**Session 3B: Sala Balint**	**Session 3C: Sala Eranos**
09:40 - 10:00	Y. Haghighi	S. Gao	N. Balthasar
10:00 - 10:20	S. Zeier	L. Sun	R. Hoerler
10:20 - 10:40	L. Hardegger	J. Trepat	Y. Hong
10:40 - 11:00	L. Ballo	T. Spanninger	N. Rezvany
11:00 - 11:30	Coffee-Break		
	Session 4A: Auditorium	**Session 4B: Sala Balint**	**Session 4C: Sala Eranos**
11:30 - 11:50	F. Fuchs	Y. Ni	S. Saadatnejad
11:50 - 12:10	Z. Yang	M. Nold	Y. Zhang
12:10 - 12:30	V. Klasovità	W. Xiong	K. Massaoud
12:30 - 13:30	Lunch		
13:30 - 14:30	Committee meeting (Sala van der Heydt)		
14:30 - 15:30	Keynote 2: Prof. T. Waller (Auditorium)		
15:30 - 15:40	Break		
	Session 5A: Auditorium	**Session 5B: Sala Balint**	**Session 5C: Sala Eranos**
15:40 - 16:00	M. Bruening	M. A. Costa	M. Wang
16:00 - 16:20	S. Sticher	H. R. Farahani	B. Martin-Iradi
16:20 - 16:40	A. Danalet	J. Lordieck	R. Ancel
16:40 - 17:10	Coffee-Break		
	Session 6A: Auditorium	**Session 6B: Sala Balint**	**Session 6C: Sala Eranos**
17:10 - 17:30	R. Yao	Y. Tak	M. Abdelfattah
17:30 - 17:50	M. Maljkovic	K. Blättler	S. ElBaklish
17:50 - 18:10	L. Fayed	Y. Borhani	M. Kukic
18:10 - 18:50	Break		
18:50	Photo (at stairway)		
19:30	Gala Dinner (Grotto)		

Friday, May 17th

09:00 - 09:40	Breakfast		
	Session 7A: Auditorium	**Session 7B: Sala Balint**	**Session 7C: Sala Eranos**
09:40 -10:00	A. Rahimi	N. Ortelli	S. Kim
10:00 - 10:20	C. Cortes Balcells	C. Baud	K. Riehl
10:20 - 10:40	M. Shukla	Y. Gao	G. Anagnostopoulos
10:40 - 11:10	Coffee-Break		
11:10 - 12:10	Keynote 3: Prof. B. van Wee (Auditorium)		
12:10	Closing of the Conference (Auditorium)		

Sessions 1: Wednesday, May 15th 2024

Sessions 1				
Chair	Zhenyu Yang (EPFL-LUTS)	**Session 1A: Transport policy & pricing**		
Room	Auditorium			
No.	**Start**	**End**	**Speaker**	**Title**
1.1	14:40	15:00	Daniel Heimgartner (EHT-IVT-VPL)	Does Climate Change Policy Have Regressive or Progressive Distributional Effects? Insights From a Priority Evaluator Experiment
1.2	15:00	15:20	Catherine Elliot (EHT-IVT-VPL)	Unveiling Public Sentiment: Analyzing Commenter Feedback on the E-Bike City Research Project in Zurich
1.3	15:20	15:40	Hannes Wallimann (HSLU)	Austria's KlimaTicket: Assessing the short-term impact of a cheap nationwide travel pass on demand
Chair	Kevin Blättler (HSLU)	**Session 1B: Activity- and agent-based models**		
Room	Sala Balint			
No.	**Start**	**End**	**Speaker**	**Title**
1.4	14:40	15:00	Selin Ataç (HEIG-VD, HES-SO)	Exploring electric vehicle charging dynamics: Literature review and future framework
1.5	15:00	15:20	Adrian Meister (ETH-IVT-VPL)	Incorporating discrete route choice models into the agent-based simulations
Chair	Michael Stiebe (HSLU)	**Session 1C: New forms of mobility**		
Room	Sala Eranos			
No.	**Start**	**End**	**Speaker**	**Title**
1.7	14:40	15:00	Widar von Arx (HSLU)	Obstacles to Economic Sustainability of Free-Floating E-Bike Sharing Systems: A Basel-Based Case Study
1.8	15:00	15:20	Michael Stiebe (HSLU)	Comparative Analysis of User Characteristics and Use Patterns in Free-Floating and Station-Based E-Bike Sharing Systems – Insights from the Basel Metropolitan Area
1.9	15:20	15:40	Lukas Ballo (ETH-IVT-VPL)	Accessibility Effects of the E-Bike City

Sessions 1 - abstracts

Session 1A

Daniel Heimgartner

Does Climate Change Policy Have Regressive or Progressive Distributional Effects? Insights From a Priority Evaluator Experiment

Florian Lichtin, Daniel Heimgartner, Keith Smith, Kay W. Axhausen, Thomas Bernauer

Efforts to implement urgently needed, ambitious climate policies are hampered by controversy about potentially regressive distributional effects of such policies. Regressive means that such policies could result in disproportionate costs for lower-income citizens and consumers. We study this issue bottomup by exploring how individuals across different income groups and initial carbon footprint levels evaluate and trade-off various behavioral changes and financial costs when having to reduce individual emissions as a result of more stringent climate policy. Specifically, we study how individuals are likely to respond when tasked with reducing their carbon emissions to a level that is compatible with netzero goals. We do so by combining a carbon calculator that estimates individualized emissions and a novel priority evaluation-based methodology, which are implemented in an online survey amongst a population-representative sample of Switzerland (N=5941). This approach involves a highly individualized and interactive choice task that allows each individual to develop a set of behavioral responses and mitigation pathways to reach a personalized reduction target. The choices made are analysed with a multiple discrete-continuous extreme value (MDCEV) model. First modelling results will pe presented at the STRC.

Catherine Elliot

Unveiling Public Sentiment: Analyzing Commenter Feedback on the E-Bike City Research Project in Zurich

Dr. Catherine Elliot (ETH Zurich), Prof. Kay Axhausen (ETH Zurich)

This study explored public perceptions of an online newspaper article about transitioning Zurich to an E-Bike City (EBC). We employed an inductive qualitative content and thematic analysis of 361 relevant comments posted by 225 contributors. All comments were separated into 969 individual statements which were then coded by the sentiments in each statement as well as general directions towards EBC (391 neutral, 356 positive, and 222 negative). Prominent themes included funding, street space allocation, safety, impacts on tradespeople, access issues and infrastructure. Pearson's correlations found significant clusters among these key themes, 1.) ETH Zurich researchers being commended and also critiqued for the study concept, 2.) accessibility, tradespeople, people with limited mobility, elderly, and deliveries; 3.) cyclist behaviour, following road rules and pedestrians; and 4.) weather, bicycle and new ways of thinking. The research unveils community concerns, expectations, and recommendations, offering insights for policymakers and urban planners. The findings emphasize the need for transparent communication regarding EBC financing, safety-focused road space reallocation, and considerations for tradespeople, the elderly, and those with mobility issues. Addressing these key points in future communications is vital to aligning strategies with public sentiment on sustainable urban transportation initiatives which would need voter support in future referendums.

Hannes Wallimann

Austria's KlimaTicket: Assessing the short-term impact of a cheap nationwide travel pass on demand

University of Applied Sciences and Arts Lucerne, Competence Center for Mobility

Measures to reduce transport-related greenhouse gas emissions are of great importance to policy-makers. A recent example is the nationwide KlimaTicket in Austria, a country with a relatively high share of transport-related emissions. The cheap yearly season ticket introduced in October 2021 allows unlimited access to Austria's public transport network. Using the synthetic control and synthetic difference-in-differences methods, I assess the causal effect of this policy on public transport demand by constructing a data-driven counterfactual out of European railway companies to mimic the number of passengers of the Austrian Federal Railways without the KlimaTicket. The results indicate public transport demand grew slightly faster in Austria, i.e., 3.3 or 6.8 percentage points, depending on the method, than it would have in the absence of the KlimaTicket. However, the growth effect after the COVID-19 pandemic appears only statistically significant when applying the synthetic control method, and the positive effect on public transport demand growth disappears in 2022.

Keywords: Public transport; Policy evaluation; Synthetic control method; Case study; Natural experiment

Acknowledgments: Michael Stöckli provided excellent research assistance. I would like to thank Kevin Blättler, Silvio Sticher, and Widar von Arx for interesting discussions and helpful comments.

Session 1B

Selin Ataç

Exploring electric vehicle charging dynamics: Literature review and future framework

Institut Interdisciplinaire du Développement de l'Entreprise (IIDE), Haute Ecole d'Ingénierie et de Gestion du Canton de Vaud (HEIG-VD),
Matthieu de Lapparent IIDE, HEIG-VD

While fossil fuels currently dominate the energy landscape, the anticipated widespread transition to electric vehicles (EVs) in the near future introduces challenges related to infrastructure development and changing mobility patterns. This study explores the obstacles and possibilities associated with the increasing use of EVs and the essential charging station infrastructure. In contrast to studies relying on aggregated data, this work emphasizes the significance of analyzing individual user behaviors, trip characteristics, and socio-economic contexts based on microeconomic foundations. In this work, we provide a systematic literature review and reveal four key dimensions within the EV landscape: (i) competition between users and energy providers, (ii) user travel behavior by integrating Discrete Choice Modeling, (iii) trip-chain modeling to understand trip purposes and their relationship to charging station infrastructure, and (iv) optimization of charging station location and allocation to meet user needs. After positioning the existing works in the proposed framework, we finally identify research gaps based on the framework, suggest

potential research directions, and provide a comprehensive view of the evolving EV landscape.

Adrian Meister

Incorporating discrete route choice models into the agent-based simulations

Adrian Meister, Institute for Transport Planning and Systems (IVT), ETH Zurich
Miloš Balać, Center for Sustainable Future Mobility (CSFM), ETH Zurich
Kay W. Axhausen, Institute for Transport Planning and Systems (IVT), ETH Zurich

This paper presents the integration of explicit discrete route choice models into the agent-based simulation framework MATSim, as an example. It represents an obvious research direction, which to the best of the authors' knowledge has not yet been presented for any other agent-based transport simulation framework. Discrete route choice models, estimated from stated- or revealed preference data, are backed by years of research and can be effectively used for prediction. They allow to realistically model heterogeneity using econometric theory, and typically allow for faster model convergence towards user equilibria. We describe the technical integration of such models into MATSim and demonstrate the results using a scenario of Zurich. In a first step, we implement the route choice model only for cycling, but stress that our method is applicable to any non-PT mode.

Fabian Torres

Dynamic programming framework for activity based models

This paper introduces a dynamic programming framework to generate optimal schedules of daily activities in an activity based model. We model the daily choices of activities by individuals as
a resource constrained stochastic shortest path problem, where individuals try to maximize the combined utility of the set of activities performed in a day. The random utilities of each activity are generate through simulation and the resulting deterministic problem is solved with a label orrecting algorithms. We apply decremental state space relaxations (DSSR) to gradually eliminate infeasible cycles between mutually exclusive activities. Our results show that it is feasible to find the optimal solution quickly (i.e., in less than a second per individual) showing the potential to apply our framework to populations with millions of inhabitants.

Keywords: Dynamic programming, Shortest path problem, Activity-based modelling, Discrete choice modelling, Reinforcement Learning.

Session 1C

Widar von Arx

Obstacles to Economic Sustainability of Free-Floating EBike Sharing Systems: A Basel-Based Case Study

Institute of Tourism and Mobility, Lucerne University of Applied Sciences and Arts (HSLU)

This study, focusing on a case study in Basel, aims to provide a better understanding of the factors influencing the financial viability of FF-EBSS, offering strategic insights for optimizing business models and informing policy decisions for sustainable mobility. Leveraging an extensive provider dataset from 2018 to 2023, encompassing over 1 million rentals and 40,000 users, alongside additional weather, spatial, and financial business data, this research uncovers patterns in customer behavior and their implications for profitability.Drawing insights from existing literature, such as Guidon et al. (2019), Meireles et al. (2013), and Chen et al. (2020), we explore the perational challenges in the context of Basel's urban and peri-urban landscape. The study evaluates the comprehensive costs per shared e-bike, addressing the gap identified in the literature egarding provider-side expenses. By integrating provider-side financial data, we evaluate the minimum threshold of rental minutes necessary for profitable operations. Furthermore, we examine the disproportionate impact of a subset of highly active customers on revenue, employing machine learning and regression methods to understand user behavior patterns. The role of seasonality and weather conditions, as discussed in Ji et al. (2014) and Bieliński et al. (2021), is scrutinized to quantify their effect on e-bike sharing demand.

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Michael Stiebe

Comparative Analysis of User Characteristics and Use Patterns in Free-Floating and Station-Based E-Bike Sharing Systems – Insights from the Basel Metropolitan Area

Institute of Tourism and Mobility, Lucerne University of Applied Sciences and Arts (HSLU)

Over recent years, shared micromobility services have gained substantial momentum all around the globe. Along with shared e-scooters, e-bike sharing systems (EBSS) have seen significant growth in various Swiss cities and are assumed to bear great potential as a possible catalyst for
the sustainable multimodal mobility transition in urban and peri-urban contexts (e.g., Julio et al., 2022). While societal and political optimism favoring the promotion of EBSS prevail in most cases, it must not be neglected that there is growing number of studies identifying undesirable public transport substitution effects (Zhou et al., 2023). To date, there some noteworthy international (e.g., Bieliński et al., 2021) and Swiss (e.g., Reck et al., 2021; Hess et al., 2019; Guidon et al., 2019) studies that have explored shared e-bike use patterns and user behavior. Our data-driven analysis adds to the existing body of knowledge and understanding of user characteristics and use dynamics in EBSS by providing a comprehensive comparison of user characteristics and spatiotemporal usage patterns in free-floating and station-based EBSS in the still under-researched Basel metropolitan area. We draw on extensive user and rental datasets from two leading EBSS providers in Basel covering a period of more than four years, one million rentals and 80,000 users.

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Lukas Ballo

Accessibility Effects of the E-Bike City

Institute for Transport Planning and Systems, ETHZ

The E-Bike City project develops a vision of future transport policies based on small vehicles. The plan assumes reallocating a substantial proportion of road space in urban environments from motorized traffic to safe infrastructure for micromobility. A network plan for Zurich, as well as various building blocks of this vision, are being developed in multiple ongoing research projects. In this work, we explore the effects of such a policy direction on structures of accessibility. The emphasis is put on understanding how will the accessibility experienced by different population groups change. We use SNMan (a network redesign tool developed as part of the E-Bike City project) to build variations of the roadnetwork in Zurich. Then, we simulate the traffic flows in MATSim and analyze the resulting accessibility changes. The results are aggregated into several personas representing different population groups. Since no mode choice models exist that can reliably predict the mode shifts after such large changes, we choose a reverse process: We create multiple scenarios with different scaling of a commonly used mode choice model and evaluate the accessibility changes in connection with the assumed scale of mode shift. The presentation will focus on the chosen methodology and the preliminary results.

This research is part of the E-Bike City project, funded by D-BAUG, Swiss Federal Office of Energy, and internal resources of Kay Axhausen’s research group.

Sessions 2: Wednesday, May 15th 2024

Sessions 2				
Chair	Antonin Danalet (SBB)	**Session 2A: Transport policy**		
Room	Auditorium			
No.	**Start**	**End**	**Speaker**	**Title**
2.1	16:10	16:30	Arnor Elvarsson (ETH - IBI)	An early-stage planning support framework for predicting infra-structure development considering uncertainty
2.2	16:30	16:50	Fabrice Marggi (ETH - IBI)	Implementing early-stage highway planning support under un-certainty in Dübendorf-Hinwil considering uncertain land-use and mobility demand
2.3	16:50	17:10	Basil Schmid (UVEK-ARE)	Preferences for transport policy measures in Switzerland
Chair	Selin Ataç (HEIG-VD, HES-SO)	**Session 2B: Models & dynamics**		
Room	Sala Balint			
No.	**Start**	**End**	**Speaker**	**Title**
2.4	16:10	16:30	Pengbo Zhu (EPFL-LUTS)	Dynamic Path Planning of Ride-sharing Vehicles
2.5	16:30	16:50	Charles Corbière (EPFL-VITA)	Taking the Driving Theory Test with Vision-Language Models
2.6	16:50	17:10	Tom Haering (EPFL-TRANSP-OR)	Fast Algorithms for Capacitated Continuous Pricing with Discrete Choice Demand Models
Chair	Matthieu De Lapparent (HEIG-VD, HES-SO)	**Session 2C: Computer vision for transport**		
Room	Sala Eranos			
No.	**Start**	**End**	**Speaker**	**Title**
2.7	16:10	16:30	van Delft Bastien (EPFL-VITA)	Navigating the Unknown: Adaptive Input Enhancement for AI Generalization
2.8	16:30	16:50	Po-Chien Luan (EPFL-VITA)	Bird’s-Eye-View Human Trajectory Prediction from Camera
2.9	16:50	17:10	Reyhaneh Hosseininejad (EPFL-VITA)	Predictive Uncertainty in Human Pose Forecasting

Sessions 2 - abstracts

Session 2A

Arnor Elvarsson

A methodology to identify and assess transport infrastructure development considering land-use uncertainty

Arnor Elvarsson, Fabrice Marggi & Bryan T. Adey, IBI ETH Zurich

This paper presents a methodology to identify and assess transport infrastructure development considering land-use uncertainty, emphasizing the challenges posed by divergent stakeholder views, uncertain assumptions, and the time-consuming consensus-building process. In this paper, the methodology is explained through an example of an algorithm designed to generate potential new highway access points, the associated land use scenarios, and their effects on mobility demand. The mobility demand is dependent on the land use scenario and is allocated to the highway infrastructure using travel-time based Voronoi polygons. The demand defined in an origin-destination matrix is allocated to the highway via its access points, i.e., the Voronoi polygon centroids and can be dynamically reallocated dependent on the proposed development. The generated infrastructure development is then assessed using factors like construction costs, travel time delay, noise externalities, and environmental emissions. This methodology enables planners to prioritize the generated developments at an early stage in the planning process both effectively and efficiently. As a consequence, the planner may allocate resources and facilitate transparent communication to stakeholders in early planning stages. The methodology can be used to help accelerate the early stages of the planning process, reducing iterations and efforts required for consensus among diverse stakeholders. It is expected to enhance the effectiveness and efficiency of transport infrastructure planning in anticipation of evolving societal needs.

Fabrice Marggi

Implementing early-stage highway planning support under uncertainty in Dübendorf-Hinwil considering uncertain land-use and mobility demand

Fabrice Marggi, Arnor Elvarsson & Bryan T. Adey, IBI ETH Zurich

This paper identifies potential for more efficient and effective infrastructure planning, emphasizing foresight in accommodating societal changes. It showcases an implementation for a novel ex-ante framework for generating and assessing infrastructure developments, focusing on their impact on stakeholder needs and consensus-building. Illustrated through a case study on the Swiss A15 highway corridor, the framework explores a large number of variants within the solution space, enabling evaluation of the variants. The study addresses uncertain land use and mobility scenarios, applying the framework to assess additional highway developments, more specifically, new access points. These are furthermore compared to making no change. The evaluation considers costs and benefits such as construction and maintenance cost, travel time, and environmental factors across the different scenarios. This scalable, open-data-reliant framework empowers regional planners to strategically allocate resources, prioritize areas, and make evidence-based decisions, fostering transparent consensus-building. The results show that the

methodology and framework can be used to streamline early-stage planning, guiding further study of specific variants and facilitating efficient infrastructure improvements.

Basil Schmid

Preferences for transport policy measures in Switzerland

Schmid, Basil (ARE) and Mathys, Nicole (ARE)

As part of the Swiss Mobility and Transport Microcensus (MTMC) 2021, Switzerland's representative travel survey that is conducted every five years, various transportation-related policy measures were investigated. While initial analyses on the priorities of different policy measures (stated ranking) have been published in the MTMC report (BFS and ARE, 2023), this research presents the results of the stated ranking part: individual preferences for different policy bundles for car/motorbike (MIV) and public transportation (PT). The aim is to investigate the public's acceptance for different policy measures, where respondents were asked to trade-off the bundles' characteristics.Multiple variants of mobility pricing were examined, including different infrastructure improvements by using the additional revenues. We show which measures are particularly rejected or approved and how preferences differ for different user-types. Financing and traffic control measures, which ask all users to pay equally regardless of situational bottlenecks or congestion, are rated most negatively, while location and/or time targeted measures are more likely to be supported. While general improvements in PT received the highest level of approval in the MIV experiment, improvements in local and regional PT connections were considered particularly desirable in the PT experiment.

Session 2B

Pengbo Zhu

Dynamic Path Planning of Ride-sharing Vehicles

Urban Transport Systems Laboratory (LUTS), EPFL Pengbo Zhu
Urban Transport Systems Laboratory (LUTS), EPFL, Nikolas Geroliminis

The rapid evolution of urban mobility demands efficient path planning algorithms capable of adapting to dynamically changing environments. This paper introduces an innovative approach to path planning, developing a D* algorithm that not only considers the planned path length in urban landscapes but also incorporates utility values representing dynamic environmental factors, such as traffic conditions and passenger demand in ridesharing taxi routing scenarios. We introduce the concept of node utility, which comprises opportunity utility reflecting high-demand areas, and cost utility indicating areas of potential congestion. This utility is integrated into the D* pathfinding process, thereby allowing real-time adaptation of routes as utility values evolve. We verified the algorithm’s efficacy in dynamically adjusting paths in response to fluctuating urban environments, emphasizing its potential in navigation of on-demand transportation services.

Keywords: Ride-sharing systems; Dynamic Routing Algorithms; Taxi Navigation; Orienteering Problem; A* Algorithm

Charles Corbière

Taking the Driving Theory Test with Vision-Language Models

Charles Corbière, VITA; Simon Roburin, VITA; Alexandre Alahi, VITA

The recent advances in artificial intelligence, driven by the emergence of large language models, have led to the development of powerful multimodal learning, in particular for vision-language models (VLMs). Yet, their potential applications to transport and autonomous driving remain largely unexplored. This work investigates VLMs' ability to pass driving theory exams. First, we introduce DrivingTT, a specialized multi-modal dataset with 3,367 unique driving problems, each featuring a multiple-choice question along with an image, possible answers, and explanations. These data are sourced from French driving theory test websites. Then, we employ LaVIN, a recent parameter-efficient VLM that demonstrated strong performance in multimodal science question answering.
When fine-tuning this model on DrivingTT, preliminary experiments show promising results, achieving 70% accuracy on the DrivingTT test set. While the model slightly falls short of achieving the necessary number of correct answers in test series to pass the driving theory exam, there is clear potential for further development to reach this goal.

Keywords: Autonomous Driving; Vision-Language Models; Multimodal; Deep Learning

Tom Haering

Fast Algorithms for Capacitated Continuous Pricing with Discrete Choice Demand Models

Tom Hearing, ENAC EPFL; Robin Legault, ORC MIT; Fabian Torres, ENAC EPFL ;
Michel Bierlaire, ENAC EPFL

We introduce the Breakpoint Exact Algorithm with Capacities (BEAC), based on the state-of-the-art Breakpoint Exact Algorithm (BEA) to address the choice-based pricing problem (CPP) with capacity constraints, together with the Breakpoint Heuristic Algorithm (BHA) for both uncapacitated and capacitated instances. For capacity management, an approach based on an exogenous priority queue, as well as a supplier-controlled queuing strategy to generate maximal or minimal profit for robust optimization is developed. The BHA leverages a coordinate descent method, which we propose to extend with a dynamic line search (DLS) to escape local optima. Our results show that for the capacitated case, the BEAC reports runtimes up to 20 times faster than the state-of-the-art mixed-integer linear programming (MILP) approach, while the BHA performs from 100 to 5000 times faster than the MILP. For the uncapacitated case, the BHA outspeeds the BEA as well as the current state-of-the-art Branch & Benders Decomposition (B&BD) approach by multiple orders of magnitude, especially for high-dimensional instances. The average gap in optimality between the solution reported by the BHA and the global optimum was less than 0.2%, with the extension via DLS finding the global optimum in all tested instances, albeit at a significant computational cost.

Keywords: discrete choice; pricing; capacity constraints; heuristic, robust optimization

Session 2C

Bastien van Delft

Navigating the Unknown: Adaptive Input Enhancement for AI Generalization

In contemporary research, models excel in addressing specific tasks within well-defined scenarios. Yet, a prevailing challenge is their ability to generalize across out-of-distribution (OoD) samples. This issue, termed OoD generalization is paramount for real-world deployment. Effective response to unfamiliar situations and the ability to derive insights from distorted observations are critical human-like capabilities that models need to embody, especially when interacting with humans in dynamic environments. Current methodologies predominantly tackle OoD generalization at the task-specific level, focusing on enhancing model robustness against OoD samples within particular tasks. Similarly, conventional denoising techniques show efficacy in known corruption scenarios or where paired clean and corrupted data exist. Yet, there is a notable gap in methodologies capable of addressing unknown corruptions comprehensively. Our research aims to redefine the approach to denoising and sample enhancement by mapping OoD samples to a distribution of in-distribution samples, thereby repositioning OoD samples within the training distribution. This task-agnostic strategy allows any pre-trained model to utilize the enhanced input, offering a novel perspective on model robustness against OoD samples by leveraging advanced generative models. Our research target both visual and audio inputs ranging from images to music samples.

Luan Po-Chien

Bird’s-Eye-View Human Trajectory Prediction from Camera

This paper explores the integration of egocentric and bird’s-eye views (BEV) for human trajectory prediction in autonomous driving, addressing the limitations inherent in each approach. While the egocentric view offers an intuitive, cost-effective method using only camera input, it struggles with precise 3D localization and modeling social interactions—key components necessary for effective autonomous navigation. Conversely,BEV provides accurate 3D positioning and enhances social interaction modeling but requires sophisticated technologies such as LiDAR, increasing the complexity and cost. Our research aims to synthesize these perspectives into a unified model that predicts human trajectory directly from RGB images. This approach involves estimating 3D localizations from monocular inputs and projecting future positions, striving to combine the simplicity and cost efficiency of camera-based systems with the accuracy of BEV. Preliminary results demonstrate that our model, Monoloco, can fit the nuScenes-mini dataset effectively, suggesting potential for broader application. Future work will expand experiments to full datasets and compare Monoloco against state-of-the-art (SOTA) models to refine our end-to-end prediction capabilities. This study marks a significant step towards developing a more integrated and efficient strategy for autonomous vehicle navigation in complex environments.

Hosseininejad Reyhaneh

Predictive Uncertainty in Human Pose Forecasting

This paper addresses the effect of multimodality on uncertainty estimation in pose forecasting, a key factor for applications in transportation and autonomous driving. Recent studies have explored aleatoric and epistemic uncertainties in this field but typically assume homoscedasticity, meaning a constant noise level across all pose sequences, and inaccurately use large distances in latent space as indicators of dissimilarity in regression tasks. To overcome these issues, we propose new methods for both aleatoric and epistemic uncertainty by incorporating multimodality. Our approach includes heteroscedasticity, utilizing statistics from the input pose sequences to quantify aleatoric uncertainty more precisely. Additionally, we use nearest neighbors as a more accurate measure of sample similarity, thereby improving the detection of out-of-distribution samples. Preliminary experiments on the Human 3.6m dataset demonstrate that our methods lead to enhanced accuracy and more effective identification of out-of-distribution samples, marking a significant advancement in pose forecasting for transportation and autonomous driving.

Sessions 3: Thursday, May 16th 2024

Sessions 3				
Chair	Ying-Chuan Ni (ETH-IVT-SVT)	**Session 3A: Pedestrians & cyclists**		
Room	Auditorium			
No.	**Start**	**End**	**Speaker**	**Title**
3.1	9:40	10:00	Yasaman Haghighi (EPFL-VITA)	Scene-aware human motion generation
3.2	10:00	10:20	Silvan Zeier (ETH)	Potential and Systematisation of Video based Analysis of Bicycle Conflicts
3.3	10:20	10:40	Livio Hardegger (FHNW)	Integration of S-Pedelecs into the Existing Mobility System: Acceptance of Regulations and Infrastructure from a User-Centered Perspective
3.4	10:40	11:00	Lukas Ballo (ETH-IVT-VPL)	Optimizing bike lane allocation for radical urban space redistribution
Chair	Linghang Sun (ETH-IVT-SVT)	**Session 3B: Vulnerability & dynamics**		
No.	Sala Balint			
Präsentation	**Start**	**End**	**Speaker**	**Title**
3.5	9:40	10:00	Siyu Gao (VU (NL))	Understanding the spatial-temporal dynamic vulnerability for multi-modal transportation networks under extreme weather
3.6	10:00	10:20	Linghang Sun (ETH-IVT-SVT)	The Fragile Nature of Road Transportation Systems
3.7	10:20	10:40	Jacob Trepat (ETH-IVT-TS)	Real-time Mitigation of Power Peaks in Railway Networks using Train Control Measures
3.8	10:40	11:00	Thomas Spanninger (ETH-IVT-TS)	Real-time Information in Public Transport Systems
Chair	Silvio Sticher (HSLU)	**Session 3C: Travel demand**		
Room	Sala Eranos			
No.	**Start**	**End**	**Speaker**	**Title**
3.9	9:40	10:00	Noah Balthasar (HSLU)	The effect of a fare-reduction voucher on pupils mobility behavior: result from a living lab approach
3.10	10:00	10:20	Raphael Hoerler (ZHAW)	How to decrease the need for large and high range battery electric vehicles
3.11	10:20	10:40	Ye Hong (ETH)	Towards realistic individual travel demand synthesis using deep generative networks
3.12	10:40	11:00	Negar Rezvany (EPFL-TRANSP-OR)	Household-level choice-set generation and parameter estimation in activity-based models

Sessions 3 - abstracts

Session 3A

Yasaman Haghighi

Scene-aware human motion generation

Scene-aware human motion generation has various applications in robotics, computer vision, VR/AR, and gaming. A key application in robotics is generating humanoid motions that facilitate movement in the environment. While existing motion generation algorithms can produce realistic motions, they typically lack scene-awareness. This paper presents a novel pipeline for generating scene-aware human motions. Our approach integrates a Visual Language Map (VLMap) with Large Language Models (LLMs) to interpret text commands and determine the necessary actions and interactions. Additionally, we introduce a diffusion-based motion generation algorithm, enhanced with novel loss terms, to ensure that the motions are not only realistic and contextually appropriate but also interactive with the environment.

Silvan Zeier

Potential and Systematisation of Video-based Analysis of Bicycle Conflicts

Silvan Zeier a,b,*, David Zani a, Andrea Uhr b, Dr. Markus Deublein

a) Institute for Construction and Infrastructure Management Department of Civil, Environmental and Geomatic Engineering, ETH
b) Zurich Swiss Council for Accident Prevention, BFU

Road accidents involving bicycles and e-bikes are becoming increasingly common in urban areas. To improve accident prevention, proactive road safety instruments (i.e., conflict analysis) are a promising supplement to the existing reactive road safety instruments. However, current research does not sufficiently account for the particularities (underestimated injury severity based on weight, speed, and collision angle) of road conflicts involving cyclists and e-bike riders in video-based conflict analyses. To further the research on proactive safety instruments, this work develops a systematisation of existing methods for video-based conflict analysis. The systematisation is developed using a video-based conflict analysis. The recordings took place at a critical traffic node in Zurich and the resulting video data was evaluated. Conflict attributes (post-encroachment-time and time-to-collision) are calculated from the extracted trajectories. A risk formula is developed to identify and weight the potentially most relevant conflicts. The conflicts are thus analysed according to traffic mode, type of conflict, and risk, generating an analysis of conflict events at critical traffic nodes that considers the particularities of bicyclists. It is shown that the conflict risks are highest for bicyclists and other vulnerable road users. These results provide an improved understanding of the conflicts and safety, supporting a more proactive approach to increasing road safety. Although the developed systematisation offers an improvement to the state-of-the-art, the collected video data has deficits. The trajectories extracted by the video remain imprecise and often cannot distinguish between the different road users. Based on this, the generation of trajectories should be further developed, and the current results of a conflict analysis should be interpreted with caution. As this work is a first attempt at a risk-based conflict analysis, the methodology should be further evaluated and verified at other urban traffic nodes.

Livio Hardegger

Integration of S-Pedelecs into the Existing Mobility System: Acceptance of Regulations and Infrastructure from a User-Centered Perspective

Livio Hardegger, Michael van Eggermond, Dorothea Schaffner, Nicole Haiderer, Somara Gantenbein

Amid the two-wheeler market's clear trend towards electrification in [1], S-pedelecs are witnessing high growth rates [2]. S-pedelecs have a higher maximum speed of 45 km/h as compared to conventional E-Bikes and present a competitive option for longer trips that are currently undertaken using motorized transport. Nevertheless, the integration of S-pedelecs into existing infrastructure in a safe and accepted manner poses a challenge and different countries have taken a different approach to integrating S-pedelecs in the mobility system. On the one hand, the relatively high differential speed of S-pedelecs versus other forms of active mobility, such as biking and walking, can result in conflicts on cycling facilities and shared sidewalks. On the other hand, it is possible to allow S-pedelecs to share the roadway with vehicular traffic. [3] [4]; yet, sharing the roadway can result in dangerous interactions between S-pedelecs and vehicular traffic. Against this backdrop, the study at hand takes on a user-centered approach to better understand road users' acceptance of different regulations covering the integration of S-pedelecs into the mobility system from the perspective of S-pedelec riders as well as other road users. To this end an online survey (n = 1402) with participants from Germany (n = 455), Austria (n= 470) and Switzerland (n = 477) was conducted. Participants were recruited using an online panel and quota were set to ensure a balance between S-pedelec riders and other road users, varying from car drivers to pedestrians. Participants assessed regulations on three dimensions – acceptance, fairness, and safety – using a 5-point Likert scale. Additionally, respondents rated the likelihood of using an S-pedelec. All ratings were measured for regulations on urban roads, rural roads and regardless of location. Multi-level analyses accounting for repeated measures, revealed a stronger acceptance for the integration of S-pedelecs on dedicated cycling facilities by all road users as compared to all other regulations. Similarly, integrating S-pedelecs on dedicated cycling facilities is perceived as safer and fairer in comparison to all other regulations. Notably, car users exhibited lower acceptance for sharing roads with S-pedelecs, while pedestrians, cyclists, and public transport users displayed reduced acceptance for S-pedelecs on shared sidewalks.Results from this study fill a gap in the existing research and can inform policy makers and planners on the next generation of mobility infrastructure that is accepted, safe and inclusive for S-pedelec riders as well as for other road users. Acknowledgements: This study is part of the D-A-CH Cooperation Transport Infrastructure Research programme 2022: Safe and efficient S-pedelec infrastructure (FO999897373)

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Nina Wiedemann (Presented by Lukas Ballo)

Bike network planning in limited urban space

Nina Wiedemann, Christian Nöbel, Henry Martin, Lukas Ballo, Martin Raubal

The lack of cycling infrastructure in urban environments hinders the adoption of cycling as a viable mode for commuting, despite the evident benefits of (e-)bikes as sustainable, efficient, and health-promoting transportation modes. Bike network planning is a tedious process, relying on heuristic computational methods that frequently overlook the broader implications of introducing new cycling infrastructure, in particular the necessity to repurpose car lanes. In this work, we call for optimizing the trade-off between bike and car networks, effectively pushing for Pareto optimality. This shift in perspective gives rise to a novel linear programming formulation towards optimal bike network allocation. Our experiments on six real urban street networks testify the effectiveness and superiority of this optimization approach compared to heuristic methods. In particular, the framework provides stakeholders with a range of lane reallocation scenarios, illustrating potential bike network enhancements and their implications for car infrastructure. Crucially, our approach is adaptable to various bikeability and car accessibility evaluation criteria, making our tool a highly flexible and scalable resource for urban planning. This paper presents an advanced decision-support framework that can significantly aid urban planners in making informed decisions on cycling infrastructure development.

Session 3B

Siyu Gao

Understanding the spatial-temporal dynamic vulnerability for multi-modal transportation networks under extreme weather

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Urban multi-modal transportation networks, which are vital for socio-economic development and citizens' lives, face vulnerability to extreme weather disruptions. To take efficient measures to cope with the increasing occurrence of extreme weather events in the future, understanding the vulnerability of multi-modal transportations is crucial. Existing studies primarily focus on vehicle roads or rail networks individually, neglecting the interconnected nature of urban multi-modal transportation networks. The latter have an important influence on passenger flow redistribution and may lead to severe cascading failures. Therefore, this study aims to propose a spatial-temporal dynamic vulnerability model for urban multi-modal transportation networks under extreme weather, investigating cascading failures and their societal impact due to disrupted public transportation. The methodology involves generating a baseline multi-modal transport graph from real-world data, simulating geographical and physical interdependencies, and mimicking passenger transfer behaviors. This forms the foundation of the urban multi-modal transportation model. Subsequently, hourly passenger flow redistributions under normal and extreme weather conditions are examined

to identify system failures. Parameters such as travel time, passenger capacity, and network integrity are then analyzed to assess the spatial temporal dynamic vulnerability of multi-modal transportation networks.

Sun Linghang

The Fragile Nature of Road Transportation Systems

Linghang Sun, Yifan Zhang, Cristian Axenie, Margherita Grossi, Anastasios Kouvelas, Michail A. Makridis

Abstract: Major cities worldwide experience problems with the performance of their road transportation systems. The continuous increase in traffic demand presents a substantial challenge to the optimal operation of urban road networks and the efficiency of their traffic control strategies. Although robust and resilient transportation systems have been extensively researched over the past decades, their performance under an ever-growing demand can still be questionable. Meanwhile, the operation of road transport systems is widely believed to display fragile properties, i.e. the loss in performance increases exponentially with the linearly increasing magnitude of disruptions, which undermines their continuous operation. The risk engineering community is embracing the novel concept of (anti-)fragility, which enables fragile systems to learn from historical disruptions and exhibit improved performance as disruption levels grow. In this work, we demonstrate the fragile property of road transportation systems using mathematical analysis for theoretical proof and stochastic numerical simulation for demonstration purposes. The work aims to help researchers better comprehend the necessity to explicitly consider antifragile design toward the application of antifragile traffic control strategies in the future, coping with constantly growing traffic demand and subsequent traffic accidents.

Jacob Trepat Borecka

A Simulation-based Local Search Algorithm for Real-time Mitigation of Power Peaks in Railway Networks

Jacob Trepat Borecka IVT, ETH Zürich, Daniel Regueiro Sánchez IVT, ETH Zürich, Francesco Corman IVT, ETH Zürich, Nikola Bešinović, TU Dresden

Power peaks are an undesirable phenomenon occurring in railway networks when multiple electric trains require large amounts of power simultaneously, for instance, during acceleration. This phenomena puts too much pressure on the power grid, which in the worst cases it can result into a blackout, and hence it represents a relevant concern for operators. One solution for this is fine-tuning of timetables to minimize power peaks. Nevertheless, the benefits of adjusted timetables can be lost in situations with train delays in the network. In this paper, we develop a simulation-based optimization approach to mitigate anticipated power peaks in real-time by means of train control measures, i.e. traction power limitation and departure time shift, combined with real-time rescheduling. To do this, we propose a discrete-event simulation model for real-time traffic management in railways and heuristic algorithms to solve the problem in a very short computational time. We use precomputed train trajectories and power consumption profiles. We demonstrate the performance of the approach developed in a real-life case in a part of the Swiss Federal Railways network.

Keywords: Power peaks, rail traffic management, railway simulation, train control, mixed-integer linear programming

Thomas Spanninger

Real-time Information in Public Transport Systems

Thomas Spanninger, Institute of Transport Planning and Systems ETH
Alessio Daniele Marra, Institute of Transport Planning and Systems ETH
Francesco Corman, Institute of Transport Planning and Systems ETH

Real-Time Information (RTI) systems play a crucial role in managing disturbances within public transport systems. Smartphone applications, in particular, have emerged as a prevalent channel for conveying information to passengers. A lot of studies focus on the impact of RTI systems mostly by simulating the adaptive behavior of passengers. However, there remains a significant gap in understanding the quality of real-time information in public transport systems in terms of accuracy and timeliness. This study introduces a methodological framework and a series of metrics for evaluating text-based RTI systems by comparing the alerts issued to passengers with the actual disturbances recorded in the network, as captured by Automatic Vehicle Location (AVL) data. A focused case study on Zurich's RTI system is conducted to assess its quality. The findings indicate that the system achieves a high accuracy in delivering information, although it reports only a limited fraction of disturbances. Based on these outcomes, the paper offers strategic recommendations for enhancing RTI system in public transport systems.

Keywords: Public Transport, Real-Time Information, Disruption, AVL data

Session 3C

Noah Balthasar

The effect of a fare-reduction voucher on pupils mobility behavior: result from a living lab approach

Noah Balthasar, Mobility Competence Centre, Lucerne University of Applied Sciences & Arts
Prof. Dr. Timo Ohnmacht, Mobility Competence Centre, Lucerne University of Applied Sciences & Arts
David Walter, City Of Lucerne - Mobility

The city of Lucerne serves as an open-space Living Lab for mobility-interventions. As a timely-limited intervention the city of Lucerne provides their pupils reduction vouchers for public transport stimulated by a participatory process rooted in the "children's & youth parliament". Our research examines how this intervention is linked to the living lab (LL) methodology and shows first results how the provision of vouchers changes the travel behavior of young children in the age from 6 to 16. The survey-waves were carried out in the years 2023 and 2024. The paper will present first empirical results from the first and second wave. First longitudinal analysis of the data will be presented that analyses the mobility behaviour before and after the intervention. Based on the results of this study, decisions will be made as to whether the public transport subsidy should be introduced or whether adjustments of the vouchers are necessary. From a policy dimension, we will reflect on the efficiency of this intervention regarding energy consumption in the mobility domain.

Raphael Hoerler

How to increase the willingness to buy small and low-range battery electric vehicles

Raphael Hoerler, ZHAW Institute for Sustainable Development

More than half of new vehicle registrations are categorized as a large car in many countries and people still expect battery electric vehicles (BEV) to perform similar to conventional cars regarding driving range. Yet, smaller cars with a smaller battery would be sufficient for typical daily distances and could reduce greenhouse gas emissions, consumption of raw materials and pedestrian fatalities. I applied a within- and between-subject design study with 1000 participants from the German- and French-speaking population of Switzerland, testing the provision of information, charging station availability and carsharing availability on the potential to influence participants' vehicle choice preference. Results suggest that providing charging stations at home in combination of information about typical travel needs could be a promising lever to increase the switch from conventional cars and high range BEVs to lower range BEVs. The results are relevant for transport planners and politicians in designing efficient strategies to decrease the trend towards increasing size and range requirements for BEVs.

Hong Ye

Towards realistic individual travel demand synthesis using deep generative networks

Ye Hong, Institute of Cartography and Geoinformation, ETH Zurich
Yatao Zhang, Future Resilient Systems, Singapore-ETH Centre
Martin Raubal, Institute of Cartography and Geoinformation, ETH Zurich

Traffic modeling and transport planning applications increasingly require a pipeline for synthesizing individual travel demands, including daily activity patterns and their location realizations. Unfortunately, the capacity to generate realistic location sequences is still constrained by the vast option space and the flexibility in choosing an activity location. Traditional demand synthesis pipelines typically use the space-time prism approach, sampling locations from a constrained candidate location set, resulting in oversimplified location patterns. Deep generative models, such as GANs and diffusion networks, have shown their potential, mostly on small-scale datasets and without considering the interdependence between multifaceted travel behaviors. Here, we employ state-of-the-art deep generative networks on individual GNSS tracking datasets to simulate individual travel demand at a large scale, which adheres to location visit patterns for individuals and satisfies activity parameter distributions at the population level. We also demonstrate that the network can obtain realistic activity-location sequences by incorporating various dimensions of travel behavior. The presented approach introduces new possibilities for activity sequence generation and holds the potential for integration with other steps in the demand generation pipeline, such as population synthesis. Additionally, realistic spatiotemporal trajectories can be applied in related fields requiring knowledge of individual movements.

Keywords: Travel demand, Activity-location, Human mobility, Deep learning, Generative model, Sequence generation

Negar Rezvany

Household-level choice-set generation and parameter estimation in activity-based models

Transport and Mobility Laboratory (TRANSPOR), École Polytechnique Fédérale de Lausanne (EPFL)
Tim Hillel, Department of Civil, Environmental and Geomatic Engineering University College London (UCL), United Kingdom
Michel Bierlaire, Transport and Mobility Laboratory (TRANSPOR) École Polytechnique Fédérale de Lausanne (EPFL)

Traditional Activity-based models (ABMs) treat individuals as isolated entities, limiting behavioural representation. Econometric ABMs assume agents schedule activities to maximise utility, explained through discrete choices. Using discrete choice models implies the need for calibration of maximum likelihood estimators of the parameters of the utility functions. However, classical data sources like travel diaries only contain chosen alternatives, not the full choice set, making parameter estimation challenging due to unobservable, and combinatorial activity spatio-temporal sequence. To address this, we propose a choice set generation framework for household activity scheduling, to estimate
significant and meaningful parameters. Our methodology adopts a Metropolis-Hastings sampling approach, and extends this approach to encompass parallel generation for all household agents, household-level choices, and time arrangements. Utilising this approach, we then estimate the parameters of a household-level scheduling model presented in (Rezvany et al., 2023). This approach aims to generate behaviourally sensible parameter estimates, enhancing the model realism in capturing household dynamics.

Keywords: Activity-based modelling, Choice-set generation, Discrete choice modelling, Intra-household interactions.

References

Rezvany, N., M. Bierlaire and T. Hillel (2023) Simulating intra-household interactions for in- and out-of-home activity scheduling, Transp. Res. Part C Emerg. Technol., 157.

Sessions 4: Thursday, May 16th 2024

Sessions 4				
Chair	Lynn Fayed (EPFL-LUTS)	**Session 4A: Planning of transit operations**		
Room	Auditorium			
No.	**Start**	**End**	**Speaker**	**Title**
4.1	11:30	11:50	Florian Fuchs (ETH-IVT-TS)	Efficient Railway Timetabling and Vehicle Circulation: A Novel SMT Framework Application
4.2	11:50	12:10	Zhenyu Yang (EPFL-LUTS)	Modelling and optimization of flexible users in large-scale rideshar-ing systems
4.3	12:10	12:30	Viera Klasovità (ETH-IVT-TS)	Including Uncertainties in Line Planning
Chair	Evangelos Paschalidis (EPFL-TRANSP-OR)	**Session 4B: Urban traffic simulation**		
Room	Sala Balint			
No.	**Start**	**End**	**Speaker**	**Title**
4.4	11:30	11:50	Ying-Chuan Ni (ETH-IVT-SVT)	A New Link-level Urban Traffic Modeling Paradigm based on Corridor Macroscopic Fundamental Diagram
4.5	11:50	12:10	Michael Nold (ETH-IVT-TS)	Calibration of vehicle simulations by using acceleration sensors
4.6	12:10	12:30	Weijiang Xiong (EPFL-LUTS)	Multi-Source Urban Traffic Prediction using Drone and Loop Detec-tor Data
Chair	Nicola Ortelli (EPFL-TRANSP-OR)	**Session 4C: Trajectories**		
Room	Sala Eranos			
No.	**Start**	**End**	**Speaker**	**Title**
4.7	11:30	11:50	Saeed Saadatnejad (EPFL-VITA)	JRDB-Traj: A Dataset and Benchmark for Trajectory Forecasting in Crowds
4.8	11:50	12:10	Yfan Zhang (ETH-IVT-SVT)	A Time-varying Shockwave Speed Model for Trajectory Reconstruc-tion using Lagrangian and Eulerian Observations
4.9	12:10	12:30	Messaoud Kaouther (EPFL-VITA)	Manipulating Trajectory Prediction with Backdoors

Sessions 4 - abstracts

Session 4A

Florian Fuchs

Efficient Railway Timetabling and Vehicle Circulation: A Novel SMT Framework Application

Florian Fuchs, Florin Leutwiler, Francesco Corman

This paper examines the optimization of the Periodic Timetabling Problem (PESP) and Vehicle Circulation through a novel Satisfiability Modulo Theories (SMT) approach, applied to the Rhätische Bahn Network (RhB-Network). Like traditional Mixed Integer Programming (MIP), our methodology utilizes the Event Activity Network (EAN) to model railway timetable events and activities. However, our approach encodes the PESP and vehicle circulation constraints within an SMT framework, extending SAT with difference logic. This extension allows for high-resolution time calculations, addressing the scalability limitations of existing SAT methods. Furthermore, we introduce the concept of selectable activities, enhancing the model's capability to incorporate vehicle circulation effectively during train scheduling and routing. Empirical analysis on the RhB Network reveals that although MIP and SMT solvers show comparable performance on smaller instances, the SMT solver significantly outperforms on larger scales, consistently finding optimal solutions. This study underscores the potential of SMT-based methods for complex scheduling problems, offering significant advancements in public transport optimization.

Zhenyu Yang

Modelling and optimization of flexible users in large-scale ridesharing systems

Patrick Stokkink, Zhenyu Yang, Nikolas Geroliminis, LUTS EPFL

The performance of ridesharing systems is intricately entwined with user participation. To characterize such interplay, we adopt a repeated multi-player, non-cooperative game approach to model a ridesharing platform and its users' decision-making. Users reveal to the platform their participation preferences over being only riders, only drivers, flexible users, and opt-out based on the utilities of each mode. The platform optimally matches users with different itineraries and participation preferences to maximize social welfare. We analytically establish the existence of equilibria and design an iterative algorithm for the solution. A case study is conducted with real travel demand data in Chicago. The results highlight the effect of users' flexibility regarding mode preferences on system performance. A sensitivity analysis of the participation level of users underscores the effect of economies of scale in such systems, emphasizing the pivotal mode of user participation in system efficiency.

Viera Klasovità

Including Uncertainties in Line Planning

Viera Klasovità, Francesco Corman

This paper examines some important aspects of uncertainties in the line planning problem and in timetabling within the context of public transport. A literature review considers various methods for modelling the problem and associated uncertainties. These models range from (light) robustness to stochastic programming, e.g. 2-stage models, for stochastic parameters. In addition, the paper explores various solution strategies that have been applied to address uncertainties in line planning and related problems. The synthesis of the different literature papers shows which uncertainties are usually considered, which seem to be omitted, and different ways of modelling them. Moreover, it also reveals variations in terminology across different papers, highlighting the complexities researchers face.

Session 4B

Ying-Chuan Ni

A New Link-level Urban Traffic Modeling Paradigm based on Corridor Macroscopic Fundamental Diagram

Ying-Chuan Ni, Anastasios Kouvelas, Michail A. Makridis
Institute for Transport Planning and Systems (IVT), ETH Zurich

An efficient and accurate dynamic traffic model which can reproduce the congestion propagation within an urban road network is required to assess the effect of different traffic management strategies. This paper proposes a link-level traffic flow modeling paradigm based on interrupted flow fundamental diagrams, which describes the relationship between flow, mean speed, and density on an urban link for each path. With the link traffic dynamics depicted by FDs, signal timing information does not need to be modeled explicitly. The adopted path-based approach and event-based resolution scheme ensures first-in-first-out at intersections for multi-commodity flow in congested situations with spillback. We test the model in scenarios with different network layouts and path compositions. The performance of the model is also compared with the store-and-forward models. The outcomes show a high level of compliance with the results computed from SUMO. It is anticipated that the model can be integrated into model-based optimization or control problems in an urban network.

Michael Nold

Fast calibration of dynamic and energy parameters of railway vehicles using acceleration sensors

Michael Nold, Francesco Corman, IVT ETH Zurich

In recent decades, vehicle simulations have become widespread in science and industry. The usability of simulations depends on the model, the implementation and the correct parameters. Therefore, determining realistic parameters is often a challenge. This paper aims to describe a process to determine parameters of dynamic and energy, for railway vehicles, based on data from acceleration sensor, speed and power. The approach enables accurate parameter estimation within a few minutes of data collected.

Weijiang Xiong

Multi-Source Urban Traffic Prediction using Drone and Loop Detector Data

Traffic forecasting has been a fundamental task in transportation research, with many methods and datasets mainly based on highway loop detector data. In recent years, drones are becoming a favorable choice for urban traffic monitoring, due to their flexibility, high data quality and larger spatial coverage. However, the lack of public datasets has made the joint use of drone and loop detector data fairly under-explored. Therefore, we create a novel simulated multi-source dataset SimBarca for urban traffic prediction, featuring speed measurements from both drones and loop detectors. We provide a graph-based model HiMSNet to handle multiple input modalities and evaluate it along with other basic benchmark predictors. Our analysis shows that HiMSNet achieves good performance for regional speed prediction, but the road segment-level prediction still requires more in-depth efforts.

Session 4C

Saeed Saadatnejad

JRDB-Traj: A Dataset and Benchmark for Trajectory Forecasting in Crowds

Saeed Saadatnejad & Yang Gao & Alexandre Alahi, VITA EPFL, Hamid Rezatofighi, VL4AI Monash

Predicting future trajectories is critical in autonomous navigation, especially in preventing accidents involving humans, where a predictive agent's ability to anticipate in advance is of utmost importance. Trajectory forecasting models, employed in fields such as robotics, autonomous vehicles, and navigation, face challenges in real-world scenarios, often due to the isolation of model components. To address this, we introduce a novel dataset for end-to-end trajectory forecasting, facilitating the evaluation of models in scenarios involving less-than-ideal preceding modules such as tracking. This dataset, an extension of the JRDB dataset, provides comprehensive data, including the locations of all agents, scene images, and point clouds, all from the robot's perspective. The objective is to predict the future positions of agents relative to the robot using raw sensory input data. It bridges the gap between isolated models and practical applications, promoting a deeper understanding of navigation dynamics. Additionally, we introduce a novel metric for as-

sessing trajectory forecasting models in real-world scenarios where ground-truth identities are inaccessible, addressing issues related to undetected or over-detected agents. Finally, we propose a transformer-based model performing better that state-of-the-art. The code and the
benchmark are publicly available.

Keywords: Attention Mechanism; Trajectory Forecasting; Autonomous Driving; Crowd Navigation

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Yifan Zhang

A Time-varying Shockwave Speed Model for Trajectory Reconstruction using Lagrangian and Eulerian Observations

Yifan Zhang, Anastasios Kouvelas, Michail A. Makridis
Institute for Transport Planning and Systems (IVT), ETH Zurich

Inference of detailed vehicle trajectories is crucial for applications such as traffic flow modeling, energy consumption estimation, and traffic flow optimization. Static sensors can provide only aggregated information, posing challenges in reconstructing individual vehicle trajectories. Shockwave theory is used to reproduce oscillations that occur between sensors. However, as the emerging of connected vehicles grows, probe data offers significant opportunities for more precise trajectory reconstruction. Existing methods rely on Eulerian observations (e.g., data from static sensors) and Lagrangian observations (e.g., data from probe vehicles) incorporating shockwave theory and car-following modeling. Despite these advancements, a prevalent issue lies in the static assignment of shockwave speed, which may not be able to reflect the traffic oscillations in a short time period caused by varying response times and vehicle dynamics. Moreover, energy consumption estimation is largely ignored. In response, this paper proposes a novel framework that integrates Eulerian and Lagrangian observations for trajectory reconstruction. The approach introduces a calibration algorithm for time-varying shockwave speed. The calibrated shockwave speed of the CV is then utilized for trajectory reconstruction of other non-connected vehicles based on shockwave theory. Additionally, vehicle and driver dynamics are introduced to optimize the trajectory and estimate energy consumption by applying a vehicle movement model.

Kaouther Messaoud

Manipulating Trajectory Prediction with Backdoors

Kaouther Messaoud, Kathrin Gross, Alexandre Alahi, EPFL

Autonomous vehicles ought to predict the surrounding agents' trajectories to allow safe maneuvers in uncertain and complex traffic situations. As companies increasingly apply trajectory prediction in the real world, security becomes a relevant concern. In this paper, we focus on backdoors - a security threat acknowledged in other fields but so far overlooked for trajectory prediction. To this end, we describe and investigate four triggers that could affect trajectory prediction. We then show that these triggers (for example, a braking vehicle), when correlated with a desired output (for example, a curve) during training, cause the desired output of a state-of-the-art trajectory prediction model. In other words, the model has good benign performance but is vulnerable to backdoors. This is the case even if the trigger maneuver is performed by a non-casual agent behind the target vehicle. As a side-effect, our analysis reveals interesting limitations within trajectory prediction models. Finally, we evaluate a range of defenses against backdoors. We find that neither offroad detection nor masking nor clustering beat manual inspection of random samples within the data.

Sessions 5: Thursday, May 16th 2024

Sessions 5				
Chair	Hannes Wallimann (HSLU)	**Session 5A: Pricing**		
Room	Auditorium			
No.	**Start**	**End**	**Speaker**	**Title**
5.1	15:40	16:00	Matthias Bruening (UNISG)	Willingness-to-pay for micromobility and public transport bundles
5.2	16:00	16:20	Silvio Sticher (HSLU)	Public-Transportation Credits: The Potential of Three-Part Tariffs in Public Transportation
5.3	16:20	16:40	Antonin Danalet (SBB)	Agent-based simulation of peak pricing in Switzerland
Chair	Mariana A. Costa (ETH-IVT-TS)	**Session 5B: Rationality & uncertainty**		
Room	Sala Balint			
No.	**Start**	**End**	**Speaker**	**Title**
5.4	15:40	16:00	Mariana A. Costa (ETH-IVT-TS)	How Rational are Travellers in Zurich? Exploring Trips from a Shortest Path Perspective
5.5	16:00	16:20	Hossein R. Farahani (EPFL-HOMES)	Multi-hop Control Scheme for Urban Traffic Congestion Mitigation with Non-Compliant Users
5.6	16:20	16:40	Jan Lordieck (ETH-IVT-TS)	A Railway System in the Multidimensional State Space – Applications of Empirical Dynamic Modelling
Chair	Michael van Eggermond (FHNW)	**Session 5C: Optimizing on-demand transport**		
Room	Sala Eranos			
No.	**Start**	**End**	**Speaker**	**Title**
5.7	15:40	16:00	Minru Wang (EPFL-LUTS)	Dynamic Ride-Sourcing Optimization through Spatially Aggregated Flow Maximization
5.8	16:00	16:20	Bernardo Martin-Iradi (ETH-IVT-TS)	Dynamic capacity planning for demand-responsive multimodal transit
5.9	16:20	16:40	Raphael Ancel (UVEK-ARE)	Who owns Light Commercial Vehicles? An empirical analysis in Switzerland

Sessions 5 - abstracts

Session 5A

Matthias Bruening

Seamless Intermodality: Exploring Consumer Preferences for Public Transport and Shared Micromobility Bundles

Matthias Bruening, University of St. Gallen

Shared micromobility services, encompassing (e-)bike and e-scooter sharing, have a controversial space within urban mobility. While possessing the potential to reduce individual car usage, particularly as first/last mile solutions complementing public transport, they also pose a competitive challenge to the latter. Despite this inherent synergy, efforts to integrate ticketing systems and incentivize intermodal travel have been scarce. While a few studies have investigated the willingness to pay (WTP) for micromobility as a part of larger Mobility-as-a-Service (MaaS) bundles, little is known about preferences for different types of bundles. Addressing this gap, this study explores preferences for different bundle configurations combining micromobility and public transportation. A stated choice experiment was conducted with Swiss residents (n = 1,379) to compare market potential for three types of bundled subscriptions: 1) Flat rate offerings 2) a 50% discount pass and 3) minute packages. Additionally, bundles tailored for single journeys are
investigated. A flexible mixed-logit model is used to analyze the impact of demographic factors and experience with micromobility on the willingness to buy the bundles. A flexible mixed-logit model analyzes the influence of demographic factors and prior micromobility experience on bundle purchase willingness. The results demonstrate substantial interest in both subscription and single-ride bundles, particularly when offered at discounted rates. Particular interest was found for the single-ride bundle during nighttime. These results can help practitioners to design attractive offers for their customers.

Keywords: micromobility, stated choice, bundling, consumer preferences

Silvio Sticher

Public-Transportation Credits: The Potential of Three-Part Tariffs in Public Transportation

Silvio Sticher and Kevin Blättler, University of Applied Sciences and Arts Lucerne, Institute of Tourism and Mobility

Abstract: In December 2023, public-transportation providers in Switzerland introduce Public Transportation Credits (PTCs). PTCs are credits (or "allowances") that are greater in amount than their price and can be used to purchase any type of public-transportation tickets within a year. With the initial fixed payment, the subsequent use of the allowance and the eventual return to the standard fare, PTCs represent three-part tariff models. We explore the potential of PTCs to target particularly elastic segments of the demand curve, simultaneously allowing for increased consumption and higher revenue. To assess the revenue impact of the PTC empirically, we analyze a pilot study conducted by the Swiss public-transportation providers. In a randomized field experiment with 200,000 PTC invitees and 911 actual PTC buyers, we use the dispatch of invitations as an instrumental variable. While observing substantial revenue increases, this result is insignificant due to the weak relationship between invitees and buyers. Therefore, we complement our analysis with a selection-on-observable approach, utilizing machine-learning techniques to match PTC buyers to customers in the control group. This way, we reveal a highly significant treatment effect, indicating a revenue enhancement of CHF 179.7 per PTC (approximately USD 200). Leveraging our comprehensive dataset and insights from a non-buyer survey, we predict a demand of around 200,000 units for the market-launch version of the PTC.

Keywords: randomized field experiment, public transportation, price elasticity, revenue management, three-part tariff.

Acknowledgments: We gratefully acknowledge the support of the Swiss Federal Railways (SBB). In particular, we would like to express our appreciation to Sascha Venosta, Reto Luescher, Ruediger Baessler, and Samuel Frei for their enduring assistance.

Antonin Danalet

Agent-based simulation of peak pricing in Switzerland

Antonin Danalet, Joschka Bischoff, Annick Noll, David Seematter, Julien Heckly, Patrick Bützberger

The Swiss public transport system has an open fare system: A single ticket can be used on any train during the day. Most distances are made with a travelcard. In this context, it is difficult to steer demand out of the peak hour. "Mobility pricing", as known in Switzerland, consists in a peak hour surcharge both for trips by car and by public transport (PT), together with a discount outside peak hours for PT trips. In this paper, we present the results of simulation experiments of Mobility Pricing on the corridor between Luzern and Zurich (1) only for long-distance trains and (2) for both car and long-distance trains.The simulations ran in SIMBA MOBi, SBB's agent-based simulation model. It uses MATSim for route choice, mode choice, mode choice for rail access, departure time choice, activity duration and traffic flow simulation for car and public transport. These simulations show the influence of time-differentiated fares on the utilisation of trains and the modal split. We observe lower load

factors on trains during peak hour. We conclude that (1) road should also be priced, to avoid losing train passengers, and (2) regional trains should also be priced.

Session 5B

Mariana A. Costa

How Rational are Travellers in Zurich? Exploring Trips from a Shortest Path Perspective

Mariana A. Costa & Francesco Corman, IVT ETH Zürich

This paper uses unlabelled GPS tracking data, enriched by fusion with Automatic Vehicle Location (AVL) data, to assess the rationality of individuals' travel choices in the city of Zurich, Switzerland. By examining thousands of public transport journeys, we introduce trip metrics normalized by the respective shortest path, providing an intuitive method to compare trips across diverse users and attributes. According to the patterns encountered, we further classify trips into five distinct groups: i) the 'as fast as possible'; ii) too early or too late for connections; iii) walking-prone; iv) sitting-prone; v) do not mind a bit of walking. By employing a tree-boosting algorithm, we demonstrate that a statistical model can learn to distinguish well between the five groups of trips. The findings suggest that our approach is promising for aiding planners in optimizing routes and schedules
to enhance efficiency and meet passenger demand. This research also provides valuable insights into user behaviour by showing that individuals exhibit a mix of different trip patterns, rather than a single predominant behaviour, when choosing their trips. These insights on individual behaviour heterogeneity can contribute to data-driven improvements in public transportation systems.

Keywords: GPS Tracking data, Public Transport, Route Choice, Shortest Path, Rationality of Travellers, Trip Clustering, Behavioural Patterns

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Hossein Farahani

Multi-hop Control Scheme for Urban Traffic Congestion Mitigation with Non-Compliant Users

Hossein R. Farahani, Postdoctoral Researcher, EPFL
Kenan Zhang, Professor, EPFL

Traffic congestion has negative impacts on both the individual and social aspects of urban life. The multi-hop control scheme (MHCS), which recommends users pass through some intermediate checkpoints (ICs), has shown great potential in alleviating network congestion and enhancing network efficiency. While MHCS enables users to travel through the shortest routes between ICs and thus induces lower unfairness compared to other route control schemes, it cannot prevent non-compliant behaviors of selfish travelers. This study aims to shed light on the impacts of such behavior on the performance of MHCS. We relax the assumption of full compliance by adding a set of constraints to the original MHCS problem that define the non-compliance ratio. The numerical results suggest that, despite the overall negative effect of non-compliance, the ultimate system performance is largely related to the design of ICs. It was also found that enforcing full compliance over all travelers may not be worth the total travel time savings in consideration of the trade-off between fairness and efficiency.

Keywords: Multi-hop control scheme, System optimum, Traffic Management, User compliance, User Equilibrium

Jan Lordieck

Causal Inference for Railway Systems with Empirical Dynamic Modelling

Jan Lordieck, IVT ETH Zurich

Railways are human-made engineering systems which operate often after a carefully designed periodic timetable. Single trains are scheduled periodically and their movement can be represented by simple equations of motion. However, multiple trains interacting in a network form a complex dynamic system which behavior is hard to predict and to control. Modelling approaches for different purposes on the microscopic scale exist, but are very resourceintensive. Recently some papers model the railway system as complex systems and thereby reduce resource requirements while still retrieving useful results e.g. for delay prediction. This work aims on extending this approach and modelling railway systems as state-space models to better understand the system's dynamics for derivation of better control strategies without relying on resource intensive, microscopic models. Therefore, methods from empirical dynamic modelling, e.g. cross-convergent-mapping are applied to a case study to investigate if railway system behave non-linear during out of timetable operation while still identifying relevant causal relationships between different system elements for derivation of control strategies. Nonlinear behavior is thereby associated with unexpected causal relationships between different system state variables with varying influencing lags and strengths. Early results show that causality between different system elements can be established with cross-convergent-mapping thus pointing to non-linear relationships in the system.

Session 5C

Minru Wang

Dynamic Ride-Sourcing Optimization through Spatially Aggregated Flow Maximization

Minru Wang, Nikolas Geroliminis, LUTS EPFL

This paper proposes a flow maximization model for the operation of a ride-sourcing platform, where the operator dynamically optimizes the number of matched trips for spatially aggregated demand data. To accomplish this, we construct a data preprocessing pipeline to predict the ealtime service capacity for matching two types of trips, namely solo trips which serve one trip request at a time, and pool trips which simultaneously serve two requests that are close to each other. The service capacity estimation is achieved through sampling techniques that account for service characteristics including waiting time, detour, and traffic conditions characterized by average network travel speed. By testing the framework in a case study of simulated taxi data in Shenzhen, China, we show that while spatial demand clustering is capable of estimating matching capacity to a certain extent, to achieve more realistic and accurate capacity prediction, the operator must leverage information on the network geometry to provide appropriate matching suggestions.

Bernardo Martin-Iradi

Dynamic capacity planning for demand-responsive multimodal transit

Bernardo Martin-Iradi, Francesco Corman, Institute for Transport Planning and Systems, ETH Zurich

Demand-responsive multimodal transit offers opportunities to complement existing public transport systems and provide an overall better service level to passengers while at the same time making better use of the resources. This study optimizes the capacity of such system by strategically sizing the required fleet and allocating it to the operating services. We formulate a two-stage stochastic optimization model that plans the transit system and the required fleet in the first stage, and optimizes the demand-responsive operations in the second stage. We develop a decomposition-based method that exploits the network-based formulation of the second stage, allowing us to solve practical instances. Preliminary results from a case study in the city of Zurich show that designing a public transport system together with demand-responsive mobility systems can benefit both transport operators and passengers. By allocating the system capacity more efficiently, operators reduce operational costs while maintaining or improving the travel experience for passengers.

Keywords: Public transport, On-demand mobility, Stochastic optimization

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Raphaël Ancel

Who owns Light Commercial Vehicles? An empirical analysis in Switzerland

Swiss Federal Office for Spatial Development (ARE)

The number of Light Commercial Vehicles (LCV) in Switzerland increases faster than any other type of vehicle. Despite a growing interest from public authorities, we still know relatively little regarding their actual use. In this study, we matched the national vehicle register with the national business register in order to identify the NOGA branches of the companies owning LCVs. As register matching is highly regulated, this is the first time that such results are published in Switzerland. The paper presents the methodology used for matching (there is no common unique identifier) and provides results aggregated at the first NOGA level. The resulting distribution of vehicles across branches significantly differs from previous survey-based estimates. We also provide some statistics about the vehicle purposes and average daily distance traveled per branch, based on the national LCV survey. These statistics are crucial to better understand the road traffic generated by the economic activity and represent key inputs for the Swiss LCV traffic model.

Sessions 6: Thursday, May 16th 2024

Sessions 6				
Chair	Thomas Spanninger (ETH-IVT-TS)	**Session 6A: Improving on-demand transport**		
Room	Auditorium			
No.	**Start**	**End**	**Speaker**	**Title**
6.1	17:10	17:30	Rui Yao (EPFL-HOMES)	How would mobility-as-a-service (MaaS) platform survive as an intermediary? From the viewpoint of stability in many-to-many matching
6.2	17:30	17:50	Marko Maljkovic (EPFL-LUTS)	A Blotto Game Approach to Ride-hailing Markets with Electric Vehicles
6.3	17:50	18:10	Lynn Fayed (EPFL-LUTS)	On the effect of batching for on-demand high-capacity micro-transit services
Chair	Bernardo Martin-Iradi (ETH-IVT-TS)	**Session 6B: Behaviour change**		
Room	Sala Balint			
No.	**Start**	**End**	**Speaker**	**Title**
6.4	17:10	17:30	Yura Tak (EPFL-LUTS)	Deep Learning-based Visual Vehicle Re-identification - Using Spatio-Temporal Information in Urban Traffic
6.5	17:30	17:50	Kevin Blättler (HSLU)	Does a free arrival and departure offer for tourists lead to a mode shift towards public transport?
6.6	17:50	18:10	Yasamin Borhani (EPFL-VITA)	OpenPifPaf++: Towards a Unified Framework for Multi-Category Pose Estimation
Chair	Charles Corbière (EPFL-VITA)	**Session 6C: Deep-learning**		
Room	Sala Eranos			
No.	**Start**	**End**	**Speaker**	**Title**
6.7	17:10	17:30	Mohamed Abdelfattah (EPFL-VITA)	S-JEPA: Skeleton Joint Embedding Predictive Architecture for Self-supervised Action Recognition
6.8	17:30	17:50	Shaimaa ElBaklish (ETH-IVT-SVT)	A Variable Time Gap Feedback Policy for String Stable Adaptive Cruise Control
6.9	17:50	18:10	Marija Kukic (EPFL-TRANSP-OR)	Synthetic population projections and unforeseen events: a hybrid simulation approach

Session 6 - abstracts

Session 6A

Rui Yao

How would mobility-as-a-service (MaaS) platform survive as an intermediary? From the viewpoint of stability in many-to-many matching

Rui Yao & Kenan Zhang, EPFL

Mobility-as-a-service (MaaS) provides seamless door-to-door trips by integrating different transport modes. Although many MaaS platforms have emerged in recent years, most of them remain at a limited integration level. This study investigates the assignment and pricing problem for a MaaS platform as an intermediary in a multi-modal transportation network, which purchases capacity from service operators and sells multi-modal trips to travelers. The analysis framework of many-to-many stable matching is adopted to decompose the joint design problem and to derive the stability condition such that both operators and travelers are willing to participate in the MaaS system. To maximize the flexibility in route choice and remove boundaries between modes, we design an origin-destination pricing scheme for MaaS trips. On the supply side, we propose a wholesale purchase price for service capacity. Accordingly, the assignment problem is reformulated and solved as a bi-level program, where MaaS travelers make multi-modal trips to minimize their travel costs meanwhile interacting with non-MaaS travelers in the multi-modal transport system. We prove that, under the proposed pricing scheme, there always exists a stable outcome to the overall many-to-many matching problem. Further, given an optimal assignment and under some mild conditions, a unique optimal pricing scheme is ensured. Numerical experiments conducted on the extended Sioux Falls network also demonstrate that the proposed MaaS system could create a win-win-win situation—the MaaS platform is profitable and both traveler welfare and transit operator revenues increase from a baseline scenario without MaaS.

Marko Maljkovic

A Blotto Game Approach to Ride-hailing Markets with Electric Vehicles

Marko Maljkovic, Gustav Nilsson & Nikolas Geroliminis LUTS, École Polytechnique Fédérale de Lausanne (EPFL)

When a centrally operated ride-hailing company considers to enter a market already served by another company, it has to make a strategic decision about how to distribute its fleet among different regions in the area. This decision will be influenced by the market share the company can secure and the costs associated with charging the vehicles in each region, all while competing with the company already operating in the area. In this paper, we propose a Colonel Blotto-like game to model this decision-making. For the class of games that we study, we first prove the existence and uniqueness of a Nash Equilibrium. Subsequently, we provide its general characterization and present an algorithm for computing the ones in the feasible set's interior. Additionally, for a simplified scenario involving two regions, which would correspond to a city area with a downtown and a suburban region, we also provide a method to check for the equilibria on the feasible set's boundary. Finally, through a numerical case study, we illustrate the impact of charging prices on the position of the Nash equilibrium.
Keywords: Ride-hailing, Electric vehicles, Blotto games

Lynn Fayed

On the effect of batching for on-demand high-capacity micro-transit services

Authors: Lynn Fayed, Gustav Nilsson, Nikolas Geroliminis

Abstract: The surge of on-demand ride-hailing services provides network users with a convenient and flexible transportation alternative. While ride-hailing and two-passenger ride-splitting services have been extensively studied, much less is known about the efficiency and operation of high-capacity on-demand services. In this work, we aim to improve our understanding of the operation of these services by casting them into a queuing theory framework. We do so to theoretically investigate the impact of batching on the micro-transit service level. Given the fast-growing complexity of this model with the network structure, we resort to a micro-simulation environment to reproduce the deployment of on-demand micro-transit in large-scale networks. In this simulation framework, we analyze the request waiting time and request detour under different batching strategies and assess the service performance compared to a simple greedy vehicle-request matching. The results show that batching has significant potential to improve the passenger detour, yet the waiting time is rarely reduced when batching is involved.

Session 6B

Yura Tak

Deep Learning-based Visual Vehicle Re-identification Using Spatio-Temporal Information in Urban Traffic

Yura Tak, Robert Fonod & Nikolas Geroliminis
LUTS, EPFL

With the rapid development of navigation, communication, and sensing technologies, Unmanned Aerial Vehicles (UAV) based vision applications have grown increasingly popular. Combined with Computer Vision (CV) techniques such as vehicle detection and tracking, UAVs have emerged as a promising solution to monitor traffic. Nevertheless, despite the advancements, achieving full spatial and temporal coverage of a large network remains challenging, requiring the deployment of multiple UAVs. Consequently, reidentifying a vehicle from one video frame to another becomes important for various traffic estimations, including continuous trajectory extraction. Vehicle re-identification (ReID) works as a key technology since it aims at localizing and tracking the queried targeted vehicle from a large volume of vehicles. However, two major challenges exist in the existing UAV-based vehicle ReID studies. The first challenge is the limited perception of the vehicle from the Bird's Eye View (BEV) environment. The drone's camera captures only the top view of the vehicle, losing uniquely identifiable information. This leads to low image-to-image matching accuracy. The second challenge is highly dependent on the appearance-based method. To address these challenges, this study proposes a deep learning-based vehicle re-identification framework which combines visual, temporal and spatial information. Specifically, this method first extracts the latent feature vector that embeds the appearance information of the vehicle. Then, we enhance it by the predicted travel time of the vehicle. Finally, the spatial information is embedded as a graph of the neighboring vehicles, leveraging the platoon formation in the urban intersections. Our results show that

our framework notably improves vehicle ReID accuracy in the BEV environment, outperforming existing models. The suggested method can be applied to complement the vehicle tracking, merge the separated trajectories, and reduce the cost of data collection in the limited monitoring area.

Keywords: Vehicle ReID; Computer Vision; UAV; Travel Time Prediction; Signalized Intersection

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Kevin Blättler

Free public transport to the destination: A causal analysis of tourists' travel mode choice

Kevin Blättler, Hannes Wallimann and Widar von Arx, University of Applied Sciences and Arts Lucerne, Institute of Tourism and Mobility

In this paper, we assess the impact of a fare-free public transport policy for overnight guests on travel mode choice to a Swiss tourism destination. The policy directly targets domestic transport to and from a destination, the substantial contributor to the CO2 emissions of overnight trips. Based on a survey sample, we identify the effect with the help of the random element that the information on the offer from a hotelier to the guest varies in day-to-day business. We estimate a shift from private cars to public transport due to the policy of, on average, 16.9 and 11.6 percentage points, depending on the application of propensity score matching and causal forest. This knowledge is relevant for policy-makers to design future offers that include more sustainable travels to a destination. Overall, our paper exemplifies how such an effect of comparable natural experiments in the travel and tourism industry can be properly identified with a causal framework and underlying assumptions.

Keywords: leisure travel, travel mode choice, causal effect, overnight stays, fare-free public transport

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Yasamin Borhani

OpenPifPaf++: Towards a Unified Framework for Multi-Category Pose Estimation

Yasamin Borhani, EPFL VITA

In autonomous driving scenarios, it is necessary to estimate the pose of objects from different categories simultaneously. While existing approaches typically employ separate networks for each category, it is imperative to minimize computational overhead through the utilization of a unified network. This project aims to address this limitation by jointly estimating poses for different objects such as humans, animals, and cars.

Session 6C

Mohamed Abdelfattah

S-JEPA: Joint Embedding Predictive Architecture for Self-Supervised Skeletal Action Recognition

Mohamed Abdelfattah, Alexandre Alahi

Self-supervised skeletal action recognition has demonstrated promising potential to learn strong action representations without costly human annotations. However, existing methods rely on feature reconstruction in the low-level joint space as their pretext task, missing the high-level action features. In this work, we propose a novel and simple pretext task: from masked 2D skeletons as inputs, we aim to reconstruct the 3D skeleton representations (i.e., 2D-to-3D lifting in the latent space.) To that end, we adopt a transformer teacher encoder taking standard 3D skeletons to output their representations as target features for a student encoder. Due to the self-attention mechanism in the transformer architecture, the teacher representations implicitly contain the global context and depth information of the complete skeleton sequence, forming a highly semantic objective for the student encoder. A core design choice to guide our framework is our proposed acceleration-guided masking strategy. Specifically, we mask the joints where motion is changing with higher probability, leading to richer, more semantic target representations for the pretext task. We term our approach S-JEPA: Skeleton Joint-Embedding Predictive Architecture. Notably, our approach does not require any hand-crafted view augmentation. Initial experiments show that S-JEPA achieves superior performance on NTU60, NTU120, and PKU-MMD datasets.

Shaimaa K. El-Baklish

A Variable Time Gap Feedback Policy for String Stable Adaptive Cruise Control

Shaimaa K. El-Baklish, Anastasios Kouvelas & Michail A. Makridis IVT, ETH Zurich

In vehicle platooning, time gap settings of Adaptive Cruise Control (ACC) systems have a significant impact on car-following dynamics, traffic capacity and road safety. Traffic capacity increases with the reduction of the average time headway; however, this raises concerns of safety and string stability. This work presents a variable time gap feedback control strategy to balance following a minimum time gap setting under equilibrium car-following conditions for increased traffic capacity; and guaranteeing string stability to attenuate disturbances away from the equilibrium flow. This is achieved using nonlinear H∞ control; where a variable time gap component is set as the manipulated control signal. Also, a constant time gap component is present which dominates during car-following equilibrium and is prescribed to the minimum value. Numerical simulations demonstrate that the proposed scheme yields less perturbations in space headway compared to its constant time-gap ACC baseline; showcasing the potential benefits of better road utilization and increased capacity from a traffic perspective.

Keywords: Adaptive Cruise Control (ACC), String Stability, Variable Time Gap, Nonlinear H∞ control

Marija Kukic

Hybrid Simulator for Projecting Synthetic Households in UnforeseenEvents

Marija Kukic, EPFL, TRANSP-OR
Michel Bierlaire, EPFL, TRANSP-OR

In this paper, we tackle the problem of synthetic population projection methods sensitivity to unforeseen events. Usually, projection methods model the evolution of synthetic populations using rates for life events derived from historical demographic trends. However, these rates, updated every few years, may not take into account unexpected events like COVID-19, compromising the representativeness of synthetic projections. To make projections more resilient to unforeseen events, we develop a novel hybrid framework that combines dynamic projection and resampling for generating and projecting a synthetic population. We apply the Markov Chain Monte Carlo simulation to create a baseline synthetic population for the year 2010 and project it to 2021 using the Swiss Mobility and Transport Microcensus datasets. We test two scenarios using pre-pandemic and post-pandemic demographic rates and compare projected samples generated with our methodology and the dynamic projection method. The results show that the hybrid simulator is more robust and less dependent on rates when it comes to unexpected events compared to dynamic projection.

Keywords: COVID-19; Population Dynamic Model; Simulation and Modeling; Synthetic Population Generation

Sessions 7: Friday, May 17th 2024

Sessions 7				
Chair	Noah Balthasar (HSLU)	**Session 7A: Trajectories 2**		
Room	Auditorium			
No.	**Start**	**End**	**Speaker**	**Title**
7.1	9:40	10:00	Ahmad Rahimi (EPFL-VITA)	Including Human Preference in Trajectory Prediction Models
7.2	10:00	10:20	Cloe Cortes Balcells (EPFL-TRANSP-OR)	Integrating Psychological Insights into Activity-Based Modeling: A Policy-Aware Activity-Based Approach for Epidemiological Studies
7.3	10:20	10:40	Megh Shukla (EPFL-VITA)	TIC-TAC: A Framework For Improved Covariance Estimation In Deep Heteroscedastic Regression
Chair	Saeed Saadatnejad (EPFL-VITA)	**Session 7B: Discrete choice & preferences**		
Room	Sala Balint			
No.	**Start**	**End**	**Speaker**	**Title**
7.4	9:40	10:00	Nicola Ortelli (EPFL-TRANSP-OR)	A conditional trust-region algorithm for the estimation of discrete choice models
7.5	10:00	10:20	Evangelos Paschalidis (EPFL-TRANSP-OR)	Model transferability in the context of migration aspiration discrete choice models
7.6	10:20	10:40	Yang Gao (EPFL-VITA)	Multi-Transmotion: Multi-modal Multi-task Human Motion Prediction
Chair	Kevin Riehl (ETH-IVT-SVT)	**Session 7C: Models & signal control**		
Room	Sala Eranos			
No.	**Start**	**End**	**Speaker**	**Title**
7.7	9:40	10:00	Sohyeong Kim (EPFL-LUTS)	Lane changing behavior prediction in the urban signalized road
7.8	10:00	10:20	Kevin Riehl (ETH-IVT-SVT)	Priority Pass: Signal Control with Focus on Needs
7.9	10:20	10:40	Georg Anagnostopoulos (EPFL-LUTS)	Modeling mode dependent lane discipline in hybrid traffic

Session 7 - abstracts

Session 7A

Ahmad Rahimi

HPTP: Including Human Preference in Trajectory Prediction Models

Recent advancements in vehicle trajectory prediction have notably improved data-driven models, yet they struggle with complex scenarios, showing limited prediction diversity and sometimes failing to comply with road constraints. These critical yet hard-to-evaluate issues hinder the development of safer, more robust models. Reflecting on similar challenges in natural language processing (NLP), where Reinforcement Learning from Human Feedback (RLHF) has effectively enhanced model quality, our study investigates integrating similar human feedback into vehicle trajectory models. We propose a novel approach using a learned reward model to infuse human judgment, aiming to improve prediction accuracy and reliability. This research marks a pivotal step in combining artificial intelligence with human expertise for more precise and secure vehicle trajectory forecasting.
Keywords: Vehicle trajectory prediction, Human feedback

Cloe Cortes Balcells

Enhancing Epidemiological Models with Activity-Travel Behavior and Risk Perception: A Simulation Framework for Policy Management

Cloe Cortes Balcells, Rico Krueger, Michel Bierlaire

This paper presents an Activity-Based Model (ABM) for modeling epidemiological responses during or after a pandemic. The objective of the model is to include pandemic-related restrictions, such as imposed curfews or other activity-restriction policies, when computing activity schedules. Building upon the ABM developed by [1], this study presents an updated formulation capable of including pandemic restriction and typical responses. In particular, we integrate two key aspects: first, we estimate latent factors that capture the psychological and emotional sensitivity of people to the pandemic's effects, integrating these into the optimization problem. Second, we account for the direct impact of restrictions on activity participation and the adaptive strategies individuals might employ, such as altering the time, location, or nature of their activities. This dual approach allows for a more comprehensive understanding of population behavior in response to public health policies. Moreover, we introduce a dynamic programming algorithm to efficiently solve the updated optimization problem. The use of dynamic programming allows for efficient handling of large-scale populations and numerous activities, a significant advancement over the limitations identified in [1]. This methodological improvement ensures accurate representation of all possible contacts, capturing the true dynamics of infection transmission within the population.

References
[1] Janody Pougala, Tim Hillel, and Michel Bierlaire. Capturing trade-offs between daily scheduling choices. Journal of Choice Modelling, 43:100354, June 2022.
Cloe Cortes Balcells, Fabian Torres, Michel Bierlaire, January 2024

Megh Shukla

TIC-TAC: A Framework For Improved Covariance Estimation In Deep Heteroscedastic Regression

Megh Shukla, Mathieu Salzmann, Alexandre Alahi

Deep heteroscedastic regression involves jointly optimizing the mean and covariance of the predicted distribution using the negative log-likelihood. However, recent works show that this may result in sub-optimal convergence due to the challenges associated with covariance estimation. While the literature addresses this by proposing alternate formulations to mitigate the impact of the predicted covariance, we focus on improving the predicted covariance itself. We study two questions: (1) Does the predicted covariance truly capture the randomness of the predicted mean? (2) In the absence of supervision, how can we quantify the accuracy of covariance estimation? We address (1) with a Taylor Induced Covariance (TIC), which captures the randomness of the predicted mean by incorporating its gradient and curvature through the second order Taylor polynomial. Furthermore, we tackle (2) by introducing a Task Agnostic Correlations (TAC) metric, which combines the notion of correlations and absolute error to evaluate the covariance. We evaluate TIC-TAC across multiple experiments spanning synthetic and real-world datasets. Our results show that not only does TIC accurately learn the covariance, it additionally facilitates the optimal convergence of the negative log-likelihood. Our code is available at https://github.com/vita-epfl/TIC-TAC.

Session 7B

Nicola Ortelli

A conditional trust-region algorithm for the estimation of discrete choice models

Nicola Ortelli, Corresponding author, School of Management and Engineering Vaud, EPFL
M. de Lapparent School of Management and Engineering Vaud, M. Bierlaire Transport & Mobility Laboratory, EPFL

In the field of choice modeling, the availability of ever-larger datasets has the potential to significantly expand our understanding of human behavior, but this prospect is limited by the poor scalability of discrete choice models (DCMs): as sample sizes increase, the computational cost of maximum likelihood estimation quickly becomes intractable for anything but trivial model structures. This is particularly the case for models that are estimated through simulated maximum likelihood estimation, for which the issue is further exacerbated by the additional burden imposed by Monte Carlo integration. This study proposes a simple extension to the resampling estimation method presented in Ortelli et al. (2024), which consists in using carefully generated subsamples of a dataset as batches in a stochastic optimization algorithm. By embedding the resampling within the iterations of the estimation process, the size of the samples can be dynamically adapted to the algorithm’s progress, until convergence is reached on the full dataset. In this context, we specifically focus on the interactions between locality-sensitive hashing and Monte Carlo integration to extend the use of our approach to the estimation of mixed logit models. We use real-world datasets and models of different sizes and complexity to assess the performance of our method in a variety of instances.

References: Ortelli, N., Lapparent, M. (de) & Bierlaire, M. (2024). Resampling estimation of discrete choice models. Journal of Choice Modelling 50, 100467

Candice Baud

Migration patterns of Europeans after Brexit

Candice Baud, Evangelos Paschalidis & Michel Bierlaire, Transport and Mobility Laboratory, EPFL
Andreas B. Vortisch & Michel Beine, Department of Economics and Management, University of Luxembourg

International migration represents human mobility at a higher level in the field of transportation, and it is at the forefront of political debates in many countries around the world for a variety of reasons. The use of discrete choice models is a regular approach to investigating migration aspirations concerning destination choices. However, given the complex substitution patterns between destinations, more advanced model specifications than the multinomial logit are required. Specifications such as the cross-nested logit model allow for a more sophisticated representation of the stochastic structure of destination choices, through the use of overlapping nests while it is also addressing deviations from the property of independence of irrelevant alternatives. However, individuals from different origins are expected to have different preferences when choosing destinations, hence a "one-size-fits-all" model specification may not be suitable for all cases. In this study, we evaluate model transferability by considering case studies based on attributes of origin countries such as economic status, size, desired emigration level and others. Our objective is to understand how determinants of emigration vary across different origin countries and test poolability in model estimation to determine potential criteria that allow for joint model estimation from multiple origins.

Keywords: Migration, aspiration, cross-nested logit, transferability

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Yang Gao

Multi-Transmotion: Multi-modal Multi-task Human Motion Prediction

The ability to anticipate future events is crucial for intelligent systems, especially in applications like autonomous vehicles and social robotics. This work investigates the potential of transformer-based foundation model to predict human motions—encompassing trajectory, pose keypoints, and intentions. Despite their success in other domains, such as natural language processing and image semantic segmentation, foundation models are underexplored in human motion prediction. Addressing this, our study focuses on developing a multi-modal, multi-task foundation model tailored to human motion. We start by creating a unified dataset framework that accommodates diverse data characteristics and setups, aiming to overcome the challenges posed by existing heterogeneous datasets and model-specific configurations. By advancing the capabilities of foundation models in this domain, our work seeks to enhance the intelligence and safety of autonomous systems and robotics, fostering safer human-machine coexistence.

Session 7C

Sohyeong Kim

Lane changing behavior prediction in the urban signalized road

Sohyeong Kim und Nikolas Geroliminis, LUTS, EPFL Lausanne

Lane change behavior is a povital aspect of vehicle maneuvering within urban arterial networks, where it plays a crucial role in influencing traffic flow and safety. Previous research has predominantly concentrated on highway contexts, leaving a gap in our understanding of urban driving behaviors. This study focuses on predicting lane change events in urban settings, specifically on signalized multi-lane roads, an area not extensively explored in existing literature. We examine a variety of factors that could predict lane changes, including strategic elements like origin-destination information, and external influences such as traffic density, the presence of other road users, and signal timings. Vehicle-specific parameters like type, geo-position, speed are also considered. PNEUMA has been used for a data for this study which are collected through field observations in Athens using unmanned aerial vehicles (UAVs). To analyze and predict lane change events, we employ a transformer encoder-decoder architecture, which is recognized for its superior performance in handling sequential data compared to traditional models. The findings from this study are expected to significantly enhance urban planning and traffic management strategies, offering insights into the dynamic interactions at play in urban traffic systems and informing targeted interventions to improve both traffic flow and safety in urban environments.

Keywords: Lane Change behavior, Transformer, Urban traffic, Trajectory prediction

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Kevin Riehl

Priority Pass: Signal Control with Focus on Needs

Kevin Riehl, Anastasios Kouvelas & Michail Makridis, IVT, ETH Zurich

Signalized intersection management is typically designed with a focus on transportation efficiency metrics such as throughput, queue length and average delay time, to the neglect of vehicle-specific urgencies. This conceptual work proposes a Priority Pass for urban networks as a feasible, economic instrument to expedite entitled vehicles at auction-controlled signalized intersections using movement-phase bidders. The interplay of transportation and economic efficiency at intersections with varying saturation, symmetry, and entitlement is analyzed. The value of the concept is robustly demonstrated for a wide range of scenarios. The Priority Pass creates significant benefits for entitled vehicles without causing arbitrary delays for not-entitled vehicles or de trop worsening transportation efficiency. What's more, no significant conflict between transportation and economic efficiency was found in the given setup.

Keywords: Transport and society, Traffic engineering, Transport economics, signalized intersection control, auctions, value of time (VOT)

Georg Anagnostopoulos

Lane formation in multispecies urban traffic

Georg Anagnostopoulos, Corresponding Author, Urban Transport Systems Laboratory (LUTS), EPFL
Nikolas Geroliminis, Ph.D., Urban Transport Systems Laboratory (LUTS), EPFL

Phenomena of self-organization can be observed in multispecies transportation systems, where cars compete for limited space with microvehicles such as motorcycles, bicycles, e-bikes or e-scooters. Detailed empirical evidence collected by a swarm of drones during the pNEUMA experiment in Athens, Greece, shows that cars follow lanes as defined by the infrastructure, while motorcycles do not necessarily adhere to predefined rules and may participate in spontaneous formation of virtual lanes in the available free space without any prior agreement in a self-organized manner. This phenomenon might increase the overall capacity compared to lane-based behavior, but it can also introduce more risky interactions that jeopardize traffic safety. Understanding the dynamics of multispecies urban traffic is more relevant than ever given the recent emergence of micromobility solutions and the questions raised by the proliferation of connected and automated vehicles, yet the topic remained elusive and a possible mechanism of lane formation is investigated for the first time in this work. Overcoming the traditional dualism between lane-based and lane-free traffic, our modeling approach draws inspiration both from vehicular, as well as from pedestrian dynamics literature. At the same time, we recognize that motorcycles are neither pedestrians nor cars, as they have their own special features, and we expect that our findings should generalize well to other scenarios with microvehicles operating in heterogeneous crowds. After estimating the model with actual data, we simulate multispecies traffic on an urban arterial road with periodic boundary conditions. Our results show a nonlinear drop in car flow with increasing motorcycle share. Furthermore, we introduce an efficiency-based index of lane formation in order to understand the emergence of motorcycle lanes and its dependence on car density. Finally, we utilize exposure to risk as a surrogate safety measure. Surprisingly, exposure of microvehicles to risk attains its maximum only at moderate congestion levels.

Keywords: Anticipatory Navigation, Newell Nonlinear Model, Time to Collision, Virtual Lane

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