BikeSimWS: Workshop on Simulators, Scenarios, and Test Standard for Bicycle Research

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Figure 1: We will use our multiuser bicycle simulation to elaborate requirements and scenarios for more standardized HCI cycling experiments. Workshop participants can bring their own hardware and connect to the simulation via an API.

ABSTRACT

Research on cyclists‘ safety and comfort is a growing topic. Existing works address support systems with novel interaction concepts such as augmented reality but also the design and evaluation of high-fidelity bicycle simulators. Since the field is still in its exploratory phase, there have been few attempts to systematically provide guidance for conducting experiments. For example, there is no consensus on the choice of representative driving scenarios, the proper choice of different bicycle simulators, and measurement standards to systematically compare the results of different studies. With this workshop, we want the community to gather and discuss a roadmap for the future of HCI bicycle research so that these issues can be overcome.

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CCS CONCEPTS

• **Applied computing** → **Transportation**; • **Human-centered computing** → *Ubiquitous and mobile devices*; **Empirical studies in HCI**; **HCI design and evaluation methods**; *Laboratory experiments*.

KEYWORDS

Human-computer interaction, bicycle, cycling, mixed reality, standardization

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1 INTRODUCTION

Cycling is not only a healthy activity for recreation and sports, but it should also become one of the major ingredients for more livable and sustainable urban environments. Still, this requires promoting the uptake of cycling and increasing cycling comfort. At the same time, cyclists are still involved in many accidents. The higher speeds of electric bicycles and pedelecs have increased the risk of severe injuries in bicycle accidents [25]. Further, cyclists increasingly interact with smart devices such as smartphones [23] or glasses [6, 15]. Consequently, cycling safety and comfort have recently become a prominent research topic in human-computer interaction and ubiquitous computing. This is shown by the high number of publications that aim at designing technological artifacts for cycling, including augmented reality support for helmets, bicycles, and the environment around them [1, 4, 11–14, 26–29]. Other works have addressed methods to quantify user experiences [2, 5, 7, 16], or how to build realistic, high-fidelity bicycle simulators [3, 8, 18, 20, 21, 30]. Even futuristic concepts such as "highly-automated bicycles" have been proposed by researchers in this domain [19, 31, 32].

Despite the high amount of publications in recent years, bicycle research is still in an early and exploratory phase. First, the field needs to have agreed-upon best practices for bicycle simulations in laboratory environments. It is still unclear to what degree particular features of bicycle simulators, such as tilting mechanisms or mixed reality support, contribute to the complex issues of motion sickness and relative/absolute ecological validity. Second, although many experiments use similar traffic situations, such as blocked bike paths or junctions, no agreed-upon scenarios or test catalogs exist. Third, there needs to be more consensus on how to best evaluate cyclist safety, comfort, and experience in terms of objective and subjective measurements, particularly since bicycle research is independently conducted by transport researchers, infrastructure planners, psychologists, computer scientists, or experts in mechatronics or electronics. Consequently, there is a long way to reach maturity, like similar transport-related domains. For example, the automotive sector has a long history of simulator research and development (where the relative validity of various simulator types is proven and well-accepted), standardized test scenarios (such as Euro-NCAP or the Daimler Lane Change Test), and widely used evaluation metrics (such as the standard deviation of lateral position or take-over times), which are documented in standards handed out by the society of automotive engineers.

2 WORKSHOP GOALS

In the long run, a major goal of cycling research must become as elaborated as the automotive domain. Specifically, we aim to use this workshop to discuss the abovementioned issues. Therefore, we invite researchers and practitioners not only from computer science and HCI but also transportation, mechatronics, and electrical engineering, where research on two-wheelers like motorcycles already has some history. During the workshop, we want to discuss the requirements and paths toward more standardized bicycle experiments in terms of:

- **bicycle simulator development** *Which features are most important to convey a realistic cycling experience? How to increase relative/absolute ecological validity? Is it even suitable to conduct valid studies when participants do not use their own bicycles? How can characteristics such as hurry or sweat be simulated? How can we reduce motion sickness in bicycle simulators? How can a research agenda across multiple labs contribute towards these goals?*
- **driving scenarios and road layouts** *Which traffic situations are most relevant? Can we design standardized test protocols? To what degree can accident statistics help to make such decisions? How to deal with parameters such as traffic volume or other road users and their behavior? Which primary and secondary tasks can be defined?*
- **objective and subjective measurements** *Which parameters can be assessed to quantify cycling safety, performance, and convenience? How can we define constraints, thresholds, and measurement points? How to promote such measures to allow for more comparable and standardized experiments in the future?*
- **end-user driven city planning** *Today, traffic planning is mostly led by experts: (1) A political motion recognizes an area needing attention, (2) Traffic planners develop a concept, (3) It gets implemented and stays for years. How do we use simulations, particularly bicycle simulators, to empower lobby groups and end-users to understand future concepts, provide feedback, and discuss alternatives?*

3 SCHEDULE AND ACTIVITIES

We will set up a range of activities to be performed before, during, and after the meeting held at the MuM'23 conference in Vienna. These activities are briefly introduced as follows.

3.1 Before the Workshop

We are currently building a multiuser bike simulation, which should be utilized during the workshop. Thus, participants can bring their own simulator hardware or simple controllers, i.e., joysticks, and gamepads. Before the workshop, we will publish an API on our workshop website so prospective participants can implement it to become part of the multiplayer experience.

3.2 In-person Event at MuM'23

We plan for a half-day workshop meeting at the conference (i.e., in the 9:00 a.m. - 1:00 p.m. or 2:00 p.m. - 6:00 p.m. session). First, we will present the topic of standardized bicycle scenarios along with examples from the Automotive domain to the group of workshop participants. Then, participants will use their brought devices (i.e., laptops, game controllers, or more complex simulator hardware; TU Wien will provide two bicycle simulators) and we will cycle through multiple virtual sections (i.e., junctions, roundabouts, etc.). Based on these live, and hands-on experiences, the group will then discuss and brainstorm about the necessary requirements to reach the workshop goals as outlined above.

3.3 After the Workshop

After the workshop, we will post the results on the workshop website and plan for future activities. Particularly, we plan to set up a working group to define standards and best practices for cycling experiences in the lab. Further, we aim to write applications for research grants in this area. Ultimately, the combined set of activities will help boost research on bicycle safety and convenience. One possible pathway would be to pursue a submission of the upcoming DUT Call 2023[1] for the 15min City[2].

4 ORGANIZERS

Philipp Wintersberger is a Professor of Interactive Systems at the University of Applied Sciences Upper Austria (Campus Hagenberg). His research addresses human-machine cooperation in safety-critical AI-driven systems. He has (co)authored many publications published at major journals and conferences (such as ACM CHI, ACM AutomotiveUI, IEEE IV, and Human Factors), and his contributions have won several awards. Further, he is a member of the ACM AutomotiveUI steering committee, contributed to HCI conferences in various roles in the past (Technical Program Chair AutomotiveUI'21, Workshop Chair MuC'21, Diversity and Inclusion Chair MuC'22), and is one of the main organizers of the CHI workshop on Explainable Artificial Intelligence (XAI). Currently, he leads a group of researchers and Ph.D. students working on human-AI cooperation in multiple FWF and FFG-funded projects.

Andrii Matviienko is an assistant professor at KTH Royal Institute of Technology in Stockholm, Sweden. His research focuses on assisting technology in urban environments, in particular on designing, constructing, and evaluating multimodal and mixed reality interfaces for vulnerable road users. Previously, he has co-organized the SIGCHI-sponsored International HCI Summer School on Cycling and a series of workshops about vulnerable road users [9, 10, 17, 22, 24].

Patrick Ebel is a Junior Research Group Leader at the Center for Scalable Data Analytics and Artificial Intelligence (ScaDS.AI) at Leipzig University. He received his Ph.D. in Computer Science from the University of Cologne and his M.Sc. in Automotive Systems from the TU Berlin. His research focuses on the analysis of large naturalistic driving data and computational models of interaction in different mobility scenarios.

Yu Wang is a Ph.D. student of Artifact-Based Computing and User Research at TU Wien, Austria. Her research focuses on virtual technique-supported Bicycle Simulation, and locomotion technology in Virtual Reality (VR).

Ammar Al-Taie is a PhD student in the School of Computing Science at the University of Glasgow. His area of research is Autonomous Vehicle-Cyclist interaction. This often involves utilizing unconventional technologies, such as new displays on the car's exterior. Ammar is a "hands-on" researcher; most of his work is conducted in real-world settings using new technologies such as eye-tracking.

Stephen Brewster is a professor of Human-Computer Interaction in the School of Computing Science at the University of Glasgow. His research focuses on multimodal HCI or using multiple sensory modalities and control mechanisms (particularly audio, haptics, and gesture) to create a rich, natural interaction between humans and computers. His work has a strong experimental focus, applying perceptual research to practical situations. A long-term focus has been on mobile interaction and how we can design better user interfaces for users on the move. Other areas of interest include haptics, wearable devices, and in-car interaction. He pioneered the study of non-speech audio and haptic interaction for mobile devices with work starting in the 1990s.

Florian Michahelles is a Professor of Ubiquitous Computing at TU Wien, Austria. His research addresses human-machine cooperation in professional and everyday environments.

Arjan Stuiver is a traffic researcher at the Traffic Psychology group in the Clinical and Neuropsychology Department at the University of Groningen in the Netherlands. He obtained his M.S. in Artificial Intelligence and has a Ph.D. in Behavioural and Social Sciences. As a researcher, he uses driving and cycling simulation to study traffic safety and road user behavior.

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REFERENCES

[1] Josh Andres, Tuomas Kari, Juerg von Kaenel, and Florian 'Floyd' Mueller. 2019. "Co-Riding With My EBike to Get Green Lights". In *Proceedings of the 2019 on Designing Interactive Systems Conference* (San Diego, CA, USA) *(DIS '19)*. Association for Computing Machinery, New York, NY, USA, 1251–1263. https://doi.org/10.1145/3322276.3322307

[2] Josh Andres, m.c. schraefel, Nathan Semertzidis, Brahmi Dwivedi, Yutika C. Kulwe, Juerg von Kaenel, and Florian Floyd Mueller. 2020. Introducing Peripheral Awareness as a Neurological State for Human-Computer Integration. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (Honolulu, HI, USA) *(CHI '20)*. Association for Computing Machinery, New York, NY, USA, 1–13. https://doi.org/10.1145/3313831.3376128

[3] Marit Bentvelzen, Gian-Luca Savino, Jasmin Niess, Judith Masthoff, and Paweł W. Wozniak. 2022. Tailor My Zwift: How to Design for Amateur Sports in the Virtual World. *Proc. ACM Hum.-Comput. Interact.* 6, MHCI, Article 216 (sep 2022), 23 pages. https://doi.org/10.1145/3546751

[4] Alexandru Dancu, Velko Vechev, Adviye Ayça Ünlüer, Simon Nilson, Oscar Nygren, Simon Eliasson, Jean-Elie Barjonet, Joe Marshall, and Morten Fjeld. 2015. Gesture Bike: Examining Projection Surfaces and Turn Signal Systems for Urban Cycling. In *Proceedings of the 2015 International Conference on Interactive Tabletops & Surfaces* (Madeira, Portugal) *(ITS '15)*. Association for Computing Machinery, New York, NY, USA, 151–159. https://doi.org/10.1145/2817721.2817748

[5] Anjani Kalra, Tommy Lim, Lauren Pearson, and Ben Beck. 2022. Methods used to capture subjective user experiences in adults while riding bicycles: a scoping review. *Transport Reviews* (2022), 1–25.

[6] Thomas Kosch, Andrii Matviienko, Florian Müller, Jessica Bersch, Christopher Katins, Dominik Schön, and Max Mühlhäuser. 2022. NotiBike: Assessing Target Selection Techniques for Cyclist Notifications in Augmented Reality. *Proc. ACM Hum.-Comput. Interact.* 6, MHCI, Article 197 (sep 2022), 24 pages. https://doi.org/10.1145/3546732

[1] https://dutpartnership.eu/funding-opportunities/dut_call_2023/
[2] https://dutpartnership.eu/the-dut-partnership/transition-pathways/

[7] Tommy Lim, Anjani Kalra, Jason Thompson, Joanne Caldwell Odgers, and Ben Beck. 2022. Physiological measures of bicyclists' subjective experiences: A scoping review. *Transportation Research Part F: Traffic Psychology and Behaviour* 90 (2022), 365–381.

[8] Markus Löchtefeld, Antonio Krüger, and Hans Gellersen. 2016. DeceptiBike: Assessing the Perception of Speed Deception in a Virtual Reality Training Bike System. In *Proceedings of the 9th Nordic Conference on Human-Computer Interaction* (Gothenburg, Sweden) *(NordiCHI '16)*. Association for Computing Machinery, New York, NY, USA, Article 40, 10 pages. https://doi.org/10.1145/2971485.2971513

[9] Andreas Löcken, Mark Colley, Andrii Matviienko, Kai Holländer, Azra Habibovic azrahabibovic, Andrew L Kun, Susanne Boll, Andreas Riener, Debargha Dey, and Azra Habibovic. 2020. WeCARe: Workshop on Inclusive Communication between Automated Vehicles and Vulnerable Road Users 1 BACKGROUND. (2020). https://doi.org/10.1145/3406324.3424587

[10] Andreas Löcken, Andrii Matviienko, Mark Colley, Debargha Dey, Azra Habibovic, Yee Mun Lee, and Andreas Riener. 2022. Accessible Automated Automotive Workshop Series (A3WS): International Perspective on Inclusive External Human-Machine Interfaces. *Adjunct Proceedings - 14th International ACM Conference on Automotive User Interfaces and Interactive Vehicular Applications, AutomotiveUI 2022* (9 2022), 192–195. https://doi.org/10.1145/3544999.3551347

[11] Andrii Matviienko, Swamy Ananthanarayan, Shadan Sadeghian Borojeni, Yannick Feld, Wilko Heuten, and Susanne Boll. 2018. Augmenting Bicycles and Helmets with Multimodal Warnings for Children. In *Proceedings of the 20th International Conference on Human-Computer Interaction with Mobile Devices and Services* (Barcelona, Spain) *(MobileHCI '18)*. Association for Computing Machinery, New York, NY, USA, Article 15, 13 pages. https://doi.org/10.1145/3229434.3229479

[12] Andrii Matviienko, Swamy Ananthanarayan, Stephen Brewster, Wilko Heuten, and Susanne Boll. 2019. Comparing Unimodal Lane Keeping Cues for Child Cyclists. In *Proceedings of the 18th International Conference on Mobile and Ubiquitous Multimedia* (Pisa, Italy) *(MUM '19)*. Association for Computing Machinery, New York, NY, USA, Article 14, 11 pages. https://doi.org/10.1145/3365610.3365632

[13] Andrii Matviienko, Swamy Ananthanarayan, Abdallah El Ali, Wilko Heuten, and Susanne Boll. 2019. NaviBike: Comparing Unimodal Navigation Cues for Child Cyclists. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems* (Glasgow, Scotland Uk) *(CHI '19)*. Association for Computing Machinery, New York, NY, USA, 1–12. https://doi.org/10.1145/3290605.3300850

[14] Andrii Matviienko, Swamy Ananthanarayan, Raphael Kappes, Wilko Heuten, and Susanne Boll. 2020. Reminding Child Cyclists about Safety Gestures. In *Proceedings of the 9TH ACM International Symposium on Pervasive Displays* (Manchester, United Kingdom) *(PerDis '20)*. Association for Computing Machinery, New York, NY, USA, 1–7. https://doi.org/10.1145/3393712.3394120

[15] Andrii Matviienko, Jean-Baptiste Durand-Pierre, Jona Cvancar, and Max Mühlhäuser. 2023. Text Me If You Can: Investigating Text Input Methods for Cyclists. In *Extended Abstracts of the 2023 CHI Conference on Human Factors in Computing Systems* (Hamburg, Germany) *(CHI EA '23)*. Association for Computing Machinery, New York, NY, USA, Article 270, 7 pages. https://doi.org/10.1145/3544549.3585734

[16] Andrii Matviienko, Florian Heller, and Bastian Pfleging. 2021. Quantified Cycling Safety: Towards a Mobile Sensing Platform to Understand Perceived Safety of Cyclists. In *Extended Abstracts of the 2021 CHI Conference on Human Factors in Computing Systems* (Yokohama, Japan) *(CHI EA '21)*. Association for Computing Machinery, New York, NY, USA, Article 262, 6 pages. https://doi.org/10.1145/3411763.3451678

[17] Andrii Matviienko, Wilko Heuten, Alan Dix, and Susanne Boll. 2021. Interactive Technology for Cycling — ideate, make – remote, together; Interactive Technology for Cycling — ideate, make – remote, together. (2021). https://doi.org/10.1145/3447527.3474870

[18] Andrii Matviienko, Hajris Hoxha, and Max Mühlhäuser. 2023. What Does It Mean to Cycle in Virtual Reality? Exploring Cycling Fidelity and Control of VR Bicycle Simulators. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems* (Hamburg, Germany) *(CHI '23)*. Association for Computing Machinery, New York, NY, USA, Article 879, 15 pages. https://doi.org/10.1145/3544548.3581050

[19] Andrii Matviienko, Damir Mehmedovic, Florian Müller, and Max Mühlhäuser. 2022. "Baby, You Can Ride My Bike": Exploring Maneuver Indications of Self-Driving Bicycles Using a Tandem Simulator. *Proc. ACM Hum.-Comput. Interact.* 6, MHCI, Article 188 (sep 2022), 21 pages. https://doi.org/10.1145/3546723

[20] Andrii Matviienko, Florian Müller, Dominik Schön, Paul Seesemann, Sebastian Günther, and Max Mühlhäuser. 2022. BikeAR: Understanding Cyclists' Crossing Decision-Making at Uncontrolled Intersections Using Augmented Reality. In *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems* (New Orleans, LA, USA) *(CHI '22)*. Association for Computing Machinery, New York, NY, USA, Article 366, 15 pages. https://doi.org/10.1145/3491102.3517560

[21] Andrii Matviienko, Florian Müller, Marcel Zickler, Lisa Alina Gasche, Julia Abels, Till Steinert, and Max Mühlhäuser. 2022. Reducing Virtual Reality Sickness for Cyclists in VR Bicycle Simulators. In *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems* (New Orleans, LA, USA) *(CHI '22)*. Association for Computing Machinery, New York, NY, USA, Article 187, 14 pages. https://doi.org/10.1145/3491102.3501959

[22] Hatice Sahin, Heiko Mueller, Shadan Sadeghian, Debargha Dey, Andreas Löcken, Andrii Matviienko, Mark Colley, Azra Habibovic, and Philipp Wintersberger. 2021. Workshop on Prosocial Behavior in Future Mixed Traffic. *Adjunct Proceedings - 13th International ACM Conference on Automotive User Interfaces and Interactive Vehicular Applications, AutomotiveUI 2021* (9 2021), 167–170. https://doi.org/10.1145/3473682.3477438

[23] Gian-Luca Savino, Jessé Moraes Braga, and Johannes Schöning. 2021. VeloCity: Using Voice Assistants for Cyclists to Provide Traffic Reports. In *Proceedings of the 29th ACM International Conference on Multimedia* (Virtual Event, China) *(MM '21)*. Association for Computing Machinery, New York, NY, USA, 3482–3491. https://doi.org/10.1145/3474085.3475509

[24] Gian-Luca Savino, Tamara von Sawitzky, Andrii Matviienko, Miriam Sturdee, Paweł W. Woźniak, Markus Löchtefeld, Andrew L. Kun, Andreas Riener, and Jonna Häkkilä. 2021. Cycling@CHI: Towards a Research Agenda for HCI in the Bike Lane. In *Extended Abstracts of the 2021 CHI Conference on Human Factors in Computing Systems* (Yokohama, Japan) *(CHI EA '21)*. Association for Computing Machinery, New York, NY, USA, Article 107, 5 pages. https://doi.org/10.1145/3411763.3441316

[25] Maya Siman-Tov, Irina Radomislensky, Kobi Peleg, H. Bahouth, A. Becker, I. Jeroukhimov, I. Karawani, B. Kessel, Y. Klein, G. Lin, O. Merin, M. Bala, Y. Mnouskin, A. Rivkind, G. Shaked, G. Sivak, D. Soffer, M. Stein, and M. Weiss. 2018. A look at electric bike casualties: Do they differ from the mechanical bicycle? *Journal of Transport & Health* 11 (2018), 176–182. https://doi.org/10.1016/j.jth.2018.10.013

[26] Haska Steltenpohl and Anders Bouwer. 2013. Vibrobelt: Tactile Navigation Support for Cyclists. In *Proceedings of the 2013 International Conference on Intelligent User Interfaces* (Santa Monica, California, USA) *(IUI '13)*. Association for Computing Machinery, New York, NY, USA, 417–426. https://doi.org/10.1145/2449396.2449450

[27] Tamara von Sawitzky, Thomas Grauschopf, and Andreas Riener. 2022. "Attention! A Door Could Open."—Introducing Awareness Messages for Cyclists to Safely Evade Potential Hazards. *Multimodal Technologies and Interaction* 6, 1 (2022), 3. https://doi.org/10.3390/mti6010003

[28] Tamara von Sawitzky, Thomas Grauschopf, and Andreas Riener. 2022. Hazard Notifications for Cyclists: Comparison of Awareness Message Modalities in a Mixed Reality Study. In *27th International Conference on Intelligent User Interfaces* (Helsinki, Finland) *(IUI '22)*. Association for Computing Machinery, New York, NY, USA, 310–322. https://doi.org/10.1145/3490099.3511127

[29] Tamara von Sawitzky, Philipp Wintersberger, Andreas Löcken, Anna-Katharina Frison, and Andreas Riener. 2020. Augmentation Concepts with HUDs for Cyclists to Improve Road Safety in Shared Spaces. In *Extended Abstracts of the 2020 CHI Conference on Human Factors in Computing Systems* (Honolulu, HI, USA) *(CHI EA '20)*. Association for Computing Machinery, New York, NY, USA, 1–9. https://doi.org/10.1145/3334480.3383022

[30] Philipp Wintersberger, Andrii Matviienko, Andreas Schweidler, and Florian Michahelles. 2022. Development and Evaluation of a Motion-Based VR Bicycle Simulator. *Proc. ACM Hum.-Comput. Interact.* 6, MHCI, Article 210 (sep 2022), 19 pages. https://doi.org/10.1145/3546745

[31] Philipp Wintersberger, Ambika Shahu, Johanna Reisinger, Fatemeh Alizadeh, and Florian Michahelles. 2022. Self-Balancing Bicycles: Qualitative Assessment and Gaze Behavior Evaluation. In *Proceedings of the 21st International Conference on Mobile and Ubiquitous Multimedia* (Lisbon, Portugal) *(MUM '22)*. Association for Computing Machinery, New York, NY, USA, 189–199. https://doi.org/10.1145/3568444.3568451

[32] Philipp Wintersberger, David Suppan, Andreas Schweidler, and Florian Michahelles. 2021. Gear Up for Safety:Development and Evaluation of an Assisted Bicycle. In *13th International Conference on Automotive User Interfaces and Interactive Vehicular Applications* (Leeds, United Kingdom) *(AutomotiveUI '21 Adjunct)*. Association for Computing Machinery, New York, NY, USA, 30–33. https://doi.org/10.1145/3473682.3480258