



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 2023¹ for the 15min City².

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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¹https://dutpartnership.eu/funding-opportunities/dut_call_2023/

²<https://dutpartnership.eu/the-dut-partnership/transition-pathways/>

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