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Looking into the Future: Weaving the Threads of Vehicle Automation

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ABSTRACT

Automated driving is one of the most discussed disruptive technologies of this decade. It promises to increase drivers' safety and comfort, improve traffic flow, and lower fuel consumption. This has a significant impact on our everyday life and mobility behavior. Beyond the passengers of the vehicle, it also impacts others, for example by lowering the barriers to visit distant relatives. In line with the CHI2019 conference theme, our aim is to weave the threads of vehicle automation by gathering people from different disciplines, cultures, sectors, communities, and backgrounds (designers, researchers, and practitioners) in one community to look into concrete future scenarios of driving automation and its impact on HCI research and practice. Using design fiction, we will look into the future and use this fiction to guide discussions on how automated driving can be made a technology that works for people and society.

CCS CONCEPTS

• **Human-centered computing** → **User interface design**.

KEYWORDS

Vehicle automation; automated driving; ADAS; road users; trust; design fiction.

BACKGROUND

The advent of automated technology in automotive industry has made it more likely that our commutes in the future happen in vehicles that control more driving-related tasks, until they are fully automated [5]. Driving automation promises to increase drivers' safety and comfort, reduce fuel consumption and air pollution, and improve traffic throughput [5]. This has the potential to significantly impact our everyday life and our mobility behavior, for example by lowering the barriers to visit distant relatives, or changing the daily routines such as sleeping and working hours. But these impacts are not only limited to automated cars' drivers/passengers. It will target everybody, even those who are not cruising in such a vehicle.

The society of automotive engineers (SAE) divides driving automation into 6 levels: In level-0, the human driver is the main actor and has full control over driving maneuvers [17]. In the highest level (level-5), the human driver is not involved in driving and the vehicle is fully automated or

WORKSHOP GOALS

Our workshop has the following aims:

- To create an interdisciplinary forum for researchers and practitioners in HCI, psychology and cognitive science, engineering, and design to identify and discuss (societal) problems related to automated driving.
- To discuss state-of-the-art research on automated driving, and how this can influence everyday life and interactions in vehicles in future automated scenarios.
- To discuss best practices for building a bridge between different threads of society to transfer knowledge from different domains to the design and evaluation of automated vehicles.
- To discuss the design space that automated vehicles provide for HCI research and practice.
- To explore new interaction paradigms for communicating with the automated vehicle in both the interior and exterior
- To create design fictions as possible future scenarios of automated driving.
- To identify opportunities for collaboration between the diverse communities that are relevant for the design, implementation, and evaluation of future automated vehicle.

"autonomous" as mentioned in some bodies of research [5]. The next generation of automated cars is predicted to belong to level-3 automation–also known as conditionally or highly automated vehicles. In the last years, many researchers have looked into the emersion of these vehicles from different perspectives, such as control transitions [3, 13, 18], trust in automation [10], and interaction with road users [12]. Furthermore, several workshops tackled and discussed questions about the design of user interfaces and interaction concepts in (highly) automated vehicles in various communities such as AutomotiveUI [2, 11, 15] and CHI [7–9].

Taking our knowledge from what we learned in our last workshops about interaction with automation from other domains[7], and designing interaction concepts based on experience [8], in this workshop, we aim to delve deeper into HCI factors in a future world of automated vehicles. This year, by using design fiction [16], we try to predict concrete future scenarios. Although the goal of all automotive manufacturers is to reach level-5 (full) automation vehicles, recent trends have shown that automation is extended gradually. Therefore, our future scenarios do not only consider fully-automated vehicles, but also the anticipated path towards those vehicles through semi-automated vehicles. In each of these paradigms, human involvement is expected, whether it is taking over control of the vehicle (level-3), aiding in complex decision making (level-4), or choosing between route alternatives (level-5). Therefore, in each of these immediate and more-distant futures, there is a need to consider the human, the vehicle, and their interaction.

Rethinking human interaction with automated vehicles is looking beyond classical transportation-related issues. Automated vehicles can provide users with an environment where they can engage in non-driving-related activities such as work-related activities introducing the concept of a "mobile office" [2]. In addition, the introduction of automated vehicles also changes our concepts on interactions outside of the vehicle, for example how possible interactions between the automated cars and road users such as cyclist and pedestrians [12], infrastructure, and other automated vehicles should be designed and implemented.

Answering these questions requires expertise from various disciplines. For example, in a world of automated vehicles, the collaboration of designers (e.g. industrial & UX designers, urban planers, architects, engineers), researchers, and practitioners (e.g., legal, and public safety practitioners) can lead us to more realistic predictions of and solutions for the future. Therefore, following the CHI2019 conference theme, our aim is to weave the threads of vehicle automation by gathering people from different disciplines, cultures, sectors, communities, and backgrounds (designers, researchers, and practitioners) in one community to discuss the future of driving automation, which can make it a technology that works for people and society (http://chi2019.acm.org/).

To date, the number of automated vehicles and access to them has been very limited. Therefore, in order to discuss the impact of automated vehicles on an interaction level, but also for society, workshop participants will create design fictions [16] of future scenarios. Workshop participants will be asked

to envision scenarios of potential futures for different levels of automation (LOA), and to discuss their implications for HCI and society. This method allows them to discuss and narrate use-case based future interaction scenarios through their designed prototypes. Furthermore, it encourages out-of-the-box thinking and boundary pushing ideas that stimulate discussions similar to what we have observed in the last years at for example alt.chi (http://chi2019.acm.org/authors/alt-chi/).

ORGANIZERS

The organizing team is a group of researchers and practitioners with different disciplinary training and experience levels, who have been involved in the field of HCI, User Experience (UX), and human-vehicle interaction for automated driving scenarios for multiple years. Their interdisciplinary nature allows the team to appreciate the diverse backgrounds of workshop attendees and to stimulate a critical discussion during the workshop. Since 2008, many of the organizers have been involved in the organization of a series of workshops on user experience in (automated) driving at the AutomotiveUI conference [2, 6, 11, 14]. Moreover, in 2015, 2016, and 2018 they organized one-day workshops at CHI related to these themes [7–9].

Shadan Sadeghian Borojeni will be the main contact person. She is a postdoc researcher at Fraunhofer institute for communication, information and ergonomy (FKIE) in Germany. Previously she was a researcher at OFFIS Institue for Information Technology, and Max Planck institute for biological cybernetics. Her research investigates interaction techniques to support task switching and takeover situations in highly automated driving using multi-modal cues evaluated in driving simulator experiments (e.g. [13]). She has co-organized several workshops and tutorials in AutomotiveUI'15-16-17-18 and CHI'18 conferences.

Alexander Meschtscherjakov is an Assistant Professor at the Center for HCI of the University of Salzburg. In his research, he deals with automotive user interface design, user experience with autonomous vehicles, and deskilling of drivers in automated vehicles [6]. He was co-organizing conferences such as AutomotiveUI'11 or Persuasive'15 and organizer of various workshops on automated vehicles (e.g., AutomotiveUI'13-16, CHI'15, CHI'16, CHI'18 [7]).

Bastian Pfleging is a postdoc researcher at LMU Munich, Germany and soon assistant professor at TU Eindhoven, Netherlands. Previously, he was researcher at the University of Stuttgart and the BMW Technology Office in California. His special research interests are automotive user interfaces, with a focus on non-driving-related activities and the transition towards automated driving. He was involved in co-organizing various workshops (e.g., AutomotiveUI'13, CHI'16) and conferences in this domain (e.g., program chair of AutomotiveUI'17, and WIP chair in 2015 and 2016).

Frank Flemisch leads the department of Human System Integration at Fraunhofer FKIE near Bonn, Germany, is Professor for Human Systems Integration at RWTH Aachen University, Germany, and member of the NATO-STO Human Factors and Medicine Panel. He started as an aerospace engineer

Time		Phases
09:00 - 09:10		Welcome and introduction
09:10 - 10:30		Position Paper Presentations I
10:30 - 10:50		Coffee break
10:50 - 12:10		Position Paper Presentations II
12:10 - 13:20		Lunch
13:20 - 14:20		World-Cafe-style group discussions
14:20 - 14:50		Presentation of results from each table
14:50 - 15:10		Coffee break
15:10 - 16:10		Design fiction prototyping session
16:10 - 16:40		Presentations of the concepts/ prototypes
16:40- 17:00		Exploration of future work (e.g., joint publication) and wrap-up
later		Joint workshop dinner (optional)

Table 1: Workshop schedule

with a specialization in systems engineering and system dynamics. He spent many years in research on assistant systems and automation at University of Munich, NASA and DLR, served as the lead of a national standardization group and a technical expert in ISO TC204. He and his teams, together with partners from academia and industry, coined the terms highly automated driving and cooperative automation.

Christian P. Janssen is an assistant professor at Utrecht University, within the division of Experimental Psychology and Helmholtz Institute. He received his PhD in human-computer interaction from UCL (2012), and MSc in Human-Computer Interaction and BSc in Artificial Intelligence from the University of Groningen. Some of his major research interests are in multitasking and (driver) distraction, including in automated driving settings. Methodologically, he appreciates interdisciplinary approaches, including the coupling between empirical studies, and formal models of human behavior and thought [1]. Christian is a General Chair of the 2019 AutomotiveUI conference. For more information see www.cpjanssen.nl.

Andrew L. Kun is associate professor of Electrical and Computer Engineering at the University of New Hampshire. His research focus is human-computer interaction in vehicles [4], primarily in speech interaction, as well as the use of visual behavior and pupil diameter measures to assess and improve the design of user interfaces. He served as the General Chair of the 2012 AutomotiveUI conference.

Andreas Riener is a professor for HMI and VR at THI with co-appointment at CARISSMA (Center of Automotive Research on Integrated Safety Systems and Measurement Area). His research interests include driving ergonomics, driver state estimation from physiological measures, human factors in driver-vehicle interaction, as well as topics related to (over)trust, acceptance [19], and ethical issues [11] in automated driving.

Wendy Ju is an assistant professor of Information Science at Cornell Tech in New York City. Her research focuses on interaction with automation, particularly human-robot interactions and autonomous vehicle interfaces, as well as novel research methods to understand interaction with autonomy (e.g. [12]).

PRE-WORKSHOP PLANS

The participants will be recruited through a call for participation (CFP) distributed via HCI and AutomotiveUI related mailing lists (e.g. chi-announcements), as well as distribution lists based on workshops and conferences we have previously organized (complying with EU GDPR). The accepted position papers will be uploaded to the workshop website to be available for all participants.

CALL FOR PARTICIPATION

This workshop aims to bring a diverse group of researchers and practitioners together to discuss human-vehicle interaction in automated vehicles. Its focus is on research and designs that have been done in areas where humans interact directly or indirectly with automated vehicles. To participate a 2-4 pages paper in CHI extended abstract format has to be submitted to shadan.sadeghian@fkie.fraunhofer.de. Accepted papers will be presented at the workshop in Pecha Kucha style (around 10 minutes including questions). Position papers should cover a topic that is relevant to the workshop:

- Interaction with automated vehicles
- Shared control and authority
- Mixed traffic scenarios
- Interaction between cyclists and pedestrians and automated vehicles
- Mode and situation awareness
- Vehicle-infrastructure interaction
- Legal issues and legislation
- Theories and research methods
- Acceptance, trust and complacency
- Economical aspects

Applications and position papers will be reviewed by the workshop organizers and evaluated based on their quality, novelty, and fit to the workshop theme. The author of an accepted paper is required to attend the workshop and register for both the workshop and for at least one day of the main conference.

Important dates:
Position paper: February 12, 2019
Notification: March 1, 2019
Workshop at CHI2019: May 4/5, 2019
More Information:
ubisys.org/chi19ws-automation

WORKSHOP STRUCTURE

This will be a one-day workshop, and is oriented towards discussions and hands-on sessions, and presentations. The number of workshop participants will be limited to 30, excluding the organizers. Table 1 shows the workshop schedule in detail.

In the beginning of the workshop, participants will be welcomed and introduced to the workshop's goals and organizers. The rest of the first half of the workshop will be dedicated to presentation of accepted position papers. Participants will be encouraged to provide provoking presentations that tackle questions inline with the workshop goals. They will be provided a 10-minute time slot for the presentation and Q&A each. To keep the session structured and in-time, we encourage Pecha Kucha style presentations (20 slides, 20 seconds for each slide, overall duration 6:40 min).

The second half of the workshop, consists of two parts. In the world cafe discussion session, participants will discuss challenges of designers, practitioners, and researchers. Three discussion tables will be created: one for each LOA (3,4, and 5). Each table will have a host from the workshop organizers who will finalize the discussion topics of the table based on the accepted position papers. Participants will be asked to change tables each 20 minutes, to ensure that by the end of the session each participant has discussed topics regarding each LOA. The results of each table will be presented in a 10-minute summary presentation afterwards.

POST-WORKSHOP PLANS

Workshop results will be made available through the workshop website, which will be kept up-to-date also after the workshop in order to provide an interactive platform for research on user experience and automated vehicles in HCI. Following the conference, we plan to prepare a special issue on the workshop outcomes in a selected journal (e.g., Interactions). Moreover, to keep the research on the topic going in the community, future workshops will be planned to be held at related conferences extending the discussions of this workshop(e.g. MobileHCI, AutomotiveUI).

The main objective of our workshop is to provide a platform that benefits from the diversity of the community. To not only restrict it to our workshop participants, throughout the workshop, we will encourage participants to work towards a reflection statement based on the workshop discussions and the developed design fictions. These statements will be publicized in form of blog posts on Mediumhttps://medium.com/ to be available for everyone interested in the topic. Before the workshop, the organizers will place example blog posts to raise discussion points.

In the second group session of the workshop, participants will be invited to explore novel interaction concepts through design fictions inspired by their discussions in the world-cafe sessions. They will be encouraged to ideate in concrete future scenarios in different LOAs and the design space of automated vehicles. They will present their ideas by creating interaction designs and user interface concepts, and

low fidelity prototypes which visualize the specifics of Automated vehicles. Prototyping material will be provided by the organizers. The prototypes/interaction concepts of each group will be presented in 10-minute time slots afterwards.

The workshop will be wrapped up with a discussion of ways to move forward. This can include initiation of joint publications, organization of workshops at future conferences (e.g., ACM AutomotiveUI'19), and special issues on the topic.

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