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Anthropomorphic and Intelligent Assistive Systems for Automated Vehicles

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Abstract

Semi-automated vehicles utilizing interactive interfaces represent a critical, emergent research field for enhancing road safety and user experience. This half-day workshop aims to advance the design and evaluation of anthropomorphic, intelligent in-car assistants to foster trust and mitigate risks like driver distraction or over-trust. Through paper presentations and interactive discussions, participants will explore agent morphology, spanning voice-only systems, screen-based interfaces, and physical robotic agents, and investigate how these agents can effectively communicate vehicle intentions and driving context. Additionally, the workshop will address the impact of these in-car assistants on driver workload and control takeovers, while establishing robust evaluation metrics, ethical guidelines, and global standardization frameworks. By bridging robotics, vehicular communication, human-machine interaction and automatic control, this workshop seeks to synthesize practical design guidance and outline a future research agenda for safer and more efficient road transportation.

CCS Concepts

• **Human-centered computing → Human computer interaction (HCI)**; **Interaction paradigms**.

Keywords

intelligent assistive systems, anthropomorphism, trust, safety, semi-autonomous vehicles.

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1 Introduction and Motivation

Automated driving systems have the potential to transform transportation by enabling vehicles to operate with minimal or no human intervention. As vehicle automation advances, drivers and passengers increasingly rely on intelligent interfaces to understand vehicle behaviour, maintain situation awareness, and foster trust in automated systems. Semi-automated vehicles with interactive interfaces for enhanced road safety is an emergent research field [5]. Previous studies have investigated, for example, how screen-based interfaces [6] or humanoid robots [3] can assist drivers. This half-day workshop aims to advance our understanding of how to design and evaluate anthropomorphic, intelligent assistants in automated vehicles to enhance user experience [1], safety [2], and trust [4]. We aim to foster discussion and collaboration that will yield both practical design guidance and a research agenda for this emerging topic.

The workshop aims to contribute to advancing the landscape of anthropomorphic and intelligent assistive systems in vehicles and enhancing road safety for all users. Through paper presentations, we aim to identify and articulate key challenges inherent in the integration of vehicle assistants (e.g., robots, Large Language Models (LLMs)) into semi- or fully-automated vehicles. This includes understanding user behavior, regulatory frameworks, standardization issues, and road safety concerns specific to anthropomorphic and intelligent systems across the globe. Participants will discuss and brainstorm the questions below and innovative solutions leveraging robotics, perception, vehicular communication, and other emerging technologies to enhance safety, efficiency, and sustainability in road transportation to explore potential future applications.

Key questions to be explored include:

- What are the benefits and drawbacks of anthropomorphism in vehicle assistive systems? Are there risks of over-trust or driver distraction?
- What is the optimal form and persona for an in-car intelligent agent? Should it have a visual embodiment (on a display or as a physical robot) or would voice-only be preferable in an automotive context?
- How should an anthropomorphic vehicle assistant communicate and assist the user? How can the assistant convey awareness of the driving context and the vehicle's intentions (for example, explaining autonomous decisions)?
- How do these intelligent assistants impact driver behavior and safety? In what ways do these assistants influence driver attention, workload, and ability to take over control when needed?
- What design guidelines and ethical considerations emerge?
- How can we evaluate and measure success for anthropomorphic in-car systems? What metrics (e.g., trust scales, reaction time, driving performance, user satisfaction) and study methodologies (simulator studies, field trials) are suitable for this domain?

1.1 Expected Outcomes

By bringing together researchers and industry professionals from diverse backgrounds and geographical locations, the workshop will facilitate knowledge exchange, interdisciplinary collaboration, and the formation of partnerships for future research and development initiatives in the field of anthropomorphic and intelligent systems for automated vehicles. Through group discussions, participants will share insights and experiences related to the deployment of anthropomorphic and intelligent systems for road safety applications. This will lead to the establishment of best practices and guidelines for policymakers, urban planners, and industry stakeholders to promote the safe and sustainable integration of robotics into transportation systems.

The workshop will also culminate in setting an agenda for future research directions in anthropomorphic and intelligent systems, in particular how robots can be integrated and which roles they can take for road safety. Participants will identify priority areas for further investigation, potential research questions, and opportunities for funding and collaboration to advance the state-of-the-art in this domain. We are considering using the results to write a special issue proposal for a journal in a related area. If accepted, we will encourage authors to extend their workshop contributions to the special issue. Overall, the workshop aims to generate actionable insights, foster collaboration, and drive innovation to address the complex challenges and opportunities associated with anthropomorphic and intelligent assistive systems for automated vehicles.

1.2 Intented Audience

This workshop aims at bringing researchers from different backgrounds and career stages to foster discussions and shared perspectives on building anthropomorphic and intelligent assistive systems for automated vehicles. The workshop is designed for human factors researchers, automotive engineers, robotics/AI experts, and industry practitioners who are interested in advancing automated vehicles through anthropomorphic and intelligent assistive systems. We particularly invite participants from human–robot interaction (HRI) and vehicle automation communities ranging from graduate students and early-career researchers to user experience designers, psychologists, and senior engineers who want to explore how embodied agents, in-car companion robots, and external assistive robots can enhance user experience, safety, and trust in automated driving contexts. These attendees are motivated to share insights, learn about emerging research, and collaborate on solutions to enhance anthropomorphic and intelligent assistive systems for automated vehicles. The expected attendance for this workshop is 25–30 participants.

1.3 Structure of the Workshop

The workshop welcomes regular papers (6 pages including references) and position papers (2-4 pages including references) following the ACM papers format. All submissions will be peer-reviewed by two reviewers from the program committee. Deadline for submission is the 14th of August and should be submitted through EasyChair. Notifications will be sent out on the 28th of August.

This workshop is designed to be half-day and on-site. The preliminary schedule is:

Time	Session
08:30–08:40	Welcome, agenda, goals, accessibility check
08:40–09:10	**Invited keynote:** Prof. Takahiro Tanaka
09:10–10:30	**Paper spotlights:** Accepted workshop papers
10:30–10:50	Coffee break
10:50–11:30	**Demo:** Robots for automated vehicles
11:30–12:00	**Invited keynote:** Dr. Didem Gürdür Broo
12:00–12:30	**Exercise:** Group discussions
12:30–12:45	Wrap-up and future directions

The invited keynotes will frame the workshop theme by connecting anthropomorphic and intelligent assistive systems with current challenges in automotive interaction design, HRI/HAI, eHMIs, and driver-assistance agents. Takahiro Tanaka and Didem Gürdür Broo have confirmed their availability to deliver invited keynote talks online and in person, respectively. Together, their expertise covers driver agents, HAI/HCI, autonomous systems, eHMIs, and participatory design for safer mobility. The demo session will present an eHMI-based robotic system that regulates interaction between vehicles and pedestrians, providing a concrete example for discussing anthropomorphic interaction design in assistive mobility systems. The final group exercise will invite participants to synthesize insights from the keynote, paper presentations, and demo around research questions prepared by the organizers, with the goal of identifying design challenges, evaluation needs, and future research directions.

1.4 List of Topics

The workshop welcomes contributions that explore the design, implementation, evaluation, and societal implications of anthropomorphic and intelligent assistive systems for automated vehicles. We particularly encourage interdisciplinary submissions that bring together perspectives from robotics, human-robot interaction, intelligent transportation systems, automotive engineering, artificial intelligence, human factors, design, and policy. Topics of interest include, but are not limited to:

- Anthropomorphic interfaces and embodied agents for automated vehicles
- In-vehicle social robots, conversational agents, and intelligent copilots/companions
- External human–machine interfaces (eHMIs) and anthropomorphic vehicle signals for communication with pedestrians and other road users
- Human factors, trust, acceptance, usability, and user experience in assistive systems for automated driving
- Driver/passenger/operator state monitoring and assessment of distraction, stress, mind-wandering, and cognitive workload in human–vehicle interaction
- Multimodal interaction design for intelligent assistive systems, including speech, gaze, gestures, LED signals, ambient lighting, touch, and affect-aware interaction
- Explainable and transparent communication in anthropomorphic intelligent vehicle assistance systems
- Social signaling, negotiation, and behavioral influence of anthropomorphic assistive systems on road-user decision-making
- Personalization and context-aware behavior in assistive vehicle systems
- Integration of anthropomorphic assistive systems with vehicle autonomy levels, shared control, and connected transport technologies (C-ITS)
- Robotics and automation for improving road safety, accessibility, and mobility inclusion
- Design methods, participatory design, co-creation, and evaluation of automated vehicle interfaces (including simulator and field studies)
- Cross-cultural, ethical, legal, regulatory, and societal implications of anthropomorphic vehicle systems
- Future applications of socially interactive and intelligent systems in sustainable mobility

1.5 Call for Participation

To stimulate participation, we will actively promote the workshop through social media channels, relevant mailing lists (such as CHI, HRI, robotics worldwide, SAFER), and local outreach in the Gothenburg area. The workshop website is already active and can be found here: https://sites.google.com/view/anthroassist/home.

2 Organizers

Neziha Akalin is an Assistant Professor in Computer Science and Informatics Department at Jönköping University, Sweden. Her research interests are human-robot interaction and social robotics, aiming to create interactive systems that are responsive to user needs and preferences. She has previously organised workshops at international conferences including ICSR, and IEEE RO-MAN.

Nihan Karatas is a Designated Assistant Professor at the Institutes of Innovation for Future Society at Nagoya University, Japan. Her work explores how anthropomorphic interfaces, social robots, and multimodal interaction can enhance trust, safety, and user experience in human–machine systems, particularly in transportation contexts.

Sofia Thunberg is a postdoc at Uppsala University, and Chalmers University of Technology and University of Gothenburg. Her research interest is human-robot interaction and interaction design. She has previously organised workshops at international conferences such as HRI, HAI, ICSR, and RO-MAN.

Alexey Vinel is a Full Professor at the Karlsruhe Institute of Technology (KIT), Germany. Previously he was a Full Professor at the University of Passau, Germany. Since 2015, he has been a professor at Halmstad University, Sweden (now part-time). He received the Ph.D. degree from the Tampere University of Technology, Finland in 2013. His areas of interests include vehicular communications, cooperative driving, future smart mobility.

Robert Lowe is docent in Cognitive Science, and Associate Professor, at the Department of Applied IT, University of Gothenburg and Senior researcher at the Human-Centred A.I. unit at RISE, Gothenburg. His research interests concern modelling and monitoring cognitive-affective processes in relation to human-interactive technologies, which he researches across both RISE and the University of Gothenburg on several Swedish-based and EU projects.

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