Advanced Interaction Research in Autonomous Vehicles

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Abstract

The Advanced Interaction Research Lab at Drexel conducts research on emerging human-computer interaction techniques, with a focus on physiological computing and brain-computer interfaces, as well as human interaction with autonomous systems and vehicles. We see potential in the combination of brain sensing and autonomous vehicle research to better understand the user experience in autonomous vehicles.

Author Keywords

Autonomous vehicles; brain-computer interfaces.

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Background

In our work, we have designed, built and evaluated systems that take advantage of emerging technologies, which have promise to lead to major shifts in human-computer interaction. This research included theoretical work defining the Reality-Based Interaction framework for understanding and analyzing emerging next-generation interaction techniques [8]. We have also investigated brain-computer interfaces, which had been relatively unexplored in human-computer interaction

research. This work has laid a foundation HCI research by overcoming many of the technical challenges and bringing brain sensing for HCI to a point where concrete research and evaluation can be conducted [1,3–7,11,13–15]. In addition, we have complementary expertise in human interaction with autonomous systems [2,9,12] and physiological measures of workload and automotive user interfaces [10,14]. In addition to this work, we have done work using eye tracking in simulated driving environments where we explored smart device setups for speech interfaces in destination search, the occurrence and safety impact of driver's mind wandering state in different environments. Moreover, we have experience in applying machine learning on brain data to classify driver workload. In that study, subjects were asked to drive in a driving simulator while wearing fNIRS brain imaging headbands. During the experiment, they were asked to do n-back task while driving. Their brain activity was recorded during the whole process.

Motivation

With our background, we are interested in deeply exploring the future of autonomous vehicle experiences. Some of the areas that we are currently interested in are: understanding the underlying challenges for interaction between drivers and autonomous vehicles, how emerging interaction modes and techniques, such as eye tracking and brain-computer interfaces, can be applied to solve these problems, and how the privacy and legal issues come with it would be prevented. Currently, brain sensing in the car has mainly focused on understanding driver workload and distraction. In this workshop, we would like to explore how brain sensing could be used to enhance the passengers' experience, once full autonomy is achieved.

Bios

Erin T. Solovey is an Assistant Professor of Computer Science at Drexel University, with a secondary appointment in the Drexel School of Biomedical Engineering, Science and Health Systems, and she directs Drexel's Advanced Interaction Research (AIR) Lab (drexelairlab.com). Dr. Solovey's research expertise is in emerging human-computer interaction modes and techniques, such as brain-computer interfaces, physiological computing, wearable computing, and reality-based interaction. Her work has applications in areas such as driving, aviation, medicine, education, gaming, complex decision making, as well as human interaction with autonomous systems and vehicles. Her work has received several awards including the NSF/CRA Computing Innovation Fellowship and three ACM CHI Best Paper Award Honorable Mentions. She serves on several editorial boards and program committees including the International Journal of Human-Computer Studies and the ACM CHI conference. She received a bachelor's degree in computer science from Harvard, and her Masters and Ph.D. in computer science from Tufts. Before joining the Drexel faculty, she was a postdoctoral fellow in the MIT Humans and Automation Lab.

Ruixue Liu is a first year PhD student in Computer Science at Drexel University, interested in applying emerging interaction modes and techniques to human interaction with complex and autonomous systems and vehicles, as well as education systems. She received

her B.S in Airworthiness and Management from Beihang University in 2014.

Reza Moradinezhad is a first year Computer Science PhD student at Drexel University. He works at AIR Lab under Dr. Solovey's supervision. His research interests are in applications of brain-computer interfaces in virtual/augmented reality and prosthetics design, as well as their role in environments in which humans and automated systems work alongside each other.

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