Tracking the Behavior and Visual Attention of a Driver Using Multimodal Sensors in Naturalistic Scenarios

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BIO
Carlos Busso received the BS and MS degrees with high honors in electrical engineering from the University of Chile, Santiago, Chile, in 2000 and 2003, respectively, and the PhD degree (2008) in electrical engineering from the University of Southern California (USC), Los Angeles, in 2008. He is an associate professor at the Electrical Engineering Department of The University of Texas at Dallas (UTD). He was selected by the School of Engineering of Chile as the best electrical engineer graduated in 2003 across Chilean universities. At USC, he received a provost doctoral fellowship from 2003 to 2005 and a fellowship in Digital Scholarship from 2007 to 2008. At UTD, he leads the Multimodal Signal Processing (MSP) laboratory [http://msp.utdallas.edu]. He is a recipient of an NSF CAREER Award. In 2014, he received the ICMI Ten-Year Technical Impact Award. In 2015, his student received the third prize IEEE ITSS Best Dissertation Award (N. Li). He also received the Hewlett Packard Best Paper Award at the IEEE ICME 2011 (with J. Jain), and the Best Paper Award at the AAAC ACII 2017 (with Yannakakis and Cowie). He is the co-author of the winner paper of the Classifier Sub-Challenge event at the Interspeech 2009 emotion challenge. His research interest is in human-centered multimodal machine intelligence and applications. His current research includes the broad areas of affective computing, multimodal human-machine interfaces, nonverbal behaviors for conversational agents, in-vehicle active safety system, and machine learning methods for multimodal processing. His work has direct implication in many practical domains, including national security, health care, entertainment, transportation systems, and education. He was the general chair of ACII 2017. He is a member of ISCA, AAAC, and ACM, and a senior member of the IEEE.

ABSTRACT
With the development of new in-vehicle technology, drivers are exposed to more sources of distraction, which can lead to an unintentional accident. As a result, there is a need for developing sensors that can be used to monitor the drivers’ attention. This seminar describes our efforts to understand, quantify and predict driver distractions using multimodal features. We explore a joint representation of visual and cognitive distractions that provides insights to better understand the deviation in driving behaviors induced by secondary tasks. This novel cognitive and visual representation and the automatic classification of driving behaviors into the proposed distraction modes offer an alternative paradigm to evaluate the detrimental effects caused by different secondary tasks. We also explore systems to monitor the visual attention of a driver, which is a useful feature for smart vehicles to understand the driver’s intents and behaviors. Given the challenges in detecting gaze in vehicle environments, studies have approximated the gaze direction of a driver using his/her head orientation. However, the gaze angle of the driver is not deterministically related to his/her head pose due to the interplay between head and eye movements, which changes depending on the driver, cognitive load, and visual task. Understanding and modeling this relation can facilitate important progress in advanced driver-assistance systems (ADAS). This presentation will discuss our effort to estimate the visual attention of the driver using machine-learning frameworks. Instead of detecting a precise gaze direction, our efforts have focused on a novel approach, which creates a probabilistic map describing visual attention. The proposed approaches rely on Gaussian process regression (GPR) and convolutional neural networks (CNNs) with upsampling to map the six degrees of freedom of the orientation and position of the head into gaze angles. Our novel formulations establish a probabilistic relationship between gaze and eye movement, providing valuable information for navigation, infotainment, safety and communication systems.