Simulation of Automotive Headlights for Human Factors Research

David A. Heitbrink

ABSTRACT

Over the past decade there have been significant advances in automotive headlamp technology. New illumination technologies have started to be deployed, from HID to LED, and now Laser Phosphor illumination. In addition to new illumination technologies, adaptive headlamps have been rapidly gaining acceptance. These systems rely on cameras/computer vision to either aim a spotlight at potential hazards, or use masking to prevent glare for oncoming vehicles.

Lighting systems play an important role in the human factors of safe driving. Issues such as glare and visibility have been well studied for more traditional headlights. This paper addresses several technical issues related to simulating advanced headlamp systems at the University of Iowa from both the perspective of drivers as well as of pedestrians and bicyclist.

Some nighttime driving simulations use a simple light curtain at a fixed distance from the vehicle. Alternatively, we simulate the shape and illuminance pattern of the beams as accurately as possible. Moreover, different headlights have different beam patterns and illuminance, and we discuss how headlight models can be efficiently switched in the simulator to represent different vehicles. Adaptive headlamp technology requires dynamic modifications to headlamp intensity and beam pattern. We discuss capabilities that have been implemented to dynamically adjust our headlight simulation.

Finally, glare is an important aspect of headlights from the perspective of vulnerable road uses such as pedestrians and bicyclists. We discuss the simulation of glare using additional light sources in a pedestrian/bicycle simulator.

In this paper we present techniques employed to simulate headlights from both the driver's perspective, and the perspective of the pedestrian. The new capabilities allow us to conduct human factors research using advanced automotive lighting systems.

BIO

PRIMARY AUTHOR

David Heitbrink is a Software Engineer at the National Advanced Driving Simulator. He is responsible for maintaining many of the software systems that run the NADS simulator, including scenario control system, scenario authoring tool set, and many other the smaller systems. He was the lead software developer on the effort to design a new Image Generator for NADS, as well a new audio subsystem a few years before that. Mr. Heitbrink received his Bachelors of Science from the University of Toledo in Computer Science and Engineering. He continued to receive is Master of Science in Engineering at the University of Toledo in the spring of 2005, after which he joined NADS.