D9 A Forensic Engineering Review of Vision in Automobile Crashes: Part I

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After attending this presentation, attendees will better understand the general complexity of the human visual system and how fundamental characteristics affect human performance under common conditions, often with fatal results.

This presentation will impact the forensic science community by assisting attendees in assessing future cases they may encounter and by offering guidance in distinguishing confounding factors in visual system investigations.

Study of the human visual system and how its fundamental characteristics affect performance under common conditions is an element of Human Factors Engineering. It has a role in defining the design aspects of the human mobile environment as well as deficiencies due to human visual system limitations. Although there is a dominant theme in forensic engineering dealing with the design of products for human use, and associated cost and performance issues, there is also a subset that is less obvious — the overall mobile environment.

Humans have altered their mobile environment, one that was formerly dominated by low-speed walking and running performed for thousands of years, to (over a few generations) one that now also includes driving, skiing, and flying, all accompanying high-speed permutations. Humans have also created other fast-paced environments in which we rely on our visual system to function; however, the human visual system is simply not designed or evolved for optimal performance in such high-speed and high-complexity regimes. Currently, artificial intelligence systems are being tasked to intervene, presently with mixed results, and eventually take over substantial parts of these visual and cognitive functions.

In nearly every investigation involving a visual perception mishap, the following key questions arise: (1) What was there to be seen?; (2) Why was this not seen?; and, (3) How did this contribute (if at all) to the mishap? The short answer is that the human visual system is extremely complex and the human visual system is not a camera!

There are literally tens of thousands of design standards for automobiles, roads, controls, visibility, materials, lights, luminaires, and all their subsystems. Despite these design standards, hundreds of thousands of accidents, crashes, and mishaps occur each year across the globe.

This brief overview of multiple forensic engineering visibility cases will provide different explanations regarding why the scenes and situations were not sufficiently defined by the participants to avoid mishaps. This sets the basis for the matrix of causative factors to be discussed in Part II of this presentation.

This presentation will touch on fundamental concepts, including Gibson's visual world, the visual field, optical projection to the retinal structure, foveal vision, peripheral vision, processing by specialized receptor sensors, translation into bio-electrical signals, feed-forward to the visual cortex, processing and integration by neural-brain system, short-term memory, further cognitive processing and perceptual responses transmitted to specific muscle response groups, and feedback to complete a control loop.

Additionally, the discussion will include (as time permits) inclusion of the following elements as part of the eight-case analysis: perception-response time, attention and limited attention capability, illusions and perceptual traps, scanning of the visual world, human-designed visual aids, mirrors, devices, geometry, contrast, conspicuity, luminance, illumination, pattern recognition, driving search patterns, visual flow, focus of expansion, eye tracking,

saccades, scans, fixations, blinking, combining images, contrast sensitivity, line of sight, foveal vision, peripheral vision, perception of color, rods and cones, human error, risk assessment, "inattentional blindness," driver expectancy, time to collision, looming, and alerted and non-alerted observers. These topics will assist attendees in assessing future cases they may encounter and offer guidance in distinguishing the confounding factors in visual system investigations.

Human Factors, Visual World, Attention