USING ADVANCED TECHNOLOGY TO UNDERSTAND ACCIDENTS AT NIGHT INVOLVING PEDESTRIANS

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Visibility of pedestrians in night accidents is evaluated in multiple ways from simple observations, to a review of literature, to calculations using published or assumed data, to comprehensive experimental data collection and testing using specialized tools and calculations, to a combination of all the above. Accordingly, the quality and cost of the resulting work product varies widely. The study is always dependent on investigational limitations such as the difficulty of closing a road, obtaining the subject or an exemplar vehicle and matching other conditions. It is also dependent on the available information or the lack of it and as such depends on the reconstruction of the accident.

EVALUATION OF VISIBILITY

A first approach, consisting of viewing the accident site, provides some information although it is essentially of a qualitative nature. For example, it can inform as to the presence of oncoming traffic, background clutter, or impact of overhead lights on the illumination of an area but it cannot provide any quantitative data. Although the eye/brain combination can understand the information, it doesn't provide a "measuring stick" to quantify the data. In addition, the age of the observer and exposure time affect the interpretation and cannot be duplicated by simple observation. Similarly, capturing a photograph or video without a calibration process yields inaccurate results with little to no connection with reality.

A second approach, consisting of reviewing available literature, offers more quantitative data and may be scientifically informative if the conditions of the accident are similar to those of the study in terms of key factors, including color of the clothing, pedestrian position, illumination type and glare. Pedestrian accident data in reputable studies have existed since at least the 1980s for mostly dark roadways, with or without oncoming glare, and for variously clad pedestrians on different sides of the road. Data on lit roadways is significantly more scarce perhaps because the position, number and types of overhead lights offer so many variables in relation to the multiple possible positions of a pedestrian as to make it very difficult to establish a baseline applicable to all lit roadway pedestrian accidents. New data is, however, becoming available based on naturalistic studies funded by the U.S. government. In these studies, private driver's vehicles are instrumented for multiple parameters, including speed and forward video of the driver view. Accidents and near misses are therefore recorded and can be analyzed. In analyzing a given accident, the challenge remains, like in all general studies, to have as many similar parameters as possible.

At night, contrast is one of the key factors to observe a pedestrian. Luminance is the amount of light reflected toward the observer's eye from a surface, such as the coat of the pedestrian. Reflectance of white clothes is higher than that of dark clothes and as such the luminance is also higher. Contrast is a measure of the relationship between the luminance of the clothes of the pedestrian and the luminance of the background (such as the ground or the sky). In addition to luminance required to calculate contrast, glare is a significant factor in night visibility. Glare is highly dependent on the angle between the glare source and the eye, a value that is changing as the observer and the glare source move toward each other, for example. As such, in trying to quantify this data for a set of accident conditions, the remaining available methods rely on measurements or a calculation of luminance or a combination of both.

Thus, the third approach is based on comprehensive full-scale testing at the accident site with specialized tools under substantially similar conditions as the accident being analyzed. This can often yield the most reliable data. This method consists of recreating a site in order to measure as many of the parameters as possible. Calculations complement this analysis for the parameters that can't be measured. Direct measurement of luminance and glare at the recreated or exemplar site with the subject or an exemplar vehicle is ideal, while calculations to account for age and the effect of glare, for example, complement the study. In the case where the accident site cannot be used, a similar site in terms of photometric characteristics can be chosen. A vehicle with similar characteristics or an exemplar vehicle can likewise be chosen.

In the case where neither the site nor a vehicle can be used directly, a fourth approach relies primarily on calculations and equations relating the amount of incident light and reflectance of the clothing to calculate luminance of the pedestrian. The background luminance at a site can either be measured or assumed based on literature. Incident light from headlights can be measured directly on a vehicle or found in available literature on vehicle headlight illumination when available. In this situation, the challenge is again to ensure that as many parameters as possible are appropriate and similar to the accident conditions.

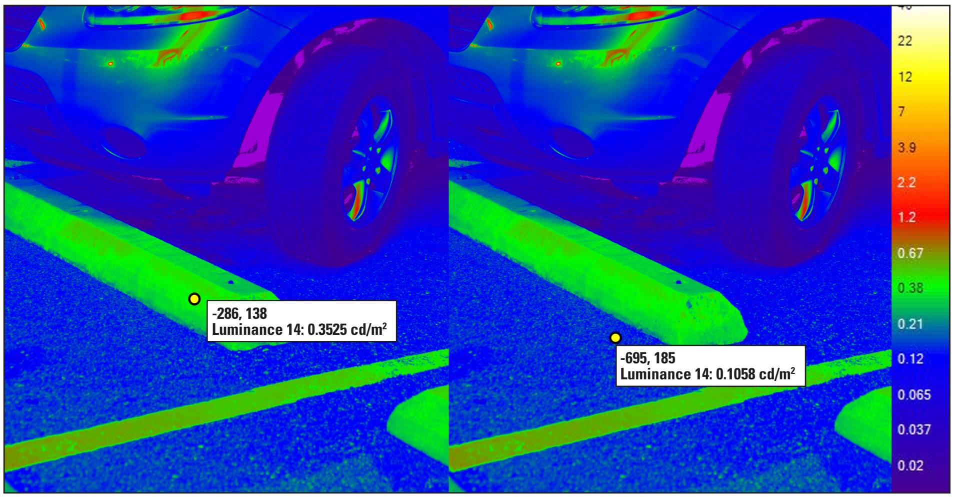
LUMINANCE MEASUREMENTS

When luminance measurements can be performed directly, specialized tools can be used that produce a high level of accuracy while allowing for detailed analyses otherwise not possible. Luminance can be measured using a spot meter, which as its name indicates, can measure one point at

a time. A luminance imaging photometer on the other hand enables an engineer to capture full-scene measurements at once and produce a luminance map with embedded luminance measurements of the entire scene. An example is shown in the luminance image of a pedestrian wearing a reflective vest standing in the middle of the road, talking to the truck driver, and illuminated by an approaching vehicle. It also results in the production of informative visuals to illustrate the concept of contrast. In this case, rather than opining in general terms about the effect of a reflective vest or lack of, the engineer can perform an evaluation specific to the accident conditions with the pedestrian and vehicle placed in the proper reconstructed accident configuration. The colors in the images are directly related to the level of luminance and, in simple terms, the larger the difference in color, the larger the contrast. The images thus convey this concept with the critical added benefit that each pixel is embedded with measured data which is in turn used to perform necessary foundational contrast calculations.

Without the imager, a detailed analysis between adjacent regions is difficult to achieve. For example, contrast between the narrow reflective vest stripe and the rest of the pedestrian body is problematic to measure and otherwise illustrate. Another example is shown below, where a pedestrian tripped on the wheel stop in a lit parking lot. The embedded luminance data of two adjacent areas is illustrated. An effectively infinite number of contrast calculations can be performed in various areas and adapted to the specifics of where and how the accident occurred.

Pedestrian multiple clothing reflectances, movements and positions in relation to lights and glare at night require a careful and often more specialized approach and are well suited to the latest technology of luminance imaging. Visual observations and the evaluation of literature do not provide actual measurements specific to the accident. Calculations alone suffer from the same disadvantage but can be significantly amended by the use of judicious measurements. In the case where full-scale measurements are possible, luminance imaging photometers provide large amounts of data that can be used to perform detailed analysis while providing effective and simple to understand visuals. This technology is available today to evaluate multiple types of pedestrian accident in a clear and convincing fashion that never existed before.



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