EFFICIENCY OF HIGH VISIBILITY GARMENTS

Vik, M., Dušek, D., Pechová, M., Viková, M., Kolcavova Sirkova, B., Dudich, T.

Technical University of Liberec, address, e-mail: michal.vik@tul.cz

Abstract: Road accidents involving pedestrians often have fatal and long-term consequences. A special problem is the safety of the first aid teams involved in rescuing injured people. Due to the different tread of their clothing, a comparative test of the effectiveness of such clothing was carried out. It will be shown that, in addition to the effectiveness of retroreflective tapes, the underlying material or local contrast is also important to increase the discriminating capability.

Keywords: *conspicuity, high visibility, safety, spectrophotometry, colorimetry.*

Introduction: In order to increase the visibility of pedestrians in general, several materials have been developed to enable their recognition. The basic concept is to use two basic materials. Garments that are intended to be highly visible are made of textile materials dyed or containing fluorescent dyes, typically yellow, orange or red [1]. These materials are intended to provide sufficient visibility during the day, when white light increases the apparent reflection due to the contribution of fluorescence to the spectral reflectance of the material. However, at night, the effectiveness of these materials is severely limited, so they are supplemented with retroreflective areas, typically retroreflective tapes. The retro-reflection of the light emitted by the headlights of vehicles informs the driver of the presence of objects, signs, or persons in the traffic area. The very color of the textile material used for the manufacture of high visibility clothing, together with the effectiveness of retroreflection, play a vital role in increasing the visibility of people. For this reason, it is necessary to carry out not only laboratory but also field tests [2]. Since the typical design of high visibility clothing is quite conservative, the focus of this research was also to compare the effectiveness of a new design of children's high visibility clothing where phosphorescent yarn was used in addition to retroreflective yarn. The advantage of phosphorescent materials is that, unlike phosphorescent materials, they continue to emit light for some time after the excitation source is no longer active. The glowing time of such materials is on the order of minutes to hours.

Materials and Methods: Krochmann RadioLux 111 luxmeter and LCAM LumiCam 1.0 luminance camera were used for measurements. The luminance camera works on the principle of capturing a given scene in a few different exposure modes, resulting in an XHDR image (Extra High Dynamic Range) that maps a wide range of luminance.
Field tests were conducted in an area without public lighting to simulate effective road visibility in an unlit landscape. For the actual test, two vehicles were used, one equipped with conventional halogen bulbs, specifically type H7. The other vehicle was equipped with modern headlights with LED chips. Figurants carrying three different types of first aid clothing, a child manikin wearing the experimental high visibility clothing and a figurant in normal clothing were photographed from 34 and 100 meters away from the vehicles.
Both low beam and high beam settings were used. The distance of 34 meters was chosen as a reference as it represents the shortest safe distance to stop a vehicle travelling at 50 km per hour and is typically used for safety assessments on illuminated roads in towns and villages.

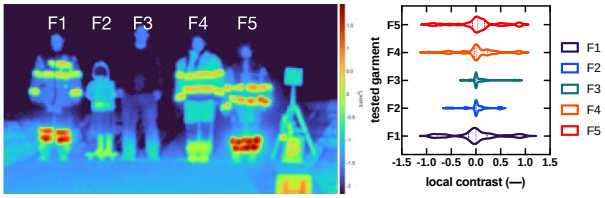

Figure 1 Luminance map and violin plot of local contrast of tested garments

Results: As shown in the brightness map in Figure 1, the tested garments exhibited different brightness intensities with the lower retroreflective stripes on figures F1 and F5 appearing to be highly effective. The third tested garment used by the first aid service showed lower effectiveness. Since contrast is important for the distinguishability of obstacles (pedestrians, animals, and other objects) on the road, it is necessary to evaluate this parameter in addition to the luminance measurement itself. In many papers, only the average contrast of a given object relative to its surroundings is evaluated. However, since it is important not only to see the pedestrian, but also to recognize it, it is necessary to measure the local contrast, i.e. to also compare the luminance of individual parts of the clothing. This evaluation was processed in the form of a violin chart, where not only positive but also negative local contrasts of the tested garments are shown. Our results demonstrate the effectiveness of the garments equipped with standard retroreflective tapes and the necessity to modify the design of the experimental children's garment. It is also clear from the results that conventional clothing shows a lack of effectiveness.

Acknowledgement: The whole research was also funded by the project SGS 2023-6385 - Enhancing pedestrian visibility in complex visual scenes in daytime and nighttime traffic conditions.

REFERENCES

[1] VIK, M. et al., 2016. Measuring Techniques for Retroreflectivity Levels of Small Signs. *Defect and Diffusion Forum*, 368, pp.193–197.

[2] VIKOVÁ, M. et al. Design of alternative warning sign and pedestrian conspicuity, CIE x046:2019 Proceedings of the 29th CIE SESSION Washington D.C., USA, June 14 – 22, 2019, s. 1069-1074.