

Practical issues in field studies using luminance cameras

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PRACTICAL ISSUES IN FIELD STUDIES USING LUMINANCE CAMERAS

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Abstract

1. Motivation, specific objective

Generally, the lighting design community focuses mainly on illuminance; however, the luminance distribution is more relevant as it relates directly to the brightness perception. This might be one of the reasons that illuminance preference studies fail to find consensus. Nonetheless, the illuminance is, traditionally, more easily measured compared to the luminance. Fortunately, with current technologies it has become a lot easier to measure the complete luminance distribution at once.

In this research, we aim to use luminance distributions, as multiple lighting quality aspects originate from the luminance distribution, as input for a control algorithm that provides human centric lighting. The luminance distribution is measured using the High Dynamic Range (HDR) technology using low cost components (camera and fisheye lens), while maintaining a practical accuracy. This technology enables us to capture images where the pixel values directly relate to the luminance values of the photographed scene. Therefore, luminance distribution measurement devices can be used to measure continuously in field studies, introducing a number of issues unique for field studies.

2. Results

A number of practical issues arise from using luminance distribution measurement devices in field studies, especially when measuring continuously, relating to privacy and accuracy, respectively.

Using cameras in field studies, to measure the luminance distribution, can be quite complex because not everybody (e.g. visitors) can formally be asked for consent while they are being photographed at a regular interval. Additionally, the question arises on how to store the data. One possibility is to only store the required data coming from the luminance distribution; however, this can potentially lead to loss of valuable information, but it can eliminate concerns about privacy. On the other hand, all data from the luminance pictures can be stored, guaranteeing that no information is lost, but this may raise privacy concerns. In addition, it is important to think of where to store the data (e.g., local or in the cloud).

Secondly, in fields studies multiple artefacts are introduced that potentially influence the accuracy of the measurements. Generally, the luminance distribution is measured from the seating position of the user. For continuous measurements in field studies this is not feasible. Therefore, the devices need to be placed at suboptimal positions. There are two distinct strategies for the placement of the device: in the ceiling similar to other frequently used sensors, or at an environment specific location that most closely approximates the seating position without bothering the local processes. The most suitable solution is also related to the specific objective of the measurements. For instance, glare measurements from a point of view on the ceiling tend to be problematic as they would not necessarily record the luminance values experienced from the user's viewing direction. Moreover, the measurement interval is a critical design aspect: a very short interval might cause a sheer amount of data that might have a little relevancy, while a longer interval might miss relevant data. It depends a lot on the fluctuation in daylight, which may best be addressed with dynamic measurement intervals. The measurement interval also relates, to a certain extent, to the privacy of the users as a very short interval might be able to track the users every move.

Finally, the resolution of the luminance distribution relates to both issues. A high resolution image allows a higher accuracy when calculating the lighting quality indicators but might invade privacy as this can, in principle, allow face recognition. Oppositely, a low resolution might introduce inaccuracies for certain lighting indicators, for instance, a glare source is spread out over a larger area. While a low resolution limits the amount of privacy sensitive data that is captured.

3. Conclusions

The luminance distribution has the potential to determine lighting quality measurements in real situations. Theoretically, the luminance distribution can be measured using only low-cost components; however, due to the environmental conditions some concessions might be required that can go at the expense of the accuracy. Additionally, some arrangement might be required to guarantee the privacy of the building users. Concluding, the practical implementation of luminance cameras is a 'tug-of-war' between privacy and accuracy.