SPATIAL DISTRIBUTION OF LIGHTING SCENES AND ITS IMPACT ON NON-VISUAL EFFECTS

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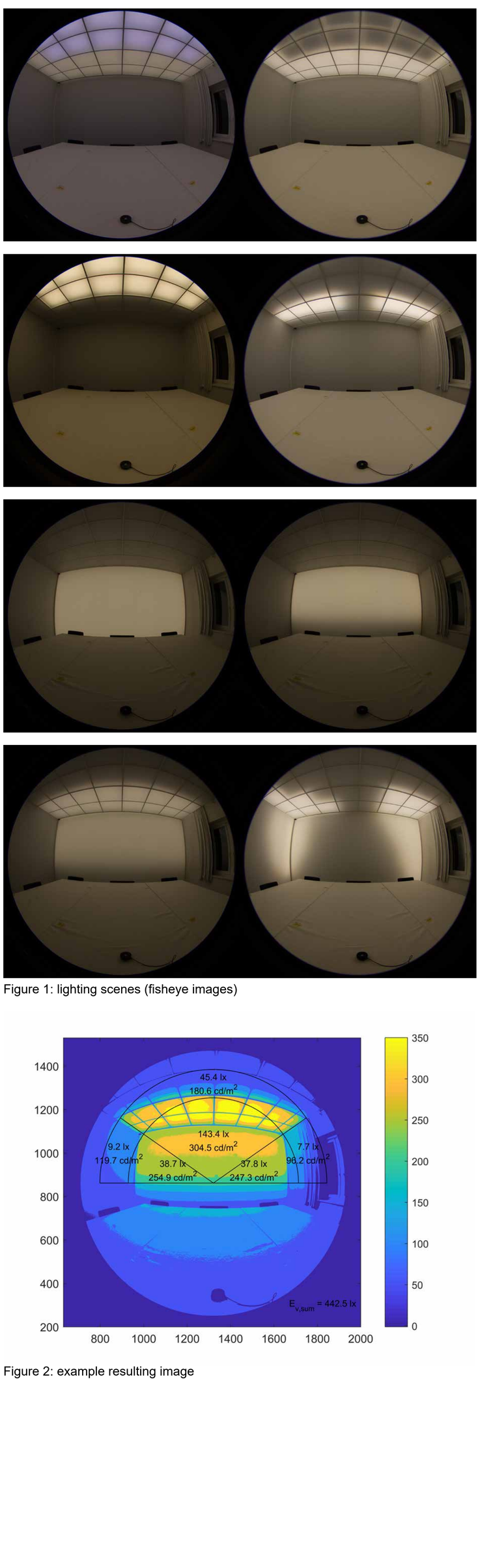


Figure 1: lighting scenes (fisheye images)

Figure 2: example resulting image

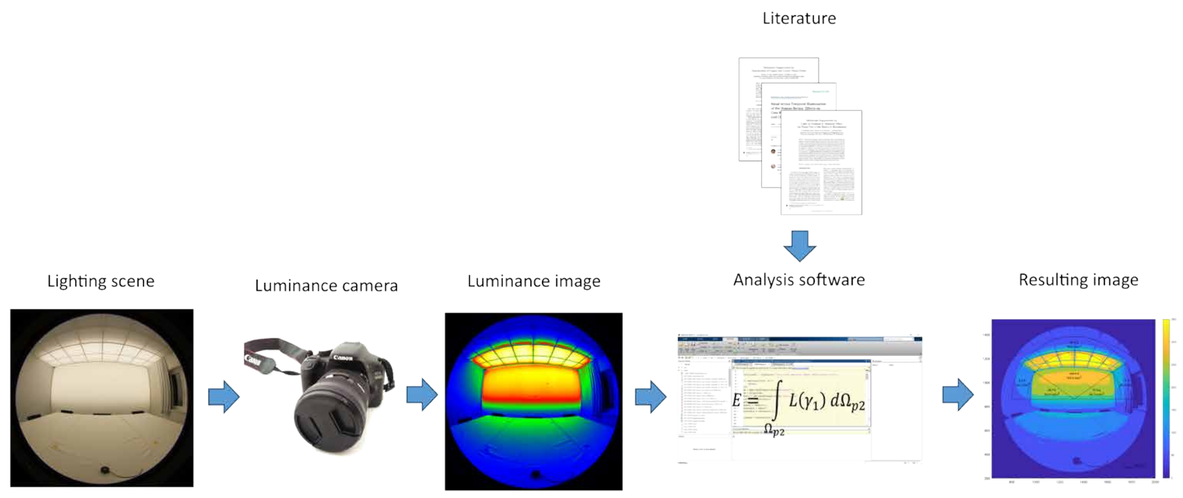
Introduction:

Functioning of non-visual effects of light is not fully understood yet. A variety of studies have been conducted, but comparing is hardly possible due to lack of detailed description of the lighting conditions. Previous works showed that the intrinsically photosensitive Retinal Ganglion Cells (ipRGCs), which are held responsible also for daytime non-image forming effects, are not evenly distributed throughout the human retina. Mainly found on the lower hemisphere of the human retina, their density respectively their sensitivity is presumably highest at the lower nasal retinal part. Thus, it is questionable if the illuminance and the melanopic irradiance of the full visual field measured at the eye, which are usually used to indicate their stimulation, are the appropriate values to quantify non-visual effects.

Research goal:

The aim of this study is to develop a measuring method to determine the partial illuminance values, which are created by special regions of the visual field measured at the eye level. Here typical office lighting scenes (lighting scenes 1-4) as well as nonstandard lighting scenes (lighting scenes 5-8), all with a constant illuminance level at the observer's eye, are investigated to reveal the range of illuminance values and to prove the capability of the developed method.

Methodology:



Results:

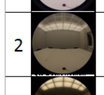
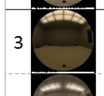
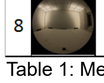
lighting scene No.		illuminance luxmeter		luminance camera Regions					
		Ev [lx]	E_h [lx]	partial Ev [% of integral Ev]	partial Ev [% of integral Ev]	partial Ev [% of integral Ev]	partial Ev [% of integral Ev]	partial Ev [% of integral Ev]	partial Ev [% of integral Ev]
1		506	657	2,8	15,1	2,8	1,5	14,0	1,5
2		511	694	3,1	19,2	3,2	1,7	11,0	1,7
3		504	619	1,9	5,6	2,0	0,8	18,6	1,0
4		499	681	3,2	14,0	3,2	1,8	15,6	1,8
5		497	263	9,9	24,3	9,5	1,6	4,2	1,2
6		500	276	11,1	29,2	10,6	1,6	4,2	1,3
7		507	329	7,7	28,6	7,5	1,8	9,0	1,5
8		496	338	7,3	19,1	8,5	5,4	10,5	2,1

Table 1: Mesurement results of eight lighting scenes (1 - 4 standard like and 5 - 8 nonstandard like) (red indicating low, green indicating higher percentages of integral E_v)

Conclusion:

A luminance camera based measuring method to determine the partial illuminance values, which are created by special regions of the visual field measured at the eye level was developed. Here regions were chosen to fit illumination of the left and right eye's lower nasal part of the retina and the illumination of the lower parts of both retinas simultaneously. Standard and nonstandard office lighting scenes were investigated. Data show that more standard like office lighting scenes cause only weak illuminance in the regions of the visual field which are considered as relevant. Lighting of the opposing wall led to much higher illuminance values for these regions. These results emphasize the importance of the direction of light in terms of investigating non-image forming effects.

Outlook:

While in the controlled environment of the LED backlit test room the spectral distribution is known, doing field measurements in real offices makes it necessary to measure as well spatially resolved spectral data. So, the next stage of expansion is to enable the luminance camera system to s_{mel}-weighted spatially resolved measurements. Furthermore, energy consumption respectively efficiency will be taken in account. These data might influence recommendations for lighting planning with focus on non-visual effects.

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