

Poster

Application of the State-of-the-Art HDR Imaging Analysis in Lighting Research: A Pilot Study on King's College Antechapel, Cambridge

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Pilot Study: King's College Antechapel

The perception of lighting is often complicated by an individual's role, eye movements and expectations. Its research progress is nevertheless hampered by heavy reliance on conventional physical light meters. In light of this, this paper presents preliminary findings of an ongoing research project, Cambridge King's College Antechapel Lighting Analysis, through the use of a state-of-the-art research tool, high dynamic range (HDR) imaging technique.

This pilot study examines lighting quality created by four artificial lighting scenarios, All Lighting, Rig Lighting, Interim Lighting and Proposed Lighting (single test unit only), with a critical analysis of their aesthetic appearance and lighting quality as perceived by audience members, conductor and musicians. The present Rig Lighting installed temporarily above the performance area of the Antechapel has received complaints about its low luminous intensity, uneven luminous distribution and visual distraction caused by the rig structure, raising the question of how a new lighting scheme, one that requires less energy consumption, might restore and maintain the sensible balance of lighting at the Antechapel.

HDR Photometric data analysis

Two approaches were set to analysis the HDR images of the Antechapel: I) To examine the luminance distribution based on non tone-mapped HDR images through the use of false-colour images and relative luminance maps; II) To examine the overall perceived brightness and contrast through mean (IM) and standard deviation (ISD) of RGB pixel intensity of tone-mapped HDR images.

Results and Discussion

False-colour images computed from the exact luminance levels do not indicate the way our visual system adapts to the threshold contrast between target and background luminances. A new way is therefore proposed to analyse the luminance pattern by mapping its relative luminance (RL). The RL is a ratio of spot luminance to maximum luminance of a visual field, and is defined as: $RL = (Luminance_{spot} / Luminance_{max}) \times 100\%$. These maps reveal a rather surprising result concerning the brightness contrast of the Antechapel: despite giving the lowest average luminance, Proposed Lighting has the highest RL. With the ratio between the spot and maximum luminances considered, the silhouette and architectural details of the Antechapel can be seen in All Lighting and Proposed Lighting. Moreover, Interim Lighting proves to be moderately effective in revealing the complexity and impression of spaciousness of the Antechapel. Rig Lighting, however, fails to reveal any spatial details or to create any spatial or aesthetic impressions. Furthermore, the IM/ISD analysis indicates that the occupants may have better visual acuity under Proposed Lighting, and the perceived luminous is also likely to be more stimulating. These results suggest that the HDR imaging technique can provide richness of spatial and mathematical data to predict and evaluate visual appearance, perceived brightness and contrast of a complex context.

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