Visualizations of perceptually relevant light parameters

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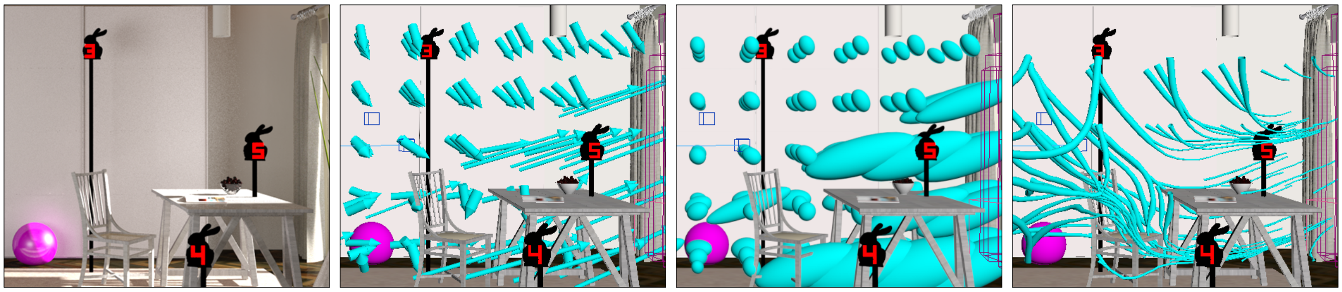

Figure 1: *Fragment of a scene and three light parameters visualizations. Left to right: scene rendering, arrows visualization, ellipsoids visualization, tubes visualization. Visualizations were presented in a viewport. Original scenes credits to Fernando Tella.*

Keywords: visualization, global illumination, perception.

Concepts: • Human-centered computing~Visualization techniques.

1 Introduction

Light strongly influences the appearance of the shape and material of an object. For example increasing the light diffuseness makes an object look more flat and matte. We consider the actual light resulting from sources and optical interactions in the scene. Taking into account the interdependence of light and scene properties, it is not easy to optimize lighting. A light design workflow is essentially an iterative process of adjusting lights and objects in a scene to achieve the desired appearance. Typically, a time-consuming rendering is used to see the results of the last manipulations. We propose a method visualizing the light parameters commonly used by light professionals and, more importantly, proven to be basic light characteristics for which human observers are sensitive: "intensity", direction and diffuseness. The visualizations are presented in the viewport and therefore are much faster than rendering. They show the light flow - global changes of the parameters - over a scene using grids of shapes or visual gauge objects.

2 Our approach

We obtain the luminance in a volume of a scene using interpolated cubic measurements [Xia, 2016] from which we consecutively extract light parameters: intensity (mean illuminance), direction (of the light vector), and diffuseness. These parameters are then visualized via three types of shapes. The visualizations reveal the variations of the light parameters through their size, shape and orientation. Arrows are in the direction of the light vectors (where the light is coming from on average). The arrow length represents the light intensity in a point (longer arrow: more intense the light), and the shaft width the diffuseness (thicker arrow: more diffuse light). Ellipsoids are aligned with the light direction. Ellipsoids' sizes represent the light intensity in a point (bigger ellipsoid: more intense light), and the shape the diffuseness (more spherical ellipsoid: more diffuse light). Tubes are aligned with the light direction at any point along its length. The thickness of a tube is inversely proportional to the light intensity (thicker tube: less intense light).

3 User study

We conducted a user study on 6 scenes. In each trial a scene was presented either as rendering, or as one of the visualizations (see Figure 1), containing 5 bunnies' silhouettes placed in points with mutually different light conditions. The user study consisted of two experiments taking up to 1,5 hours per observer. In experiment 1 (of 66 trials) our 14 participants judged three of five bunnies according to a certain light parameter by answering two questions, for example "On which bunny is the light most intense?" and "On which bunny is the light least intense?". In experiment 2 (of 24 trials) users were asked to match the bunnies' silhouettes to shaded bunnies cut out from a scene. The visualizations and renderings all resulted in accuracies significantly above chance level. The visualizations significantly outperformed the renderings for experiment 1 (thus, the visualizations were most convenient for comparing the light parameters across a scene) and showed no significant difference from renderings for experiment 2 (thus, *in the viewport* they allowed to estimate the objects' final appearance as good as in renderings). So, the proposed visualizations can form a powerful tool improving light design workflow.

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References

XIA, L., PONT, S. C., & HEYNDERICKX, I. (2016). Light diffuseness metric , Part 2 : Describing , measuring and visualising the light flow and diffuseness in three-dimensional spaces. *Lighting Research and Technology*, 1–18.

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