PhD topic

Idea to calculate luminous flux and directionality - Using RADIANCE?

source: se'lux
Developing criteria for categorisation of illumination quality in interiors

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Idea to calculate luminous flux and directionality - Using RADIANCE?

source: se`lux
Motivation:
Lighting quality in indoor workspaces
Motivation: prEN 12464-1:2009

Lighting criteria in office environment (quantitative & qualitative)

- Luminance distribution
- Illuminance level
- Glare
- Directionality, direction of light
- Colour and colour rendering
- Flicker
- Daylight
- Variation (level and light colour)

(Translated by author)
Motivation:
prEN 12464-1:2009 Directionality & Illumination quality

4.6.3 Modelling

Modelling ist die Ausgewogenheit zwischen diffusem und gerichtetem Licht. Es ist ein wesentliches Kriterium der Beleuchtungsqualität für praktisch alle Innenräume. Das allgemeine Erscheinungsbild eines Innenraumes verbessert sich, wenn seine baulichen Merkmale, die Menschen sowie die Gegenstände darin so beleuchtet werden, dass Form und Struktur deutlich und gefällig gezeigt werden. Dies wird erreicht, wenn das Licht vorwiegend aus einer Richtung kommt; die für ein gutes Modelling so wichtigen Schatten sollten dann eindeutig ausfallen.

Modelling means the balance of directed and diffuse illumination. It is an essential criterion for the quality of illumination of interiors. The appearance of room increases by illuminating space, humans and solids with emphasizing contours and structure pleasantly. This can be realised, when lighting incidents from one main direction, so the important shadows for a good modelling appear distinctly.

(translated by author)
Research questions

Directionality and the incident direction of light

– How to describe scientifically?
– Do preferred situations exist?
– How to visualize these indicators for application in lighting design?
– What could be a suitable simulation tool?
Sketch: Evaluation of the light field theory
Selection of authors & ideas

- **Michael Faraday, 1846**
  
  lecture entitled "Thoughts on Ray Vibrations"
  
  -> light should be interpreted as a field much like the magnetic fields…

- **A. Gershun, 1936**
  
  "The Light Field" - "[...] we shall introduce the concepts of the light field, as a part of space studied from the standpoint of transmission of radiant energy within that space [...]"

- **H.-J. Helwig, 1950**
  
  "Die Feldtheorie in der Lichttechnik" – In illuminating engineering as well as in electrical engineering one deals with spaces where electromagnetic waves pass through [...], so we can create an adapted theory from the electric field to a light field [...] (translated by author)

- **Moon & Spencer, 1981**
  
  "The Photic Field" – "[...] Maxwell's equations can be applied to photic-field problems. [...] the photic field is quite distinct from Maxwell's electromagnetic field [...]"
Light field theory: indicators

Luminous flux density – pharosage \(D\)

Helios \(H\) = pharosage per unit solid angle

Light vector

Flow of light

Luminous flux

Luminance distribution solid

Illumination solid

Vector component

Symmetric component

source: Helwig, 1950

source: Moon, Spencer, 1981

source: Waldram, 1971
Light field: daylight

source: Helwig, 1950

source: http://www.flickr.com/photos/13818157@N05/2331387505/
Light field: daylight

source: Helwig, 1950

source: Moon, Spencer, 1981
Light field: daylight

Figure 10 Computed luminous energy field in a room lit by a side window and a rooflight: (a) scale of the spatial grid; (b) density plot of mean spherical illuminance, using three-colour simulation; (c) vector field of mean luminous flux

(P.R. Tregenza, 2002)
Light field: daylight and artificial lighting

Light field by incident skylight

Light field by a point light source

Superposition of both light fields
Examples: Light field and barriers

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**Figure 5.15**
Uniform-strip source with barrier.

source: Moon, Spencer, 1981
Designing the light field

furnishing

daylight

artificial lighting

Carolin Liedtke

21.09.2010
The Black Box

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Thank you for your attention and discussion!