

Beyond trial and error in lighting optics design

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Beyond trial and error in lighting optics design

Illumination optics is an important field in the lighting industry. However, the knowledge is gained merely by experience and stored in the heads of a small group of aging engineers. In practice, optical design for lighting applications is a process of trial and error and thus time-consuming and expensive.

“Finding good optical design engineers in the field of lighting is a challenge. Mostly, these kinds of engineers have already worked in the industry for 25+ years, so it is more craftsmanship than science.” Wilbert IJzerman, head of LED Solutions at Philips Lighting and part-time professor at the TU/e, is trying to counter this problem with the development of appropriate models and algorithms to feed design tools and processes. “Also from the academic side, there was no serious attention for the optical side of lighting. A few groups have conducted studies on the subject, but they mostly opted for a singular approach, in physics or mathematics.

This has resulted either in abstract descriptions that design engineers cannot easily put into practice or in algorithms that work in one specific case only.”

Roadmap

So IJzerman - with the enthusiastic support of Klaas Vegter, CEO of Philips Lighting – started developing a dedicated research program. “We made a 10-year roadmap, containing six relevant topics. And the times were in our favor. Within ILI, the TU/e and Philips Lighting launched a flagship agreement, a joint research program in which our plans fitted seamlessly.”

Controlled scattering

The first example is a research project focused on the scattering of light. IJzerman: “You could say that LED as the current standard in lighting technology, is outperforming. The light is too bright for a lot of applications. So the industry found

a way to counter this. We scatter a part of the released photons by placing a phosphor coating or shield between the dye and the eye. However, we lacked exact knowledge of the scattering behavior, we didn’t completely understand it and we had no accurate and reliable models. So what we made was always designed-by-experiment: make a range of different scatter particle concentrations and see what works best. This is time-consuming and ineffective. We are trying to find a model that describes and predicts the behaviour of the scattering in a reliable way. At the TU/e, we’re performing experiments in which we use a plasma to position dust particles in a regular pattern and try to find a way to measure the interaction between the particles and the wavelengths of the light...”

Inverse methods

A second project studies ‘inverse methods’. IJzerman: “Say you want to achieve a certain light distribution. You know the

distribution characteristics of the source, but what optical structure should you use? Nowadays, optical engineers do this on the basis of experience and craftsmanship. But it remains a sort of trial and error situation. Therefore, we are trying to put this classical craftsmanship into a computer code. We want to have algorithms that can define the shape of the optical structure in order to effectively produce a certain light image. Today, we can take much more freedom in the design. Classical incandescent lamps heat up, restricting your design freedom and usage of materials enormously. Today, we can work in plastic. However, we hardly use our freedom because we do not know how to design it properly.”

Good lighting systems

“In the end. We want to make more energy-efficient and functional luminaires. With our six research projects, we are making steps towards more control in the design and the development of these lighting systems. Within ILI, we are the hardware guys. The core of ILI might be more on the perception side of light, but you need good lighting systems for that. We have just started and we are still shaping the program, but we are happy to collaborate with ILI, as it brings together all kinds of lighting professionals.”



Prof. Wilbert IJzerman