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INTERVIEW | **SYLVIA PONT INDUSTRIAL DESIGN, TU DELFT**
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Perception, determinator for designing intelligent lighting systems

"Intelligence in systems can be defined by how humans experience the functioning of a system or environment as intelligent or not," says Sylvia Pont, Antoni van Leeuwenhoek professor of Perceptual Intelligence at the Faculty of Industrial Design Engineering, TUDelft. Sylvia recently joined ILI as a core team member, connecting interesting knowledge to the research around light and (designing) effective and appealing human-centric lighting systems. Let's take a brief dive into her current work.

WHAT IS PERCEPTUAL INTELLIGENCE?

"Perceptual intelligence is about active construction of perceptual experiences by our sensory system and brain, it comprises active problem solving relating to the experience of physical phenomena, such as sound, color, light, and movement, and it is also about the meaning we describe to these phenomena: is something safe, friendly, or hostile? Perceptually Intelligent design is about identifying interactions and designing products, environments and systems that enhance human experience at different levels of perception, cognition, emotion, and behavior. An intriguing field, which I approach with a focus on light and lighting design."

INTELLIGENT SYSTEMS AND ENVIRONMENTS

To create intelligent systems, we see a tendency towards multi-sensory approaches. This is mostly about the harmonic congruence between lightscape, soundscape, colors and materials in a certain space. Another interesting topic is the area of cross-modal interactions. In other words, mimicking an experience by using stimuli for certain senses that activate associations in other senses. Take for example internet shopping. How can you use visual and auditive stimuli to create an almost haptic experience of a textile or ceramics product? It is possible to design interactions that combine visual, sound, and mouse interactions to deliver a haptic illusion, mimicking the material properties. Not physically correct, but by tapping into the existing associations in our brains, we can deliver useful illusionary experiences. Though I concentrate on light and lighting systems design, we also have people in the group working on touch and sound." >>>

LIGHTING

Lighting plays a major role in creating intelligent systems. In the past years, lighting design has developed towards human-centric approaches. Light in buildings should enhance the health, well-being, and productivity of building users. This resulted in new guidelines for lighting systems design. Sylvia: "These guidelines form a starting point. Natural light is much more than brightness and color temperature variations. It is a complex interplay of diffuse light direct light and light patterns plus their variations over time and space. Moreover, what we see and experience in a certain space is not only light(ing). It is an interplay of lighting with the surroundings, geometry, materials, colors, and dynamics of other users in the room. And each context and user have their own requirements and needs. This makes designing true human-centric lighting quite challenging. The guidelines simply do not suffice. So, in practice, we often see a process of trial and error. To truly connect to physical, cognitive, and emotional conditions of people, lighting design needs to step up."

MEASURING LIGHT

"I have worked on light measuring techniques over the past 20 years, that is, its optical and its perceptual characteristics as well as the relationships with its design. We now have developed methods and tools to accurately measure, describe, visualize, and design light and lighting conditions in spaces. Inspiration was the work of the genius Russian mathematician Gershun who wrote a beautiful article The Light Field. We describe light in a space in 7 dimensions, as a function of position, direction, time, and wavelength. This provides great understanding, however, designing in 7 dimensions is far too complex. We aimed to simplify this into workable proportions. We have made a mathematical decomposition, splitting the light into simple components, which are observable and calculable and can be used by designers in a layered design structure. We thus composed a Framework for Lighting Design that consists of three main layers:

- Ambient (the surrounding diffuse light).
- Focus (strongly directed light).
- Brilliance (light textures or patterns).

This framework provides a basic understanding of light in a defined space. It goes for indoor situations as well as for outdoor."

Golf ball as light probe

Christopher Cuttle invented a series of light probes to visually test light behavior on objects. The white disc and pen (a sort of sun dial) tells something about the focus(es), direction(s), and beam shape(s) of the lighting. The black shiny ball is about identifying highlights, and brilliance. Yet with the white ball, diffusely reflecting the light, what you see is highly dependent on how you look at it. That's why we use a golf ball instead. Thanks to its 3D texture, it helps to identify and disentangle the interacting ambient and focus parts of the lighting.

MEASURING PERCEPTION

"As I stated, our experience is an important determinator of whether a lighting system is functional, appealing and contributing to wellbeing, measuring perception is crucial. Yet, this is also a challenging area. We have developed methods that are complementary to the traditional survey of asking people how they experience the light in a room. For questionnaires, it is important to have accurate terminology, to adequately capture what one wants to know. For atmosphere perception research we can luckily build on great work conducted at ILI to construct effective surveys.

Yet. we also use a visual quantitative method. In this, we present participants with a scene white a light probe (this can be done in a real 3D scene or in a photographed or computer-simulated visual on a screen). The participant is asked to set the lighting on the probe in the scene, reflecting how the light in the scene is perceived. The parameters of the settings the participant chooses, give us information on their experience. If you perform this systematically for different rooms and scenes you can deduct how sensitive people are for certain characteristics such as direction, diffusion, focus, and shades of lighting, and how those interact perceptually with all sorts of conditions. And we can expand this test methodology to materials, colors, and shapes as well."

TOWARDS THE FUTURE

"Now we can make valuable comparisons between the physical phenomena and the human perception of these phenomena. This provides great insight into the needs and wants of people for lighting. With this research, we aim to deliver a comprehensive framework for the design of effective and appealing lighting systems. But there is still a lot of work to be done. For example, the Brilliance-aspect of lighting. Brilliance offers an infinite design space. How can we effectively describe brilliance in terms of optics and words? We need adequate vocabulary for both the effect of the light and for the interactions that lighting systems designers and users can utilize. And there are other interesting opportunities, such as cross-modal and multi-sensory intelligent systems.
I am very happy in this respect, to be part of the ILI core team. I think that our teams, together with the Light & Lighting Laboratory of KU Leuven, perform complementary research work. We can learn from each other, build on accurate and up-to-date knowledge, and help each other propel." ■