

Researchers devise a simpler way to mimic aspects of human vision

May 16 2023



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Mimicking the performance of the human visual system is viewed as a difficult endeavor because of the extremely complex optical elements involved. In new work, researchers show that it's possible to create a lens system that reproduces certain characteristics of human eyesight using simple spherical optical components.

Guillaume Allain from Université Laval in Canada will present this research at the [Optica Design and Fabrication Conference](#), which will take place June 4–8 2023 in Quebec City, Canada.

"Having a physical eye model which provides an accurate rendering of the full range of vision of a human eye as well as a biologically accurate pupil can be an important tool in the quality assurance of devices which we use for entertainment or medical purposes," said Allain.

Replicating the human vision system requires a thorough understanding of how it works. However, optical elements such as variable index materials or curved photosensitive surfaces and requirements for a wide field of view and multi-layered image processing can make it challenging to study the human visual system as if it were a traditional optical system.

In the new research, investigators report a new approach to understanding and visualizing the optical performance of the human eye in a way that can be used to design a [lens system](#) that mimics it. To do this, they used two different computational eye models to extract key optical measurements: the entrance pupil, the [resolution](#) based on the modulation transfer function, and the relative illumination.

These measurements were then used to create a simple optical design that required only spherical surfaces. The lens system was designed to first render a scene with just the right amount of detail to emulate the degradation of image quality in the human field of vision. Since the pupil shape and position are also important requirement for some instruments, accurately emulating the pupil was also an aspect of this research project.

To see how well this approach worked, the researchers compared the performance of the lens system they designed with that of the human

visual system. This quality assessment showed that the new design, which required minimal optimization, could easily reproduce the quality of the human vision system without requiring any aspherical components, which increase the complexity of the system. In fact, the initial design could be relaxed by removing some surfaces and still achieve a quality similar to that of human vision.

"We are currently looking at further simplifications in the design for a flat camera and how the addition of a curved image sensor, inspired by the curvature of the human eye's retina, could help in that regard," said Allain.

Provided by Optica

Citation: Researchers devise a simpler way to mimic aspects of human vision (2023, May 16) retrieved 26 June 2024 from <https://phys.org/news/2023-05-simpler-mimic-aspects-human-vision.html>

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