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Wearable adaptive optics for the eye

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The optics of the human eye is at once simple, robust, and remarkably well adapted to the needs of the visual system. However, how different optical aberrations, whether naturally occurring or artificially induced, affect vision remains a central question in ophthalmology and visual optics. One of the most powerful approaches to investigate this involves the use of adaptive optics (AO) visual simulators. Traditionally, AO visual simulators have been developed as laboratory or clinical desktop systems. These instruments combine wavefront sensing to measure the eye's optical aberrations with phase modulation devices, such as deformable mirrors or spatial light modulators, that allow the controlled induction of specific optical profiles. This enables direct testing of visual performance under well-defined optical conditions, providing insights into the visual impact of aberrations and the design of new advanced optical corrections. In recent years, we have extended this concept into wearable devices. These emerging systems aim to bring high-resolution visual simulation and testing into real-world settings, enabling assessment under natural viewing conditions and over extended periods of time. In this presentation, I revise the evolution of adaptive optics in vision science, from retinal imaging to visual simulation. Special emphasis will be placed on the technological challenges and opportunities of miniaturizing and adapting these systems for use in dynamic, real-life environments. Wearable adaptive optics has the potential to transform both vision research and clinical care, opening new possibilities for personalized correction or myopia control strategies.

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