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Accurate and Robust Eye Tracking with a Scanning Laser Ophthalmoscope

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Technology description

The tracking scanning laser ophthalmoscope (TSLO) provides fast and accurate measurements of fixational eye motion with flexible field of views. Currently, this system is the most accurate, fast and functional eye-tracking system used in a standard ophthalmic instrument. At a basic research level, the benefits of accurate eye-tracking are especially useful for delivering stimuli to targeted retinal locations as small as a single cone. In the clinical domain, advances in imaging and tracking technology help render accurate images which can lead to better outcomes in treating eye disease. Scanning laser ophthalmoscopy (SLO) uses both a horizontal and vertical scanner to image a specific region of the retina. Current state of the art tracking SLO systems are only suitable for observing a narrow field of view (FOV < five degrees) and will lose signal with certain types of eye motion. This is problematic for patients suffering from varying retinal or neurological disorders, where unstable fixation hinders accurate eye-tracking and image acquisition. These include retinal diseases of the macula such as: age-related macular degeneration, or neurological disorders such as: Alzheimer's and Parkinson's disease. In cases such as these, it would be desirable to capture a larger field of view whose image quality is sufficient to track the retina for larger and more rapid eye movements. To help address this problem, researchers at the University of California, Berkeley have developed systems, software, and methods for an image-based high-performance TSLO. Early laboratory experimentation results suggest significantly enhanced eye-tracking in terms of: sampling uniformity of eye motion traces, detection of eye rotation, increased frame rate of image capture, expandable/adjustable FOV, stabilization accuracy of 0.66 arcminutes, and tracking accuracy of 0.2 arcminutes or less across all frequencies. The Berkeley system and techniques show promise for observing detailed structural and functional changes in the eye as a result of age and/or disease like never before.

Related Materials

High-speed, image-based eye tracking with a scanning laser ophthalmoscope
Impact of Scanning Density on Measurements from Spectral Domain Optical Coherence Tomography
Optical coherence tomography in retinitis pigmentosa: reproducibility and capacity to detect macular and retinal nerve fiber layer thickness alterations
Retinal motion estimation in adaptive optics scanning laser ophthalmoscopy
Eye Tracking with the Adaptive Optics Scanning Laser Ophthalmoscope
Design of an integrated hardware interface for AOSLO image capture and cone-targeted stimulus

delivery
Correcting for miniature eye movements in high resolution scanning laser ophthalmoscopy
Observation of cone and rod photoreceptors in normal subjects and patients using a new generation adaptive optics scanning laser ophthalmoscope

Application area

Clinical diagnostic imaging of retina
e.g. glaucoma, macular degeneration, other retinal disorders
Research study of retina
Generation of eye motion signals to guide other ophthalmic devices e.g.
Optical coherence tomography (OCT)
Adaptive optics scanning laser ophthalmoscopes (AOSLO)
Electroretinography (ERG)

Advantages

Leverages industry-standard ophthalmic platforms
Small footprint, low cost, robust TSLO
Captures up to 10 degrees of eye motion while simultaneously acquiring high quality video

Institution

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