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Ophthalmic polarization-sensitive diagnostic technologies employing retinal birefringence scanning

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KEYNOTE SPEAKER

Retinal birefringence scanning (RBS) has recently been used to detect central fixation and proper eye alignment in ophthalmic diagnostics. It utilizes the property of the Henle fibers surrounding the human fovea to change the polarization state of light in a double-pass polarization-sensitive optical system. This principle has been employed in a series of vision screeners developed in our lab. They allow eye tracking and detection of central fixation using anatomical information directly from the fovea and without calibration, unlike other eye tracking methods that employ less accurate pupillary light reflex methods. In a binocular setting, RBS facilitates precise checking for eye alignment. These instruments have proven to be valuable in early detection of amblyopia and strabismus. Such systems are particularly useful when working with young children. The presentation focuses on a family of pediatric vision screeners and includes design optimization using a computer model of polarization-sensitive systems.

The usage can be expanded to add a fixation detection function to other ophthalmic technologies, such as laser-doppler flowmetry, fundus cameras, OCT devices, etc. As an example, a hybrid system integrating optical coherence tomography and retinal birefringence scanning is presented. It acquires and/or analyzes data only during moments of central fixation. This can significantly reduce the image processing time, and shorten the exam duration. Methods to attract the subject's attention and ensure fixation are also discussed.

Special attention is paid to possible implementation of no-moving-part technologies, liquid crystal technologies, and clinical testing. Related topics will be discussed, such as automatic detection and correction of ocular defocus in vision screening, laser safety, decision making logic, and others.

The talk will be interesting to ophthalmologists, optometrists, medical students, biomedical engineers and physicists, as well as health care managers and general practitioners.

Biography

Boris Gramatikov obtained his Dipl.-Ing. degree in Biomedical Engineering in Germany, and his Ph.D. in Bulgaria. He has completed a number of postdoctoral studies in Germany, Italy and the United States. He joined the faculty of the Biomedical Engineering Department of The Johns Hopkins University in 1996, and has been working in the Laboratory of Ophthalmic Instrumentation Development at The Wilmer Eye Institute since 2000. His areas of expertise include electronics, optoelectronics, computers, computer modeling, signal/image processing, data analysis, instrumentation design, biophotonics, ophthalmic and biomedical optics, polarization optics, all applied to the development of diagnostic methods and devices for ophthalmology and vision research. His team has developed a series of pediatric vision screeners. He has over 120 publications, 41 of which in high-impact peer-reviewed journals. He serves as a reviewer and editorial board member with a number of technical and medical journals.