Interactive live imaging of human eyes

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Optical coherence tomography (OCT) is an imaging technology used in the eye, which gives extremely detailed, almost cellular level information about the retina using non-invasive, low energy light. OCT images can be generated very rapidly. However, the technology generates so much information that it can be difficult to interpret and use the data in clinical practice. One very desirable application of OCT imaging is integration into the operating microscope during ophthalmic surgery and neurosurgery. The rapid collection of data does not disturb the surgeon's workflow, and can offer important information on the state of the retina during surgery.

However, OCT scans are difficult to interact with, and are typically displayed as a series of flat two dimensional B-scans. These characteristics make it more difficult for the surgeon to use the OCT-derived information as a guide.

Scientists from IOB and the University of Basel have introduced a novel virtual reality (VR) imaging technique for instant volume OCT data rendering, enhanced with real-time ray casting of shadows. It enables the visualization of the vitreoretinal interface, particularly the retina and its layers, with a cross-sectional and three-dimensional (3D) display. This digital transformation could alter how OCT and other imaging information are displayed and transform the medical field by providing clinicians with an environment that augments their training, facilitates surgical planning, and supports clinical decision-making intraoperatively. Trained ophthalmologists with a mean of 15 years of post-graduate professional sub-specialization rated the application positively.

The system empowers the user to switch promptly between the 3D-OCT VR model and the corresponding original OCT data by means of the cutting plane. Instantly, the user can focus on any space, section and junction, and selectively hide or display particular structures. This combined feature of synchronized mapping of original, highly complex, 3D-OCT point-cloud volume data and plane view offers an unprecedented and meaningful VR environment. This kind of 3D data modeling and data representation mitigate the risk of masking pathologic tissue, such as intracranial aneurysms, which has been shown for VR rendering. The combined, multidimensional feature in the software avoids missing critical information, because the VR image is immediately correlated and compared with corresponding OCT images.

The combination of VR and machine learning can process high-end data in real time. The Ophthalmic Imaging Research Group at IOB showed that the developed system was at least as good as humans in retinal zone segmentation – but much faster. This enables further development of the technology for the early detection and monitoring of eye tumors. The technology will be made available to doctors free of charge.