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Digital Image Processing in Ophthalmology

In this presentation,we will describe our work on digital image processing inophthalmology applications. The first application deals with the segmentation of the corneal layers and measuring their thickness from Optical Coherence Tomography (OCT) images. This is important because various corneal diseases, such as Fuchs dystrophy, Keratoconus and corneal graft rejection, can be diagnosed based on the changes of the thickness of corneal microlayers. OCT technology made it possible to obtain high resolution corneal images that show the microlayerstructures of the cornea. Manual segmentation is subjective and not practicaldue to the large volume of obtained images. Existing automatic methods, used for segmenting corneal layer interfaces, are not robust and they segment fewer corneal microlayer interfaces compared to our method. Our approach segments all the layers of the cornea and the experimentalresults show its robustness. The second application deals with Higher Order Aberrations (HOAs). HOAs are complex refractive errors in the human eye that cannot be corrected by regular lens systems. Researchers developed approaches to analyze the effect of these visual deformities. We used one of these approaches to analyze the high order aberrations for eachsubject. Then, wedeveloped animage processing technique that, when applied to a source image viewed by the subject, reversesthe effects of the HOAs for that subject.This leads to having a modified retinal image that closelyresembles the source image.