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Enhanced Framework for Concurrent correction and Segmentation in Retinal Optical Coherence Tomography

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Abstract:
A revolutionary imaging technique called optical coherence tomography of visible light (VIS-OCT) of the individual uses shorter visible light wavelengths than traditional near-infrared (NIR) light. To more accurately discern stratified retinal layers, it offers microvascular oximetry together with one-micron level axial resolution. Since the allowed illumination power is significantly lower than NIR OCT due to practical limits regarding laser safety and comfort, it might be difficult to generate VIS-OCT images of a high enough quality for further image processing. As a result, denoising VIS-OCT images is a crucial step in the whole workflow for clinical applications involving VIS-OCT. The first retinal image collection is presented in this study from normal eyes obtained using VIS-OCT. We offer a simultaneous self-denoising and segmentation system based on deep learning. Both tasks complement one another inside the same network to increase each other's productivity. Annotation-efficient training is demonstrated by a discernible increase in When the available annotation falls below 25%, the Dice coefficient was 2% higher than with the segmentation-only method.) is accomplished. Additionally, we demonstrated how well the denoising model learned on our dataset could be applied to an alternative scanning method.

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Contents

I. Introduction

A popular imaging technique in ophthalmology for diagnosing retinal abnormalities is optical coherence tomography (OCT) [1]. Near-infrared (NIR) light sources are used by currently available commercial OCT devices; these light sources are either swept source OCT at 1050 nm or spectral domain OCT at about 850 nm [2] more recent method is VIS-OCT, centres visible light at 550 nm and uses a shorter wavelength [3]. The resulting advantages allow for more accurate study of 2D images with improved contrast and resolution down to the micron level in imaging, and 3D retinal layers in therapeutic applications and preclinical animal models [4–7]. Measurement of haemoglobin oxygen saturation using label-free oximetry: a spatio-spectral study inside the microvasculature or sO2) is another benefit of VIS-OCT [8–10]. The ability to segment vessels accurately using 3D imaging helps isolate signals inside microvasculature and prevents the interference of other signals, which can occur with fundus-based oximetry. Thus, VIS-OCT has shown microvascular retinal oximetry down to the capillary level [11–13]. Numerous retinal vascular diseases have revealed the clinical viability of microvascular sO2 in parafoveal arteries with a diameter of 20–30 [14, 15]. Furthermore, structural features beyond image resolution can be obtained through spectroscopic analysis because of the unique scattering contrast between VIS and NIR-OCT. According to Song et al., pre-perimetric eyes and normal eyes may be more precisely distinguished using spectroscopy and VIS-OCT reflectivity, indicating a possible method for early glaucoma identification. Using VIS-OCT, which focuses light at specific red, green, and blue wavelength bands, Gupta et al. evaluated macular pigments and pinpointed their depth inside the human retina in vivo. One can also use the spectral contrast provided by VIS-OCT for single-scan OCTA.

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