Segmentation of diabetic macular edema in OCT retinal images

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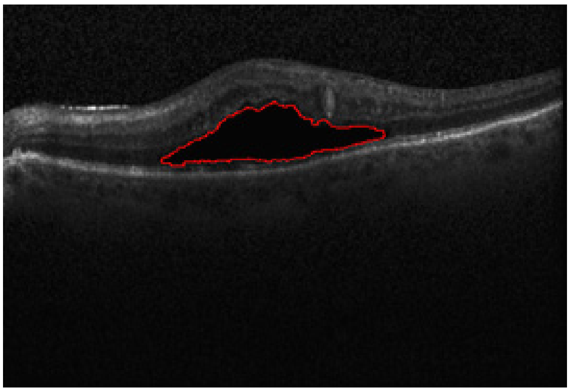

An example of segmentation result by algorithm

Overview: Diabetic macular edema (DME) is one of the important reasons leading to blindness, and the incidence of diabetic retinopathy is usually associated with macular edema symptoms. Its pathological features are mainly manifested in the accumulation of fluid in the retina. The ophthalmologist could identify and diagnosis the cystoids edema in the optical coherence tomography (OCT) image, but it is time-consuming and labor intensive. Furthermore, it is necessary to manually mark each slice of the OCT images if the ophthalmologist wants to quantify the cystic edema. Thus, an automated algorithm is proposed to enable automatic segmentation of cystoids edema and to provide an area of cystic edema in the slice to estimate the volume. The method is divided into two steps of preprocessing and segmentation. The first step, preprocessing, we should eliminate the difference in signal-to-noise of the images. A variety of reasons would result in the difference between images, such as the images come from different patients. It would also result in intensity inhomogeneity of retinal OCT images. It would also lead to intensity inhomogeneity between each layer of the retinal in the images. Therefore, it is important to eliminate these effects. To prevent the interference of blood vessels leading to false detection, we use the gamma transformation to change the brightness, which not only removes the effects of the blood vessels but also retains the characteristics of the region of interest. For speckle noise, we remove the noise effectively by the anisotropic filtering method. We eliminate the noise of the retinal OCT images as well as preserve the edge information of each layer. The second step, segmentation, we extract the cystic edema area by improved level set function. Due to the distance regularizing term, the model is no re-initialization which overcoming the shortcomings of the traditional level set function allowing for flexible initialization of level set function. Another advantage of the method is that the Gaussian kernel function reduces the sensitivity to noise. Finally, we utilize the relationship between the number of pixels and the size of the image (an image region of 0.04 mm^2 contains a set of 16 pixels×52 pixels), which calculated the area of the edema area in the OCT image quantitatively. Experiment result shows that the precision, sensitivity and dice similarity coefficient (DSC) for DME segmentation are 81.12%, 86.90% and 80.05%, respectively. It can be seen that the edema area can be divided effectively. The method provides quantitative analytic tools for clinical diagnosis and therapy.

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