Automatic Segmentation of Accumulated Fluid inside the Retinal Layers from Optical Coherence Tomography Images

M. Sahoo, S. Pal, M. Mitra

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Automatic Segmentation of Accumulated Fluid inside the Retinal Layers from Optical Coherence Tomography Images

M. Sahoo[a*], S. Pal[b], M. Mitra[b]

a Department of Applied Electronics and Instrumentation Engineering, Haldia Institute of Technology, Haldia, West Bengal, India

b Department of Applied Physics, University of Calcutta, Kolkata, West Bengal, India

*Phone No. 9433414569
E-mail- mou.sahoo@gmail.com.

Abstract: Visual impairments are mostly associated with the retinal diseases such as glaucoma, age related macular degeneration, fluid accumulation inside the retinal layers and other diseases. To evaluate the visual loss associated with the sub-retinal fluid accumulation, OCT images are widely used. So long, the effected retinal segment is visually estimated from the images. In this paper, we have proposed a novel Retinal Fluid Automatic Detection (RFAD) algorithm for automatically extracting the affected retinal segment due to fluid accumulation and thereby noticeably increasing the visual impact of the affected area than earlier by proper edge detection. The proposed method is validated qualitatively and quantitatively against 25 OCT images including both normal and different types of abnormal conditions. Good sensitivity and specificity is achieved as indicated in the result section.

Keywords: Optical Coherence Tomography (OCT), K-mean Clustering, Sub-retinal Fluid, Retinal Fluid Automatic Detection (RFAD).

1. Introduction

Optical coherence tomography (OCT) was first reported as a non-invasive ocular imaging technology [1]. It can capture macular thickness, retinal nerve fibre layer and the optic disc using high resolution scans based on low-coherence interferometry and also help in clinical diagnosis of eye diseases. Further it can capture cross-sectional images of retina. It is used for diagnosing and treatment purpose in certain eye conditions and diseases such as glaucoma, age related macular degeneration, fluid accumulation inside the retinal layers and other diseases affecting the retina [2], [3]. The principle of OCT is much like that of ultrasound, except that light is used instead of sound. In OCT, intensity of reflected infrared light is measured as a function of depth by assessing the time for the light to be reflected back or echo delay time[4]–[6]. This time difference permits the detection of tissue position and distance resolved to the scale ≤ 10μm. An OCT image is a two-dimensional or three-dimensional data set that corresponds to differences in optical backscattering or back- reflection in a cross-sectional plane or volume. In this paper, only two-dimensional images are emphasised. Cross-sectional images are constructed by performing axial measurements of the echo time delay and magnitude of backscattered or back-reflected light at different transverse positions. This results in a two-dimensional data set that represents the backscattering in a cross-sectional plane of the tissue being imaged. As a result, the nature of abnormalities in the retina and related regions along with the position of occurrence can be found out from the eye OCT images.

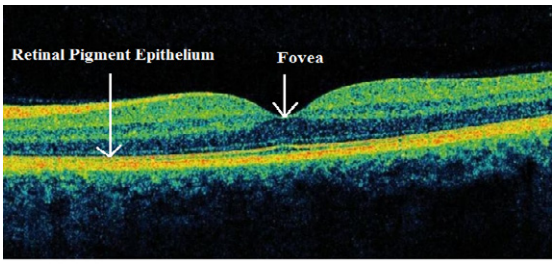

Fig1OCT image of a normal eye with a smooth depression at the middle of the Retina (Fovea) and Retinal Pigment Epithelium (RPE) is the bottom layer of the Retina

Diagnosing of various ophthalmic diseases from OCT image is still knowledge and experience based. Fluid accumulation inside the layers of the retina causes separation of retinal layers and results in distorted vision. Central serous retinopathy (CSR) is a slight accumulation of fluid in the