Accepted Manuscript

A hybrid method for 3D mosaicing of OCT images of macula and Optic Nerve Head

Alieh Ahdi, Hossein Rabbani, Alireza Vard

PII: S0010-4825(17)30357-8

DOI: 10.1016/j.compbiomed.2017.10.031

Reference: CBM 2824

To appear in: *Computers in Biology and Medicine*

Received Date: 13 May 2017

Revised Date: 26 October 2017

Accepted Date: 26 October 2017

Please cite this article as: A. Ahdi, H. Rabbani, A. Vard, A hybrid method for 3D mosaicing of OCT images of macula and Optic Nerve Head, *Computers in Biology and Medicine* (2017), doi: 10.1016/j.compbiomed.2017.10.031.

A Hybrid Method for 3D Mosaicing of OCT Images of Macula and Optic Nerve Head

Alieh Ahdi, Hossein Rabbani*, Alireza Vard

Dept. of Biomedical Engineering, School of Advanced Technologies in Medicine, Medical Image & Signal Processing Research Center, Isfahan University of Medical Sciences

* Hossein Rabbani, *Senior Member, IEEE*, E-mail: rabbani.h@ieee.org

Abstract. A mosaiced image is the result of merging two or more images with overlapping area in order to generate a high resolution panorama of a large scene. A wide view of Optical Coherence Tomography (OCT) images can help clinicians in diagnosis by enabling simultaneous analysis of different portions of the gathered information. In this paper, we present a novel method for mosaicing of 3D OCT images of macula and Optic Nerve Head (ONH) that is carried out in two phases; registration of OCT projections and mosaicing of B-scans. In the first phase, in order to register the OCT projection images of macula and ONH, their corresponding color fundus image is considered as the main frame and the geometrical features of their curvelet-based extracted vessels are employed for registration. The registration parameters obtained are then applied on all x-y slices of the 3D OCT images of macula and ONH. In the B-scan mosaicing phase, the overlapping areas of corresponding reprojected B-scans are extracted and the best registration model is obtained based on line-by-line matching of corresponding A-scans in overlapping areas. This registration model is then applied to the remaining A-scans of the ONH-based B-scan. The aligned B-scans of macular OCT and OCT images of ONH are finally blended and 3D mosaiced OCT images are obtained. Two criteria are considered for assessment of mosaiced images; the quality of alignment/ mosaicing of B-scans and the loss of clinical information from the B-scans after mosaicing. The average grading values of 3.5±0.74 and 3.63±0.55 (out of 4) are obtained for the first and second criteria, respectively.

Keywords: OCT, image mosaicing, image registration, SURF, RANSAC, image blending

I. INTRODUCTION

Retinal Optical Coherence Tomography (OCT) is a medical imaging system similar to sonography that instead of sound waves, uses light waves to take cross-section images of the retina. Three-dimensional OCT images render information about the layers of the retina, macula and Optic Nerve Head (ONH) [1]. In addition to the cross-sectional images of the retina layers, some OCT imaging systems also provide a fundus image [2], a two-dimensional image of the retina's interior surface that represents the structure of the retina and optic disc and provides information from the macula, fovea avascular zone, and posterior pole. 3D-OCT images contain multiple cross-sectional images called B-scans (Figure 1), each comprising of a series of scan-lines (namely A-scans), which are in the path of the light spreading into the tissue of interest. 3D-OCT images can provide information about intra-retinal layers and 3D pathologies within the retina which help ophthalmologists improve the diagnosis of eye diseases. Since manual analysis of 3D OCT data is an expensive, subjective, and time consuming process, many semi/fully automatic OCT image analysis algorithms have been introduced [3-13]. The mosaicing of OCT images of macula and ONH is an automatic