proceedings

MDPI

Extended Abstract

Automatic Segmentation and Measurement of Vascular Biomarkers in OCT-A Images †

Macarena Díaz [1,2,*], Jorge Novo [1,2], Manuel G. Penedo [1,2] and Marcos Ortega [1,2]

[1] Department of Computation, University of A Coruña, 15071 A Coruña, Spain; jnovo@udc.es (J.N.); mgpenedo@udc.es (M.G.P.); mortega@udc.es (M.O.)
[2] CITIC-Research Center of Information and Communication Technologies, 15071 A Coruña, Spain
* Correspondence: macarena.diaz1@udc.es; Tel.: +34-981-167-000 (ext. 1330)
† Presented at the XoveTIC Congress, A Coruña, Spain, 27–28 September 2018.

Published: 17 September 2018

Abstract: We propose an automatic methodology that identifies the vascularity zones in OCT-A images and their measurement for its use in clinical analysis and diagnostic processes. The segmentation and measurement contributes objectivity and repeatability in the results, desirable characteristics in any diagnosis and monitoring process. In the validation of the method, the correlation coefficient of Pearson and Jaccard index were used, obtaining satisfactory results.

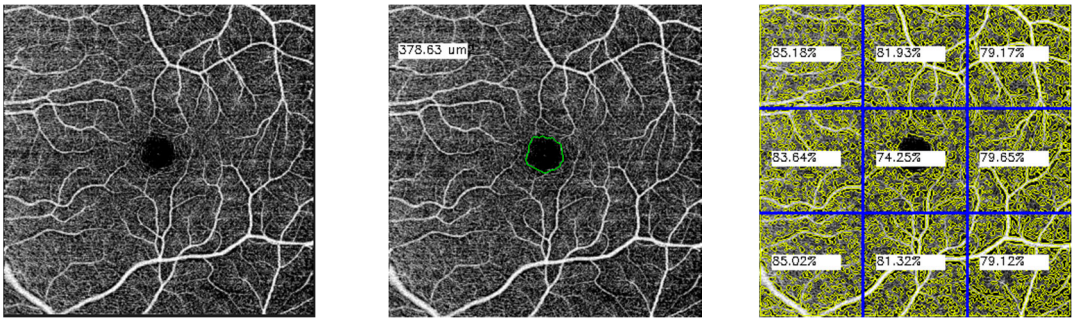
Keywords: computer-aided diagnosis; Image Segmentation; retinal imaging; Optical Coherence Tomography Angiography; vascularity

1. Introduction

Optical Coherence Tomography Angiography (OCT-A) is a new non-invasive imaging modality that facilitates the analysis of the vascularity in the retina. The extraction of this vascular and avascular zones is useful for the analysis of several pathologies such as diabetic retinopathy, but their correct extraction requires objectivity, determinism and repeatability factors. Given the recent appearance of this image modality, there are few works, most of them are clinical proposals that study the repeatability and reproducibility of different biomarkers that are based on the OCT-A vascular properties in healthy patients, indicating the satisfactory impact of this analysis. For this reason, the automatic extraction of this zones is interesting, given the repeatability and objectivity that support its automation.

2. Methodology

We propose an automatic methodology that identifies the vascular and avascular zones in OCT-A images and their measurement for its use in clinical analysis and diagnostic processes [1]. We firstly intensify the vascular characteristics using morphological operators, facilitating the extraction in further steps. Then, a set of image processing techniques are combined to maximize their differences and, posteriorly, estimate their representative parameters, respectively. These biomarkers are based in the area of the Foveal Avascular Zone (FAZ) and the vascular density, features that can vary in healthy and pathological patients. In the case of the vascular density, four different ways of measurement were performed based on: the original image, the enhanced image, the thresholded image and the vascular skeletonization of the image. Figure 1, represents an example of input and outputs system.



(**a**) (**b**) (**c**)

Figure 1. Example of the input (**a**) of the system and the outputs: avascular zone (**b**) and vascular zone (**c**).

3. Results

The proposed methodology was tested on a set of 144 non-pathological images labeled by an expert ophtalmologist, being used as reference in the validation of the method. The correlation coefficient of Pearson and the Jaccard index were used to validate the results between the expert and the system, validating the measurements and the coverage of the zone. In the correlation coefficient of Pearson, the areas of the expert and the areas of the system were compared, obtaining an average of 0.76, which represents a good correlation between both segmentations. With the Jaccard index, we obtained 0.73, also offering satisfactory results. Summarizing, the proposed methodology presented satisfactory results in both validation experiments.

Author Contributions: M.D. and J.N. contributed to the analysis and design of the automatic methods and the experimental evaluation methods. M.G.P. and M.O. contributed with domain-specific knowledge. All the authors performed the result analysis. M.D. was in charge of writing the manuscript, and all the authors participated in the revision and final approval.

Acknowledgments: This work is supported by the Instituto de Salud Carlos III, Government of Spain and FEDER funds of the European Union through the PI14/02161 and the DTS15/00153 research projects and by the Ministerio de Economía y Competitividad, Government of Spain through the DPI2015-69948-R research project. Also, this work has received nancial support from the European Union (European Regional Development Fund - ERDF) and the Xunta de Galicia, Centro singular de investigación de Galicia accreditation 2016–2019, Ref. ED431G/01; and Grupos de Referencia Competitiva, Ref. ED431C 2016-047.

Conflicts of Interest: The authors declare no conflict of interest. The founding sponsors had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, and in the decision to publish the results.

References

1. Díaz, M.; Novo, J.; Penedo, M.G.; Ortega, M. Automatic extraction of vascularity measurements using OCT-A images. KES'18 - International Conference on Knowledge Based and Intelligent Information and Engineering Systems, Belgrado, Serbia, September 2018, Procedia Computer Science, 126, 273-281.