

3D retinal vascular network from OCT data

Pedro Serranho^{1,2}, Pedro Guimarães^{2,3}, Pedro Rodrigues^{2,4}, Dirce Celorico², Rui Bernardes²

¹ Universidade Aberta, Mathematics Section, Department of Science and Technology, Rua da Escola Politécnica 141-147, 1269-001 Lisbon, Portuga

² University of Coimbra, Faculty of Medicine, Institute for Biomedical Imaging and Life Sciences, Azinhaga Santa Comba, 3000-548 Coimbra, Portugal ³ University of Padova, Department of Information Engineering, Via Gradenigo, 6/b, 35131 Padova, Italy

⁴ University of Coimbra, Institute of Systems and Robotics, Pinhal de Marrocos—Polo II, 3030 Coimbra, Portugal
pserranho@uab.pt

We will present a method to determine the 3D position of the human retinal vascular network from commercial spectral-domain (SD) optical coherence tomography (OCT) data. OCT is a noninvasive technique to collect optical properties of the human retina, therefore this method is harmless for the subject, having therefore the potential to become a screening process to diagnose alterations on the 3D location of the vessel network within the retina.

The method is divided in three steps. First one seeks the two-dimensional location of retinal vascular network on the eye fundus. this one done through support vector machines classification of properly defined fundus images from OCT data, taking advantage of the fact that on standard SD-OCT, the incident light beam is absorbed by hemoglobin, creating a shadow on the OCT signal below each perfused vessel. In a second step, the depth-wise location of the vessel is obtained as the beginning of the shadow. Finally, the classification of crossovers and bifurcations within the vascular network is also addressed.

We illustrate the feasibility of the method and show numerical reconstructions of the retinal vessel network.

Finally we will also briefly discuss some other mathematical problems that we have addressed concerning OCT, amongst which are modeling the optical properties of the human retina by proper numerical methods.

Keywords: Retina, vascular network, Optical coherence tomography

Acknowledgments. This work was supported by FCT under the research projects (Project Nos. PTDC/SAU-ENB/111139/2009 and PEST-C/ SAU/UI3282/2013), and by the COMPETE programs FCOMP-01-0124-FEDER-015712 and FCOMP-01-0124- FEDER-037299.

REFERENCES

- [1] P. Guimarães, P. Rodrigues, D. Celorico, P. Serranho, R. Bernardes, Three-dimensional segmentation and reconstruction of the retinal vasculature from spectral-domain optical coherence tomography, *Journal of Biomedical Optics*, **20**(1), 016006, 2015.