

## Phantom validation of optical attenuation coefficient estimation model with depth resolution for Optical Coherence Tomography

Marcello Magri Amaral

*Instituto Científico e Tecnológico, Universidade Brasil, São Paulo, Brazil*

Jeann C. R. Araújo, Andrea Antunes, Adamo F. G. Monte

*Universidade Federal de Uberlândia, Instituto de Física, Uberlândia, MG, Brazil*

Ana C. B. de Cara, Anderson Zanardi de Freitas, Denise Maria Zezell

*Instituto de Pesquisas Energéticas e Nucleares, IPEN-CNEN, São Paulo, Brazil*

Optical Coherence Tomography (OCT) has been used for imaging and analyzes over a broad number of applications.[1-3] Besides its use for morphological analysis [3] the OCT signal has been used to determine the optical attenuation coefficient of biological samples for classification and diagnostic proposes. [1,2] The most common model for estimating the optical attenuation coefficient based on OCT signal relies on the Lambert-Beers law. It usually assumes a constant attenuation coefficient value over the image range or over a selected range, losing the in-depth resolution on OCT. Previous published work on literature developed a model to estimate the attenuation coefficient with depth resolution [4], however it assumes that the light is totally attenuated within the image depth range failing for membrane like samples. We present a model that, using the tissue sample transmittance as input, remove this limitation and to estimate the depth-resolved optical attenuation coefficient. This method allows us to obtain an image of tissue optical properties instead of that from intensity contrast, guiding diagnosis and tissues differentiation, extending its application from thin to thick samples. The performance of our method was tested with the assistance of a home built single layer and multi-layer phantoms (  $100\mu m$  each layer). These optical phantoms are composed of a substrate polydimethylsiloxane (PDMS), Zinc-Phthalocyanine (ZnPc) dye as chromophores, and  $TiO_2$  as scattering agent. The optical attenuation coefficient ranges from 0.9 to  $2.32\text{ mm}^{-1}$ , measured using an integrating sphere followed by the Inverse Adding Doubling processing technique. We show that the estimated depth-resolved attenuation coefficient recovers the reference values, with a error deviation of 7 %.

**Reference:** [1] N.S.M. Pires, A.T. Dantas, A.L.B.P. Duarte, M.M. Amaral, L.O. Fernandes, T.J.C. Dias, L.S.A. de Melo, and A.S.L. Gomes, *Ann. Rheum. Dis.* 77, 3 (2017). [2] A.M.A. Maia, A.Z. de Freitas, S. de L. Campello, A.S.L. Gomes, and L. Karlsson, *J. Biophotonics* 9, 6 (2016). [3] A. Latrive, L.R.C. Teixeira, A.S.L. Gomes, and D.M. Zezell, *Ski. Res. Technol.* 22, 2 (2016). [4] K.A. Vermeer, J. Mo, J.J.A. Weda, H.G. Lemij, and J.F. de Boer, *Biomed. Opt. Express* 5, 1 (2014).

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