One of the techniques which allows to assess the clinical conditions of retina is confocal Scanning Laser Ophthalmoscope (cSLO). It is a retinal imaging modality based on confocal microscopy and it can image high-contrast en-face fundus images. Different techniques have been integrated in order to improve the performance in cSLO. Some examples are adaptive optics cSLO or ultra-wide field SLO. By other hand, lenses with variable focal length (tunable lenses) have many applications in different fields of optics. In microscopy, the use of an acousto-optic tunable lens (AOL) into an Optical Coherence Microscopy (OCM) has allowed to image biological samples increasing the depth of focus.

In this work, we developed a prototype cSLO system integrated with an AOL to image different eye compartments and to analyze the central defocus of the eye. The cSLO was designed by a engineering software in order to achieve a configuration of 20 degrees of Field of View for a focal telescope of M=1x. A monochromatic He-Ne laser source with a wavelength of 632.5nm was used to image the retina. A customized AOL with a focus tuning frequency at 275 KHz was integrated into the system to get a rapid depth scanning. In-vivo retinal images from myopic and hyperopic patients were acquired. acquired by the system.

Spectral analysis of the retina and the choroid in the visible and near infrared: preliminary results of a clinical study

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Many systemic and ocular pathologies can affect structures of the eye fundus, impairing the visual performance and, in the last stages, causing visual loss. The study of the ocular fundus helps in the investigation and early diagnosis of diseases related to the retina and the choroid, as several structures and substances can be highlighted and monitored. Some of the most frequent ocular diseases affecting the retina and the choroid are glaucoma, Age-Related Macular Degeneration (AMD), diabetic retinopathy, and tumors. These diseases generally involve changes in the location and thickness of retinal structures and of the concentration of anomalous substances such as drusen. There are various optical and imaging systems used in the daily clinical practice to diagnose these diseases and evaluate the effectiveness of treatments, which have become very popular because of their non-invasive basis. Some of the most used devices are color fundus photography and optical coherence tomography (OCT). Recently, multispectral imaging technology has come in to view, offering enhanced visualization of anomalies of the ocular fundus and increasing the amount of extractable spectral information, thus avoiding problems such as metamerism caused by the poor spectral sampling of the color (RGB) fundus cameras. In this regard, we developed a new multispectral fundus camera that allows acquiring 15 spectral images from 400 nm to 1300 nm, since it includes CMOS and InGaAs sensors. To validate this system, a preliminary clinical study was conducted on healthy and diseased eyes in order to notice

differences depending on the spectral band used, especially in those with disorders. Patients underwent standard ophthalmologic and optometric evaluations, including ocular fundus evaluation with conventional color retinography and OCT. Multispectral images were shown to provide additional and more specific information, especially from deeper layers of the retina and the choroid. The spectral information of longer wavelengths provided superior contrast of structures that in color fundus photography might remain hidden, especially the choroidal vasculature and lesions caused by drusen induced retinal pigment epithelium (RPE) degeneration, in which there was less concentration of melanin. In addition, thanks to the enhanced penetration depth of infrared wavelengths, drusen could be better visualized through some spectral bands as well as choroidal tumors, which were not visible in OCT images due to the poor image quality caused by scattering of preceding media.

In-vivo longitudinal imaging of glioblastoma (GBM) tumor in mouse brain microvasculature using 800nm OCT system

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We present the in-vivo imaging for a group of three mice (N=3) used for the experiments using 800 nm OCT system for Glioblastoma (GBM) tumor injected into the mouse brain to quantify and understand the growth mechanism and progression. The imaging of the tumor is challenging because the scattering properties are changed during angiogenesis and makes it difficult for imaging. The contrast agents could help to overcome this difficulty and we made our initial efforts to study the contrast enhanced signal and apply it for GBM tumor growth. The results obtained shows that GBM tumor model is successfully implanted and is imaged for period of 15 days. The experiments also show the potential for longitudinal studies with our current OCT system. We except to see the tumor vasculature more pronounced with introduction of contrast agents and it would be useful to quantify the biological growth process of tumor, pattern in the tumor shape, boundaries and size of the growth. This could lead to interesting findings to understand the angiogenesis in tumor. The experiments with intralipid with 1300 nm and 800 nm would be a reference for the contrast enhancement for our forthcoming studies on GBM tumour with contrast agents. But we still need to focus to optimize the repeatability of the system to achieve more high quality angiography. Efforts have been made to achieve the high quality angiography to analyze the growth and progression for longitudinal studies using fractal analysis for small tumors and also by stabilizing the OCT system for repeatable measurements. This experiments would shed light in a good direction to understand the basic and fundamental mechanisms and biological process involved of growth and progression of small tumors to quantify the angiogenesis process.