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Project:

Development of advanced Laser Imaging Techniques for the anterior and posterior Eye (LITE)

Technological key words:

Second harmonic generation microscopy, Scanning laser ophthalmoscopy, Adaptive optics, Keratoconus, Age-related macular degeneration

Industrial sectors addressed:

Medicine / Healthcare

Total cost: 1.210.200 Euros

Partners' descriptions:

- C.S.O. Srl
SME – Italy – web site: www.csoitalia.it

CSO is worldwide leader in the development and construction of ophthalmic instruments, including innovative fundus cameras, Scheimpflug cameras for corneal tomography, slit lamps and endothelial microscopes.

CSO will undertake the design of an instrumental prototype for SHG and AO-SLO imaging and provide clinical samples of corneas in collaboration with the public hospital Misericordia e Dolce, acting as subcontractor. CSO will coordinate this project and manage its dissemination and exploitation.

- National Research Council - INO CNR
Public Research Organization - Italy – web site: www.ino.it

National Institute of Optics (INO) belongs to National Research Council of Italy (CNR). INO has been carrying on research in optics for almost a century. Its current activities range from basic and applied research, to technology transfer and consulting. INO will provide for SHG imaging of corneal specimens with and without keratoconus, preparation of a benchtop demonstrator for SHG microscopy, design, development and implementation of SHG microscopy in a laser scanning ophthalmoscope.

- National Research Council - IFAC CNR
Public Research Organization - Italy – web site: <http://www.ifac.cnr.it/>

Institute of Applied Physics (IFAC) is part of National Research Council of Italy (CNR) with a focus on various laser applications including in biomedical optics, diagnostics and microsurgery and a history of relevant clinical developments. IFAC will undertake the modelling of SHG images from corneal samples in order to probe parameters of diagnostic relevance and follow the clinical developments of this project.

LITE



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- Institut de la Màcula i de la Retina - IMIR
SME – Spain – web site: <http://www.institutmacularetina.com/en/>

IMIR is devoted to the treatment, pre-clinical and clinical research of macular, retinal and vitreous medical and surgical conditions.

IMIR will be responsible for the preparation of protocols, local coordination, recruitment, SLO imaging and follow-up of patients suffering from AMD. The interpretation of SLO and SHG micrographs will benefit from the collaboration of Institute of Photonic Sciences of Barcelona (ICFO), acting as subcontractor.

Project abstract:

LITE is aimed at developing advanced laser imaging techniques for both the anterior and posterior eye. The main goal is to advance in the field of diagnostic imaging in the eye by developing new cutting edge techniques, their applications to specific diseases, and finally their perspective of integration in a single platform, thus reducing the equipment and costs in the ophthalmology clinic.

In the anterior eye, we will investigate the introduction of second harmonic generation (SHG) microscopy. This non-linear technique can generate high resolution images of collagen organization without exogenous dyes. This feature will be exploited to understand modifications in the organisation of corneal collagen affected by keratoconus, thus developing a non-invasive method for its early diagnosis. Cross linking is a new approach to treat this disease by inhibiting its development. In this context, early detection of keratoconus is very desirable in order to reduce vision loss and avoid extensive surgery.

In the posterior eye, we propose the use of adaptive optics (AO) scanning laser ophthalmoscopy (SLO) for high resolution retinal imaging. These images provide information at a cellular level, which is very valuable to detect degenerative processes in the retina. We will build an AO-SLO system which will be used to examine patients suffering from age related macular degeneration (AMD). AO-SLO images will be used to follow those processes involved in photoreceptor cell death in peripheral regions of geographic atrophy. Data from these images will be correlated with information from standard techniques such as OCT, autofluorescence, etc.

Finally by taking advantage of the laser scanning approach of both techniques, we will design a unique integrated device which may provide the ophthalmologist with new diagnostic information both on the anterior and posterior eye.

Expected results and exploitation plan:

LITE is aimed at developing advanced laser imaging techniques both for the anterior and the posterior segments of the eye. Its main goal is to advance in the field of diagnostic imaging both of the anterior and the posterior segments of the eye by developing new cutting edge techniques, their applications to specific diseases, and finally their perspective of integration in a single platform, thus reducing the equipment and costs in the ophthalmology clinic.

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The project will be divided in three main parts. First, the anterior segment of the eye will be addressed by the use of Second Harmonic Generation (SHG) microscopy to image corneal collagen fibrils. Meanwhile, Adaptive Optics Scanning Laser Ophthalmoscopy (AO-SLO) will be introduced to investigate the posterior segment of the eye and its applications in the retina will be developed. Finally, the combination of these two techniques in a single platform will be detailed.

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