PHOTONICS - EUROPHOTONICS MASTER COURSE
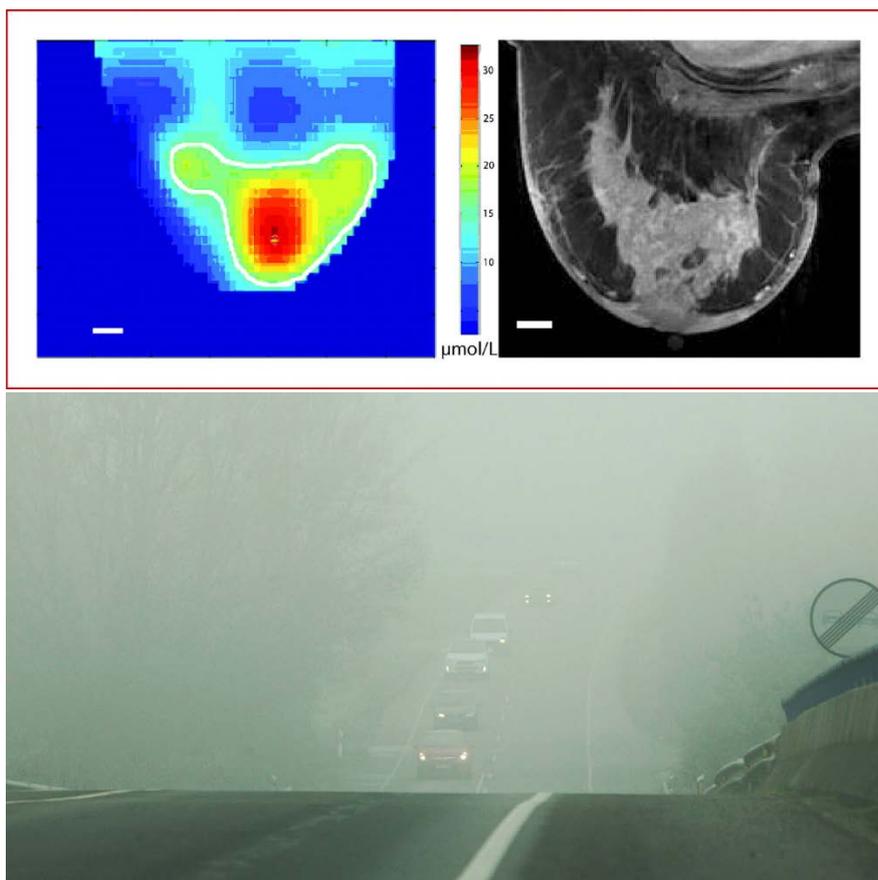
PROPOSAL FOR A MASTER THESIS

Dates : April 1st, 2019 – September 31st, 2019

Laboratory : Centre for Sensors, Instrumentation and systems Development (UPC-CD6)
City, Country : Terrassa, Spain

Title of the master thesis :

Modelling the propagation of polarized waves in turbid media

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Summary of the subject (maximum 1 page):

Lidar imaging is a powerful measurement technique where a laser pulse is shone onto an object and the beam reflected back is recovered at some solid-state detector. The time elapsed is counted so an automated measurement of the distance to the target is obtained, without any further calculation. The concept is also referred to as ladar or time of-flight imaging. Different scanning mechanisms have been proposed to recover complete 3D images out of this pointwise approach.

In several applications, though, the performance of lidar units becomes limited by the presence of obstacles which partially block the laser beam. Applications involving fog, rain, snow or dust involve or smoke get severely hampered by absorption or scattering phenomena, which are well known and characterized, and may be simulated radiometrically using Monte Carlo methods (in Matlab or C) or FEM approaches (COMSOL). Furthermore, polarized beams are expected to penetrate better into this type of media, and thus to be able to provide better observation methods under scattering. Modelling polarized beams, however, involves a higher level of complexity. The problem has also relevant applications in biomedical photonics, where a number of problems related to scattering of polarized media are currently under study.

At CD6 a radiometric model for scalar propagation based on Monte Carlo raytracing is already operative and validated. However, the implementation of a Monte Carlo polarimetric approach is required to evaluate and predict the behaviour of the polarized beam inside different types of scattering media, but presents complexities such as the measurement of the polarization in the proper planes and conditions. The student in charge of this work will first evaluate the convenience of a Monte Carlo or a FEM approaches to solve the radiometric model, and then to implement it, and validate it.

Keywords : flash ladar cameras**,** time-of-flight, 3D imaging, optical metrology, aerospace, transport

Additional information :
* Amount of the monthly allowance (if it is the case):
To be discussed depending on the value of candidate.

* Required skills :
Interest in application-driven experimental work for solving real-world problems.
Basic concepts in optical metrology and optical engineering
Programming (C++, MatLab) and use of scientific software packages (Zemax, Labview...)
Search of resources, both scientific and technical
Self-motivated, objective-driven, capable of autonomous working within a multidisciplinary team.

* Miscellaneous :
This thesis contents will be considered <u>confidential</u> due to its closeness to market.
International team with several years of experience in the topic proposed.
Multidisciplinary environment with electronics and mechanics workshops, and specialists and technicians in metrology, optics, mechatronics, and electronics.
Possibility of joining the Centre for a PhD/Project Manager career in case of common interest.
<u>Early incorporation welcome.</u>