

## **PHOTONICS - EUROPHOTONICS MASTER COURSE**

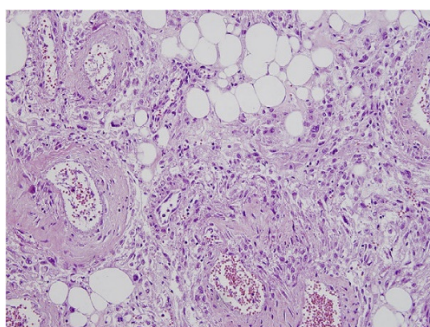
### **PROPOSAL FOR A MASTER THESIS**

**Dates: April 1<sup>st</sup>, 2020 – September 30<sup>th</sup>, 2020**

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

**Title of the master thesis:**

<b>MODELLING OF IMAGE FORMATION THROUGH TURBID MEDIA</b>
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## **Summary of the subject (maximum 1 page):**

### ***Which is the problem?***

The interaction of light with different turbid media is still a field being tackled by many research groups and companies around the world. For example, in outdoor scenarios, imaging systems may become limited by the detriment of atmospheric conditions that partially decreases light detection. Applications involving fog, dust, smoke or sand get severely hampered by absorption or scattering phenomena. In the outstanding field of navigation-security (e.g. landing a helicopter in sandstorms), detection under deteriorated vision scenes is a huge unsolved problem. In the field of biomedical optics, different techniques of diagnosis and therapy are based on the interaction of light with tissue, which can be modelled as a turbid media. There are still questions about how light is behaving under these circumstances. A better understanding of the phenomena could help to improve those techniques.

At CD6, a line of research is focused on improving light detection in turbid media using non-standard optical techniques. Characterisation of the interaction of light with a turbid media made of spherical particles (e.g. round blood cells, rain, smoke and fog...) is already made. The next step is to explore how imaging can be formed with that information.

### ***What will you do?***

This project aims 1) to understand the characteristics of light propagating through a scattering media and how it influences imaging and 2) to explore methods to image formation by modelling the process.

The milestone of this project is the implementation of the image formation method suited to our necessities and its incorporation into an existing light-propagation model. First of all, a bibliographic revision of the topic is expected. Other projects have worked in previous stages of this field so the information is already quite bounded. Alongside this, you will be encouraged to get familiar with the model used for propagating light through regular particles, as well as with the experiments performed in the lab related to this topic. Then, the selected method is expected to be implemented and used in the propagating model. Finally, an interpretation of the results would be necessary in order to assess whether the selected method fulfils the requirements or not. Any contribution of ideas on how to improve it will also be valuable. In addition, the computation is expected to be quite powerful, so skills regarding code optimization and code parallelization are welcomed.

**Keywords:** turbid media, irregular particles, T-matrix, Monte-Carlo, light-matter interactions

### **Additional information :**

\* Amount of the monthly allowance (if it is the case):

To be discussed depending on the value of the candidate.

\* Required skills:

Interest in application-driven experimental work for solving real-world problems.

Basic concepts in optical metrology and optical engineering

Programming (Matlab, C++) and code optimization

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 confidential due to its closeness to the market.

International team with several years of experience in the topic proposed.

A 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.

Early incorporation is welcomed.