

MASTER'S THESIS INTERNSHIP OFFER

DESCRIPTION

› **Title :** Metrology of the optical reflectivity of surfaces for the advanced simulation of optical wireless communication channels and energy harvesting scenarii in realistic indoor environments

› **Hosting organization:** University of Limoges

› **Lab:** XLIM (UMR7252, University of Limoges / CNRS)

› **Research Team:** Printed Electronics for Telecoms and Energy (ELITE)

› **Scientific pole:** Electronic pole / RF-ELITE Axis

› **Starting date (month/date):** 27 février 2023

› **Short description of the internship offer (up to 5 sentences):**

The prediction of the performance of various photo-receivers used in complex indoor environments is crucial in order to develop efficient wireless optical communication solutions for the next generation of IoT (Internet-of-things) systems. In particular, multiple reflections of light on the environment (walls, obstacles, etc.) drive the final data reception and energy harvesting performance of specific photo-sensors which are today considered to simultaneously supply energy to the IoT system, as well as to ensure reliable data reception. In this context, it is crucial to consider the exact optical properties of the surfaces involved. The internship is devoted to the metrology of the optical properties of various surfaces in order to validate complex simulation scenarios using the state-of-the-art channel simulator RaPSoR developed at XLIM in the context of wireless optical communications (OWC).

› **Objectives (up to 5 sentences):**

The objective of the internship are to exploit an optical goniometer available at XLIM to experimentally measure the optical reflectivity of various surfaces, and their angular and spectral dependance. The work will involve the definition of the expected specifications (selection of the physical quantities to be measured), the fine adjustment of the experimental setup to ensure a reliable and accurate measurement, and the measurements of the targeted properties for various surface



qualities (nature of the material, nature of the surface coating and painting, etc.). The final objective is to implement these physical characteristics in the advanced simulation software develop at XLIM, enabling the prediction of communication and energy harvesting performance of various photo-receivers.

› Description of the internship offer:

The internship is proposed in the frame of a collaboration between different teams at XLIM (ELITE, SYCOMOR, ICONES) which aims at demonstrating novel photoreceivers for simultaneously energy harvesting and wireless optical data reception for the next generation of indoor IoT nodes. Going from the experimental development and characterization of organic solar cells to their performance assessment for energy harvesting and data reception, the collaboration also involves their advanced modeling using the state-of-the-art simulation program developed at XLIM (RaPSoR) [1]. In this context, the internship will focus on a specific aspect associated with the consideration of the complex optical properties of realistic indoor scenario, by taking into account the exact optical response of surfaces in the simulator, in order to allow the experimental and numerical validation of the communication and energy harvesting performance of various receivers.

More specifically, the internship will allow to use a dedicated optical goniometer to extract the experimental reflectivity of various surfaces, which should be measured as a function of the angle of incidence of the light and as a function of the wavelength. The experimental setup is located at XLIM in Limoges (La Borie), with the PLATINOM technology platform and its Printed Electronic domain managed by the ELITE group. The selected student will first identify the relevant physical quantities to be measured through close interactions with the SYCOMOR / ICONES teams in Poitiers who develop the numerical simulations. He/she will then get familiar with the experimental setup in the laboratory, and adapt it to allow a consistent measurement. This step will involve specific developments on the hardware and on the software parts (interface with the equipment, definition of measurement routines, etc.). Finally, the student will carry several measurements campaigns applied to different surfaces, and he/she will validate the extracted physical quantities with regard to the known literature. A final step will be to initiate the integration of the measured quantities in the simulator, in order to eventually perform the first numerical validations.

Important notice: the internship will be proposed only if a financial support is granted (evaluation under progress).

[1] A. Behloul, P. Combeau, et L. Aveneau, *Journal of Lightwave Technology*, vol. 35, n° 9, p. 1575-1587, mai 2017, doi: 10.1109/JLT.2017.2662939.

› Description of the research team:

The ELITE team (Limoges), which is involved in the fundamental and experimental research on organic and hybrid optoelectronics for telecom and energy applications, from the integration of materials, fabrication of devices, their optoelectronic characterization, to the numerical modeling of their physical properties. The ELITE team focus on the development of a large variety of devices including solar cells, light-emitting diodes, etc. The internship will be mainly located within the ELITE team in Limoges. The SYCOMOR team (Poitiers, Limoges), specialized in Optical Wireless communication (OWC) systems, develops activities on (i) modeling/simulation (RaPSoR) of the light propagation for complex indoor environments (ii) OWC system design: formats, protocols and performance (iii) OWC prototypes and Software Defined Radio benches for applications in health, smart city or aeronautics contexts. The ICONES team (Poitiers) is organized around the modeling and the processing of color and spectral images and videos for different aspects including representation models of multivalued images, optical metrology, and perception and quality assessment.

SKILLS

› Expected skills of the applicant:

General knowledge about optical wireless communication technologies and optical properties of materials are expected. Some knowledge or experience on the metrology of optical properties will be appreciated. The applicant should also be familiar with Python or any related programming language. Good communication and work organization skills are expected in order to efficiently manage the relations between the different teams involved.

PHD THESIS OPPORTUNITIES

› PhD thesis opportunity after the Master course:

Yes No

› If yes, financing already obtained:

Yes No



› **If yes, what kind of funds:** Project OPV4COM submitted to French National Agency for Research (ANR) involving XLIM ELITE / SYCOMOR / ICONES, as well as national partners (IM2NP Marseille, CISTEME Limoges).

CONTACT & APPLICATION

› **Surname and first name of the internship supervisor(s):**

Johann Bouclé and Sylvain Vedraine (ELITE) ; Pierre Combeau (SYCOMOR), Lilian Aveneau (SYCOMOR/ICONES)

› **Email of the supervisor(s):** johann.boucle@unilim.fr

› **Phone number of the supervisor(s):** 05 87 50 67 62

› **The application shall be sent to the email:** johann.boucle@unilim.fr

› **Closing date for applications:** 17 décembre 2022