

The Biophotonics Group in Tyndall will offer up to four projects.

**Project 1: Building Multimodal Upconverting Nanoparticles (UCNP) quantum yield system to measure broadband quantum yield at multiple lines.**

This project involves research activities in the Biophotonics group at Tyndall National Institute. The research area will be Upconverting Nanoparticles (UCNP), particularly, quantum yield system building and characterization of UCNP. The project contains multiple aspects experimental system building, LabView programming for system automation and data analysis. The project is flexible and it will be inclined to match the natural interests (lab work, programming or theory) of the student.

Experimental activities:

We will create standardization UCNP system using industrial grade technology. Highly interesting for students seeking industrial based career, will provide end to end product building exposure. The knowledge gained will be supplemented with Biophotonics aspects that would bring in an interdisciplinary exposure to students. Briefly, the student will go through a rigorous methodology of building system to validate and testing it on UCNP samples.

Programming activities:

This relates to the programming aspects of the above mentioned system, which is perfectly suitable for students interested in learning new programming language like Labview. Intern will be exposed to systematic programming work culture and will building solution to control various critical components of the system.

New elements could be introduced depending on the necessity of the UCNP projects. Of course, keeping in view, the student's interests and field of expertise.

**Project 2: Building Multimodal Automated Microscope for Biomedical application: system building to testing on biological samples.**

The student will undertake research activities in Biophotonics group at Tyndall National Institute. The research area will be building a microscope for Biomedical applications. Briefly it involves upgrading, automating and testing the microscope on biological samples like bacteria so on. The project contains multiple aspects experimental system building, LabView programming for system automation and data analysis. The project is flexible and it will be inclined to match the natural interests (lab work, programming or theory) of the student.

Experimental activities:

We will be creating an industrial grade multimodal microscope using scientific grade components. Highly interesting for students seeking industrial based career, will provide end to end product building exposure. The knowledge gained will be supplemented with Biophotonics aspects that would bring in an interdisciplinary exposure to students. Briefly, the student will go through a rigorous methodology of building system, validating and testing it on biological samples.

Programming activities:

This relates to the programming aspects of the above mentioned system, which is perfectly suitable for students interested in learning new programming language like LabView. Student will be exposed to systematic programming work culture and will be building solution to control various critical components of the system.

New elements could be introduced depending on the necessity of the Microscope projects. Of course, keeping in view, the student's interests and field of expertise.

For more details feel free to contact us at [sanathana.konugolu@tyndall.ie](mailto:sanathana.konugolu@tyndall.ie). To provide more clarity, lab visit or personal discussion could be arranged up on request.

### **Projects 3 & 4: Multispectral imaging of biological samples I & II**

Multi and hyperspectral imaging are a range of methods that combine spectroscopy and imaging, so that each pixel of the image contains the light intensity as a function of wavelength. The spectral information adds image-contrast and can even be used to identify the chemical composition of the scene or sample. Hyperspectral imaging is a well-established technique and is being used in a variety of applications, such as monitoring the health of crops from a drone and non-contact identification of explosives. In the Biophotonics group at Tyndall, imaging and multispectral analysis are key areas of research for, e.g., identifying certain features in human tissue for early-stage cancer detection.

#### **Version 1:**

In this project we will define a spectral and spatial calibration procedure for our multispectral camera system. Accurate calibration is important and we will explore ways to auto-calibrate the system. We will apply the system to accurately quantify features in various biological samples.

#### **Version 2:**

This project will focus on building a miniature/microbench multi-diode system. We will explore different beam combining techniques and minimise the footprint using CAD software and Zemax modelling. The illumination system will be evaluated by capturing multispectral images of biological samples.

The projects can be tailored depending on background and interest to shift the focus to, e.g., systems design/engineering, software development (LabView) or analysis of biological samples.

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