









# Master in Photonics – "PHOTONICS BCN" Master ERASMUS Mundus "EuroPhotonics"

## MASTER THESIS PROPOSAL

## Dates: April 2022 – July or September 2023

Laboratory: Centre for Sensors, Instruments and Systems Development (CD6) Institution: Universitat Politècnica de Catalunya (UPC) City, Country: Terrassa, Spain

Title of the master thesis: Development of eye tracking systems for medical diagnosis

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Keywords: accommodation, refraction, machine learning.

#### Summary of the subject (maximum 1 page):

Eye tracking technology can precisely measure what a patient is looking at in real-time and converts eye movements into a data stream that contains information such as pupil position, the gaze vector for each eye, etc. Essentially, the technology decodes eye movements and translates them into insights that can be used in a wide range of applications, in particular medical diagnosis.

Our research group has recently worked on the development of new eye-tracking based methodologies for the objective and automated clinical evaluation of ocular movements, with the ultimate goal of bringing this technology closer to the clinic. The work carried out has made it possible to assemble a high-performance 3D vision system in the laboratory that includes the EyeLink 1000 Plus eye-tracker (SR Research Ltd., Canada), which has been used to develop different optometric tests that allow characterizing binocular disorders [1] [2][3] [4]. Currently, this system is being used to evaluate (in a hospital) eye movements in patients with persistent COVID [5], which causes neurological sequelae, and these are known to be affected in neurological disorders.









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However, the system requires from improvements in two main aspects: migrating to new, less complex eye tracking systems suitable to be used in clinical practice and the development of data processing algorithms. For this purpose, we look for a motivated and enthusiastic student with good team working skills.

The main points that will be carried out by the student during the completion of the M.Sc. thesis are the following ones:

1. Look for bibliographic information to be able to offer more ideas in the system design.

2. Implement the current system for the recording of eye movements in new eye trackers and compare them in terms of clinical suitability for medical diagnosis, in particular persistent COVID.

3. Implementation of data processing algorithms to extract characteristic patterns of the eye movements from the dataset.

- 5. Statistical analysis of the data.
- 6. Participate in experimental measurements of the systems.

It is desirable that the student has the following knowledge/skills in:

- 1. Python and Matlab programming.
- 2. Image and data processing.

#### References:

1. Mestre, C., Gautier, J., & Pujol, J. (2018). Robust eye tracking based on multiple corneal reflections for clinical applications. J Biomed Opt, 23(03), 1.

2. Mestre, C., Otero, C., Díaz-Doutón, F., Gautier, J., & Pujol, J. (2018). An automated and objective cover test to measure heterophoria. PLOS ONE, 13(11), e0206674.

3. Rovira-Gay, C., Mestre, C., Argiles, M., Pujol, J. Validation of objective methods to measure fusional vergence ranges . ARVO Annual Meeting (2022).

4. Vinuela-Navarro, V., Vilaseca, M., Goset, J., Garolera, M., Cano, N., Ariza, M., Aldaba, M. Eye movement control after COVID-19 disease: a pilot study. VPO Conference (2022).

5. Goset, J., Vilaseca, M., Aldaba, M. Suitability of the Pupil Core eye-tracker for the diagnosis of neurological disorders. VPO Conference (2022).