



**Title: Remote sensing using an optical system and machine learning**

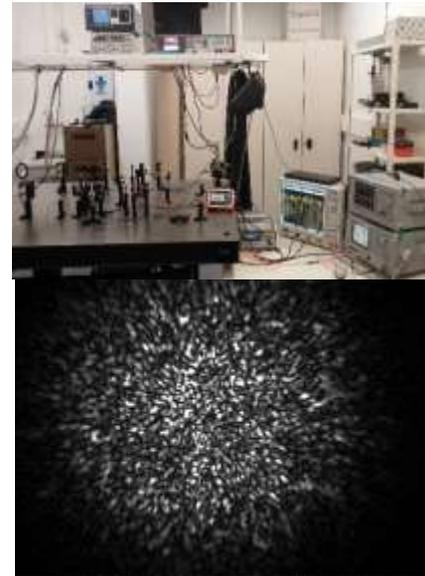
**Supervisors: Prof. Cristina Masoller (cristina.masoller@upc.edu),  
Dr. Jordi Tiana**

**Keywords: optical remote sensing; signal processing; machine learning**

**Description:**

Thanks to unprecedented advances in photonics, machine learning and signal processing tools, remote optical sensors are nowadays widely used in many fields. For example, hospitals and industrial spaces require of ventilation systems whose fans are often found in hard-to-reach places, and are monitored with optical sensors that send alarms when vibrations and/or changes in conditions occur, which may be early indicators of malfunction.

In our lab we have implemented an “optical microphone” sensor, able to recover an audio signal from the analysis of the silent video of the movement of a speckle pattern (shown in the fig.) [1,2].



The project, which can be a Bachelor or a Master thesis, has two possible goals: 1) to quantify the performance of the sensor that has been implemented in the lab or 2) to develop a portable prototype that can be demonstrated in Science fairs.

Regarding the present COVID situation, goal 1 can be achieved remotely, using machine learning tools for the analysis of videos that have been pre-recorded, and which can be downloaded from the lab website; goal 2 requires working in the lab. This is doable in present circumstances because we have a large, well-equipped and well-ventilated lab, where only one or two persons work simultaneously.

[1] C. Barcellona, et al, “*Remote recovery of audio signals from videos of optical speckle patterns: a comparative study of signal recovery algorithms*”, *Opt. Express* 28, 8716 (2020).

[2] <https://www.efe.com/efe/espana/destacada/convierten-en-imagenes-los-acordes-de-una-cancion-del-grupo-queen/10011-4300927>.

**Required skills:** Good programming skills will be needed. The student should be familiar with Matlab or python; additional knowledge of LabVIEW, machine learning, etc. is desirable but not mandatory.

**Additional information:** A scholarship is possible depending on the skills of the candidate.