

**Title :** Early Detection and Identification of Diseased Human and Vegetal Tissues Using Visible / Infrared Polarimetric Microscopy Combined with Conventional and AI-based Image Analysis

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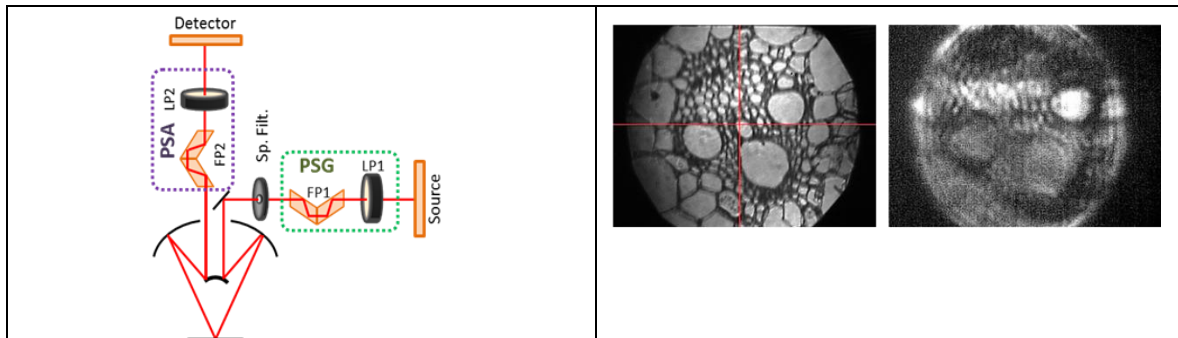
**Webpage :**

**Research Area Biophysics (primary) and Optics (Secondary)**

**Methods:** Improvement and use of an existing infrared polarimetric microscope, use of an existing polarimetric microscope in the visible, application of algebraic methods to obtain physical observables, use of AI-based numerical approaches to process the polarimetric data

**PhD track subject**

First, the work will focus on the instrumental improvement of an innovative multimodal infrared polarimetric microscope operated in reflection from the infrared (10  $\mu\text{m}$ ) to the visible (500 nm). Next, the microscope will be applied to the study of biopsies of animal tissues (histologic cuts) and vegetal tissues (leaves, roots). Polarimetric imaging can discriminate between healthy and diseased animal tissues, early detection of diseases being of prime importance for the efficiency of treatment. In plants, polarimetry can be decisive for detecting microbial infections. The work will take place in a stimulating collaboration with Universidad Aut3noma (Barcelona) and Synchrotron Soleil.



*Schematic representation of the multimodal infrared microscope mounted in reflection configuration. The generator (PSG) and analyzer (PSA) of polarization states and shown*

*Images showing a thin cut of wheat grain in the visible (550 nm; left) and the mid-infrared (8  $\mu\text{m}$ ; right)*

**References**

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2. A. Van Eeckhout, E. Garcia-Caurel, T. Garnatje, J. C. Escalera, M. Durfort, J. Vidal, J. J. Gil, J. Campos, A. Lizana, "Polarimetric imaging microscopy for advanced inspection of vegetal tissues", *Scientific Reports* **11**, 1-12 (2021).
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5. E. Garcia-Caurel, A. Lizana, G. Ndong, B. Al-Bugami, C. Bernon, E. Al-Qahtani, F. Renguez, and A. De Martino, "A mid-infrared Mueller ellipsometer with pseudo-achromatic optical elements", *Appl. Opt.* **54**, 2776-2785 (2015).