
Development of biomedical imaging systems through the integration of wavefront shaping (WS) with optical coherence tomography (OCT)

Supervisors:

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Project Summary

This PhD thesis will be framed within a cutting-edge research line that combines complex photonics with visual optics. The main objective is to address one of the great challenges in medical imaging: visualizing tissue through turbid or scattering media, as is the case of the retina in patients with cataracts.

Standard imaging techniques, such as Optical Coherence Tomography (OCT), currently fail when the ocular media presents severe opacities. The PhD candidate will research and implement solutions based on **Wavefront Shaping** to compensate for scattering and recover image quality through the opaque medium.

Research Objectives

The work will focus on experimental integration in the laboratory (optical bench), with the following tasks:

1. **Optical design:** Construction of a hybrid system (OCT Interferometer + Spatial Light Modulator).
2. **Control algorithms:** Programming of iterative algorithms to control the modulator in real time and correct the Point Spread Function (PSF), enabling sharp image formation.
3. **Validation:** Proof-of-concept testing with ex-vivo biological samples and optical phantoms.

Candidate Profile

- **Degree:** Master's degree in Physics, Optical Engineering, Telecommunications, Biomedical Engineering, or related fields.
- **Technical skills:** Optical instrumentation (lasers, alignment) and programming (MATLAB or Python). LabVIEW experience is a plus.
- **Languages:** A B2 level or higher of scientific English is a plus.

Terms and Expectations

- **Contract:** The PhD candidate will receive a PhD studentship contract from the University of Castilla-La Mancha (UCLM).
- **Workplace and mode:** The research will mainly take place on-site at the Fábrica de Armas Campus in Toledo. However, occasional remote work is possible for tasks that do not require lab presence (data analysis, writing, etc.).
- **Scientific dissemination:** The PhD candidate is expected to actively participate in the scientific community, including attending and presenting work at national and international conferences, as well as publishing results in high-impact (JCR) scientific journals.
- **Professional development:** Joining a dynamic research group with access to advanced equipment, offering solid training in highly sought-after photonic and biomedical technologies.

Enrollment

- **Standard intake:** from October 2026.
- **Late intake:** starting from January 2027.