TFM 2025-26 | Contact-lens cuvette channel design and implementation to test visual perception

Multifocal contact lenses (MCLs) are increasingly used to correct for Presbyopia and to manage Myopia progression. There are multiple MCLs designs (mostly refractive, and rotationally symmetric)[1-3], with diffractive multifocal designs allowing the modulation of longitudinal chromatic aberration (LCA) to expand the range of vision[4,5]. Diffractive multifocal Intraocular lenses (IOLs)[6] are typically a hybrid refractive-diffractive design, where light energy is split between a number of foci. In most designs, the far focus receive light that is purely refracted (0 diffraction order), whereas the other focus (intermediate and near) are generated with a combination of diffracted light (first and second order of diffraction). Refractive or diffractive focalization leads to opposite signs of LCA, thus allowing modulating the chromatic aberration of the eye at different distances. While diffractive LCA modulation via IOLs has been widely studied, diffractive MCL designs are rather new, and their on-bench evaluation presents a series of challenges.

In this project, we will design and implement a contact-lens cuvette channel into a polychromatic Adaptive Optics based visual simulator to study polychromatic visual perception on complex MCLs designs.

1 *Charman, W. N. Developments in the correction of presbyopia I: spectacle and contact lenses. Ophthalmic & physiological optics : the journal of the British College of Ophthalmic Opticians **34**, 8-29, (2014).*
2 *Perez-Prados, R., Pinero, D. P., Perez-Cambrodi, R. J. & Madrid-Costa, D. Soft multifocal simultaneous image contact lenses: a review. Clinical & experimental optometry **100**, 107-127, (2017).*
3 *Bennett, E. S. Contact lens correction of presbyopia. Clinical & experimental optometry **91**, 265-278, (2008).*
4 *Gatinel, D. & Loicq, J. Clinically Relevant Optical Properties of Bifocal, Trifocal, and Extended Depth of Focus Intraocular Lenses. J Refract Surg **32**, 273-280, (2016).*
5 *Vinas-Pena, M. et al. Understanding In Vivo Chromatic Aberrations in Pseudophakic Eyes Using on Bench and Computational Approaches. Photonics **9**, 226 (2022).*
6 *Simpson, M. J. Diffractive multifocal intraocular lens image quality. Appl Opt **31**, 3621-3626, (1992).*

Impact & opportunities. The candidate will have the opportunity to learn the basics of different methodologies (optical design, implementation of optical prototypes, visual testing, optical simulation), and a strong programming component, while working in an interdisciplinary and international environment, with great scientific, clinical and industrial impact, with opportunities for academic and business professional development. The candidate will receive specific education on visual simulation and optical design.

BIOSIM - BIOphotonics & Smart IMaging Lab, Institute of Optics of the Spanish National Research Council (CSIC) | María Viñas Peña. Development of novel imaging techniques and computational methods to investigate the visual system, with particular focus on adaptive optics, advanced optical coherence tomography, and multimodal functional imaging. BIOSIM works at the interface of photonics, neuroscience, and ophthalmology, translating high-resolution optical technologies into clinical tools for early diagnosis and personalized management of eye and vision-related neural diseases.

Candidate's profile: We are looking for a candidate with an excellent academic record, motivation for experimental and multidisciplinary work, work capacity, and excellent communication skills (in English and Spanish). The selection process includes an in-person interview. Motivation to pursue a career in Optics and Photonics will be valued.

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