



PhD in FISICA / PHYSICS - 38th cycle

PNRR_352 Research Field: DESIGN AND IMPLEMENTATION OF PHOTONICS SYSTEMS FOR AUGMENTED AND VIRTUAL REALITY

Monthly net income of PhDscholarship (max 36 months)

€ 1400.0

In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity

Motivation and objectives of the research in this field

The metaverse is a new and pervasive concept that describes the multilevel interaction between people, in which the real and virtual world are interlaced. The ultra-broad band internet and the ubiquity of smart devices connected to social media on Meta platforms and to a plethora of content providers has led to an increasing overlap of our digital and physical lives. Although the interaction with the metaverse mostly passes through our sight and hearing, it is presently mediated by a multitude of devices unnaturally connected to the human senses. Luxottica, a worldwide leading company in the eyewear market, has started a highly innovative project, in collaboration with Polimi, to design and develop the eyewear of the future. The aim of the research is to turn eyeglasses into the portal of the metaverse, exploiting their natural coupling with our senses. In the long run, this result will be achieved by adding revolutionary capabilities of Augmented Reality (AR) and Virtual Reality (VR) to age-old devices designed to correct vision impairments and to protect the eyes from sunlight. The main objective of the Ph.D. Program is the development of photonic devices needed for a new generation of smart eyewear. The Ph.D. project fulfils the requirements of the Next Generation EU in terms of innovation and strengthening competitiveness. The functionalities of smart eyewear will also help to increase inclusion and social relations.

Methods and techniques that will be developed and used to carry out the research

The eyewear of the future, featuring immersive AR and VR functions, requires new photonic devices that combine



	<p>digital images with the vision of the real world in a natural and comfortable way.</p> <p>The optical integration process consists of the realisation of a near-eye display and its adaptation to the eyeglasses. The research and development activities will consist of four main tasks.</p> <ol style="list-style-type: none"> 1. Generation of digital holograms of real objects or virtual information and their implementation on Spatial Light Modulators (SLM) illuminated by coherent light. 2. Transfer of holographic images close to the eye using refractive, reflective and/or waveguide optical systems compliant with the shape of the eyeglasses. 3. Fusion of virtual and real images by means of Holographic Optical Elements (HOE) or nanostructured metasurfaces, which redirect to the eye the holograms from the metaverse while transmitting the natural light from the environment. 4. Assembling of the optical elements in a prototype of near-eye display and testing with cameras, which simulate, as far as possible, the vision properties of the human eye in terms of field of view and accommodation capability. <p>The topics addressed by the research project belongs to photonics, an EU Key Enabling Technology. In addition, the smart eyewear will include health monitoring functions.</p>
<p>Educational objectives</p>	<p>The PhD candidate will work in a multidisciplinary team including top researchers in photonics, electronics, and artificial intelligence. He/she will learn digital holography, diffractive optics, metamaterials, nanofabrication, computational methods and system integration.</p>
<p>Job opportunities</p>	<p>The candidate will work in a Joint Research Center Polimi-Luxottica and carry out an internship at a Luxottica site in Italy or abroad. Job opportunities will be in companies that develop devices and photonics systems for virtual and</p>



	augmented reality: a highly innovative and promising technological segment.
Composition of the research group	2 Full Professors 3 Associated Professors 1 Assistant Professors 9 PhD Students
Name of the research directors	Cerullo, Della Valle, Valentini

Contacts	
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Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	700.0 €
By number of months	6

National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	Luxottica
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	The PhD Students will have the opportunity to do an internship in a leading University like MIT or Harvard.
By number of months abroad	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information	
<p>Educational activities: Educational activities (purchase of study books and material, funding for participation to courses, summer schools, workshops and conferences): financial aid per PhD student per 3 years: max 5.707,13 euros per student.</p> <p>Teaching assistantship: There are various forms of financial aid for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.</p>	



Computer availability: individual use

Desk availability: shared use

Other Information about Industrial Partner:

Luxottica is a world leader in the design, manufacture and distribution of high-end, luxury and sports eyewear with annual sales of around E 9500 M (2019).

Since 2018, it has been part of the EssilorLuxottica Group, a reference company for the design, production and distribution of ophthalmic lenses, prescription eyewear and sunglasses. With more than 180,000 employees and a strong global presence