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Basic Hands-on Introduction to Holography for Ophtalmology and Optometry Undergraduate Students

MFM Costa
University of Minho, Braga, Portugal
mfcosta@fisica.uminho.pt

Abstract. The three-dimensional visualization of objects and structures is very important in a number of situations also because that is how we normaly see.

Holography is a well-established way of creating 3D images of real objects [1]. The technical and scientific developments over last decades in this field turn holography, either analogue and digital, a very powerfull tool in many different applications including in medicine. Important advances were made also in domains involving eyesight and the eye like optometry, ophthalmology and ophthalmic optics.

Exciting developments are foreseeable on the use of holography on these fields in a variety of situations. Holographic optical elements are in the core of new auto-phoropters that, using three tunable-focus fluidic lenses and thin-film holographic optical elements, are designed to perform automatic refractive error measurement and provide a diagnostic prescription without supervision in an effective way [2]. Holographic multivergence targets are used in the subjective measurement of astigmatic errors [3]. Holographic contact lenses [4] became available as well as holographic lenses that can replace the traditional meniscus ophthalmic lenses. CAD (computer-aided design) tools [5] and new methods of engraving/printing holograms further help the modelling and tridimensional visualization of structures of the visual system and noninvasive characterization.

The introduction of the concept of holography is therefore very important on the training of future optometrists and ophtalmologists. We have designed and briefly present here a basic hands-on approach to introduce holography to undergraduate students.

From the basic concepts of coherence to the understanding of interference and diffraction, the students move forward onto the production of holograms of eye models and later one of eye models fitted with contact lenses and even ophthalmic lenses.

We focus the learning process on the Denisyuk holography [6] by its simplicity and easier implementation. Students realize in practice how holography works, understanding the meaning and importance of coherence of the light employed and of an efficient vibration isolation. The students also realised the difficulties and limitations when working with transparent optical elements and alive structures with reduced consistency.

Keywords. Holography, Optometry, Eye, Denisyuk Holography, Ophtalmology.

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