RESUM DE TESI DOCTORAL

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Títol de la tesi:	**Desarrollo de nueva instrumentación para la medida de la calidad óptica del ojo**			
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Resum[2]:

The sense of sight plays a crucial role in the relation of the human being with his environment, proportioning most of the information that he perceives from it. So the importance of the study of the quality of the eye as an imaging system is understandable.

This study is clinically carried out by means of subjective measurements, or more recently, by the determination of the ocular wave aberration. However, there is a lack of clinical tools for the evaluation of ocular optical quality taking into account all the factors degrading the image on the retina (difraction, aberrations and intraocular scattering). Thus, the main objective of this thesis work consists of the development of a clinical instrument for the measurement of the eye's overall optical quality, based on the double-pass technique, complementing those measurements with aberrometric estimations.

Therefore, the optical, mechanical and electronic design of a system based on the double-pass technique has been performed obtaining a totally automatized instrument prototype. A software tool has been implemented as well, permiting the control of the device, the register and analysis of the images, and the visualization of the results in a very simple way. It gives the user both qualitative and quantitative information (by means of the modulation transfer function MTF and several quality parameters) about the optical performance for far vision and different accommodative states. In this sense a method for the determination of the amplitude of accommodation has been developed making this instrument the only system capable of objectively measuring this magnitude.

The instrument has been clinically validated. A second prototype has also been implemented that permits the analysis of the repetitiveness of the system's results. Additionally, two separate clinical studies have been carried out that demostrate the instrument's potential. In the first study, a method for estimating psicophysical parameters (visual acuity and contrast sensitivity) have been found using the MTF obtained form the double-pass images. The second study consisted in evaluating the amplitude of accommodation both in phakic and pseudophakic subjects. Finally, the estimations obtained with the double-pass instrument have been compared with those from an aberrometric system, finding, in the latter, an overestimation of quality in cases where intraocular scattering and high order aberrations are significant. A parameter which quantifies the level of intraocular scattering has been defined by comparing the estimations obtained for both techniques.

Regarding the implemented aberrometric system, a new ocular wave-front sensor has been proposed and developed; this system conceptually solves the principal drawbacks affecting the

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current methods, principally the achievable order of aberration and the dynamic range. A curvature sensor, applied in astronomy and optical metrology, has been adapted for use in the case of the human eye. In order to test its feasibility, the sensor has been studied by means of computer simulations, analizing the performance of the sensor as a function of the characteristics of the image capture system (sensitivity, noise, bit depth, etc). This helped, as well, in the design of the optimal optical experimental set-up. Important innovations have been introduced in the algorithm for wave-front retrieval from the captured images, making it faster and more precise. This good performance has been confirmed with experimental measurements, both with artificial and real eyes. This new sensor can be easily incorporated into the double-pass instrument, obtaining in this way a system which characterizes all the factors of optical degradation of the retinal image. A design for this joint measurement system is proposed.

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