The Next Generation 3D Vision System for Measuring the Individual Parameters of Spectacle Wearers

M.Tiemann, P.C. Seitz, G. Esser

Rodenstock GmbH, München

mailto:markus.tiemann@rodenstock.com

The new version of the video centration system from Rodenstock is still based onto the approved method of a stereoscopic 3D measurement. In this paper the new features of the third generation of the so-called ImpressionIST® family are shown. For the first time the high accuracy of this system due to an automated calibration procedure is presented.

1 Introduction

In the ophthalmic industry lenses get more and more individualized to generate the best possible performance of a spectacle for the wearer. In contrast to technical optics, the lenses of a spectacle are more or less freely positioned in front of the eye. Mostly the position is more dependent on fashion then on the needs for an optimum of the visual system. In addition the eye and its optical axis are not fixed to one position but vary with gaze direction. With the free-form technology it is possible to compensate a lot of the induced errors by generating an individualized surface depending on the individual parameters of a spectacle frame and its wearer (see Fig. 1). With these parameters the exact position and orientation of the lenses in front of the eyes is determined. Therefore a measurement of these parameters with high accuracy is important and an optical 3D measurement system is the best choice.

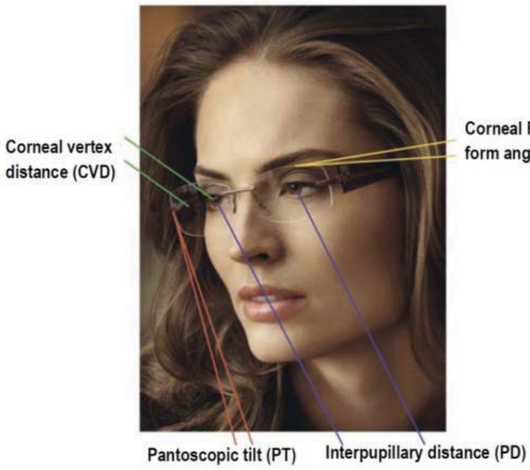

Fig. 1 *The individual parameters of a spectacle wearer*

Since the first generation of our video centration systems [1], the measurement procedure is based onto a stereoscopic dual camera system. By finding the same point in the images of two different cameras and with the knowledge of the position of these cameras to each other the 3D position of the point can be calculated.

2 Improvements of the third generation

The ImpressionIST® 3 is the third generation of the so called video-centration system from Rodenstock for measuring the individual parameters of spectacle wearers and it was launched in 2013. Since the first system from Rodenstock in 2004 these systems are based onto a two camera stereoscopic 3D measurement. This measurement system is still unique in the market and shows a high accuracy compared to other systems. Through the honored new design (iF design award 2012) the weight and the size of the whole system could be halved compared to its predecessors. Also a fast manual height adjustment system could be integrated to adapt the different human heights and all these is done in three different realizations (stand, wall and table version) to make the system as flexible as possible (see Fig. 2).

Fig. 2 *The three realizations of the ImpressionIST® 3*

Another big advantage of the mechanical setup is that in a service case the whole optical system can be easily exchanged, therefore reducing service time. The optical system was redesigned with now two 5MP cameras and in combination with its objective a bigger field of view and a higher depth of focus (~15cm) could be achieved. These both im-

DGaO Proceedings 2014 - http://www.dgao-proceedings.de - ISSN: 1614-8436 - urn:nbn:de:0287-2014-P013-5
submitted: 25. Jul. 2014 published: 18. Aug. 2014

provements make it much easier to place a customer inside the 3D measurement volume and the overall measurement time is reduced. Each camera is looking slightly from the side to the measured customer and the customer can look freely at the mirror. These improvements lead to a natural body posture within the measurement process and this is important because the body posture has a strong influence of the position and the angle under which the client is looking through the glass.

Inside the device there is an electronic board which connects the two cameras to a WLAN-Module for the communication with a measurement computer. The calibration data of the measurement system with the internal and external camera parameters is saved directly onto the camera memory. These two features enable a free positioning of the analysis computer and that any computer can be attached to any measurement system.

3 Calibration quality in series production

The most important point of the video centration system is the exact measurement of the individual parameters. Therefore a robust calibration procedure is needed to achive a high accuracy of the stereoscopic measurement system for all devices in production. This was realized by the development of a fully automatic calibration mechanism. The slider of each ImpressionIST® 3, which contains the stereoscopic camera system, is placed inside a calibration camber within the production process. In this chamber the light condition is always the same. Then 26 images of a calibration plate in different positions and orientations in the field of view of both cameras are used for the internal and external calibration (see Fig. 3). The positioning of the calibration plate is done via a robotic arm. This whole procedure enables a high quality calibration of all systems.

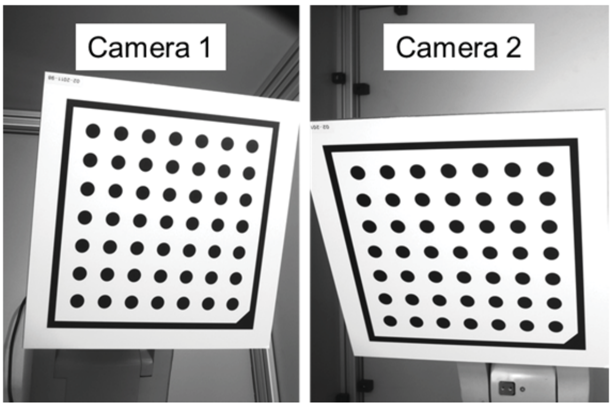

Fig. 3 *The images of the calibration target in both cameras of one video centration system inside the calibration camber*

4 The accuracy of the system

The last step before delivery of the ImpressionIST® 3 to the optician is a test measurement of a test object printed on a metal plate. The reference values of this object are for pupillary distance 81mm and for the face form angle 0°. In Fig. 4 the distribution of the measured values for 499 different devices are shown.

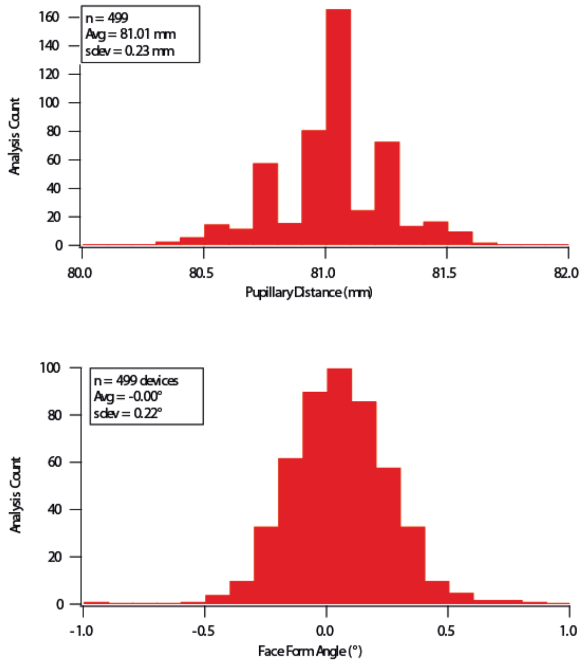

Fig. 4 *The distribution of the measured values for the pupillary distance (top) and face form angle (bottom) of the test object for 499 different devices*

These results show the high accuracy of this video centration system, which fulfill the needs for the realization of high performance progressive addition lenses [2]. The shown standard deviation (Fig. 4) for the pupillary distance and the face form angle is comparable of competitive products investigated in [3]. But what is much more important, here it is shown, that the exact values of a refernece are measured with a high accuracy.

References

[1] R. Sessner, D. Uttenweiler „3D-Videozentriersystem zur hochgenauen Vermessung der Zentrierdaten und individueller Parameter des Systems Brille Auge“ in DGaO-Proceedings 2007 ISSN: 1614-8436

[2] G. Esser, D. Uttenweiler „Performance individueller Gleitsichtgläser“ in Deutsche Optiker Zeitung DOZ 12.2005

[3] W. Wesemann, „Moderne Videozentriersysteme und Pupillometer im Vergleich, Teil 2, Schluss“ in Deutsche Optiker Zeitung DOZ 7.2009