

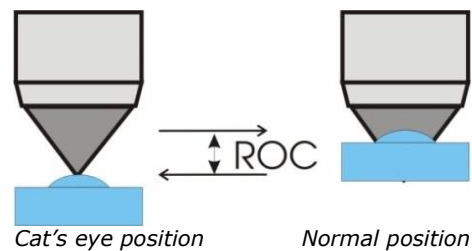
Application note:

Lathe calibration with SHSOphthalmic autoROC

1 Introduction

Lathes are widely used to manufacture contact lenses and intra-ocular lenses. The big advantage is their intrinsic flexibility to produce surfaces with high optical quality and with a wide range of specifications even at a lot size of 1. Among different key requirements, the tool calibration plays a major role for achieving high quality lenses. It must be ensured that both, surface radius and surface shape are produced according to the specification. Optocraft's product SHSOphthalmic autoROC helps in this quality ensuring production step.

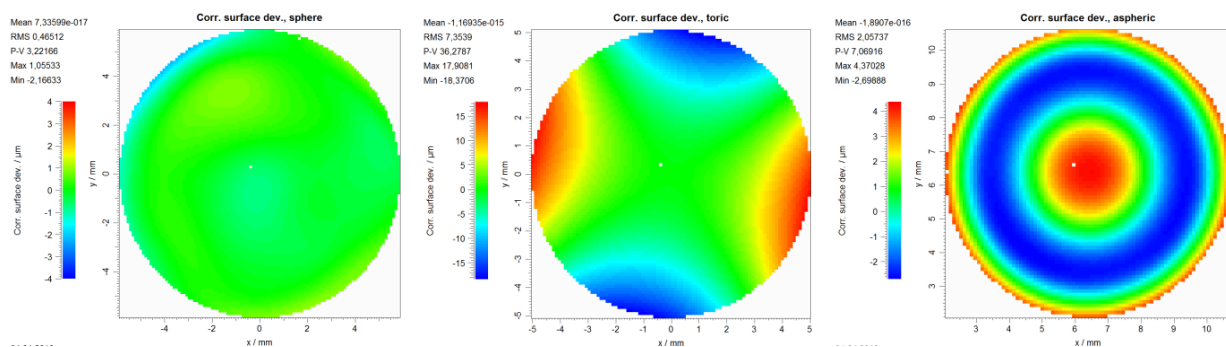
2 Principle of the SHSOphthalmic autoROC



The SHSOphthalmic autoROC measures optical surfaces using a wave-front sensor. In case of ophthalmic lenses, the surface under test is illuminated with a spherical wave-front and, thus, the reflected wave-front will carry information on the deviation of the sample from a spherical shape. This is called the "normal position". The absolute radius of curvature (ROC) can be derived by measuring the distance from the normal position to a so-called cat's-eye position, where the focus of the objective lies on the apex of the surface under test.

Examples

A typical spherical sample may have surface deviations less than 0.5microns, as shown in the example 1. A toric surface would yield a more or less strong astigmatic wave-front where the astigmatism accounts for the difference of the radii in the two major meridians. For more complex samples such as multifocal lenses, significantly higher order surface aberrations such as spherical aberration may be present.



Spheric, toric and aspheric surface deviation (from left to right)

Performance of the autoROC

The SHSOphthalmic autoROC provides high accuracy and repeatability for measurement in R&D and production. When calibrated with certified ceramic standards, the performance is

- Accuracy ROC: 2microns
- Repeatability ROC: 0.5microns
- Accuracy surface: 0.1microns pv

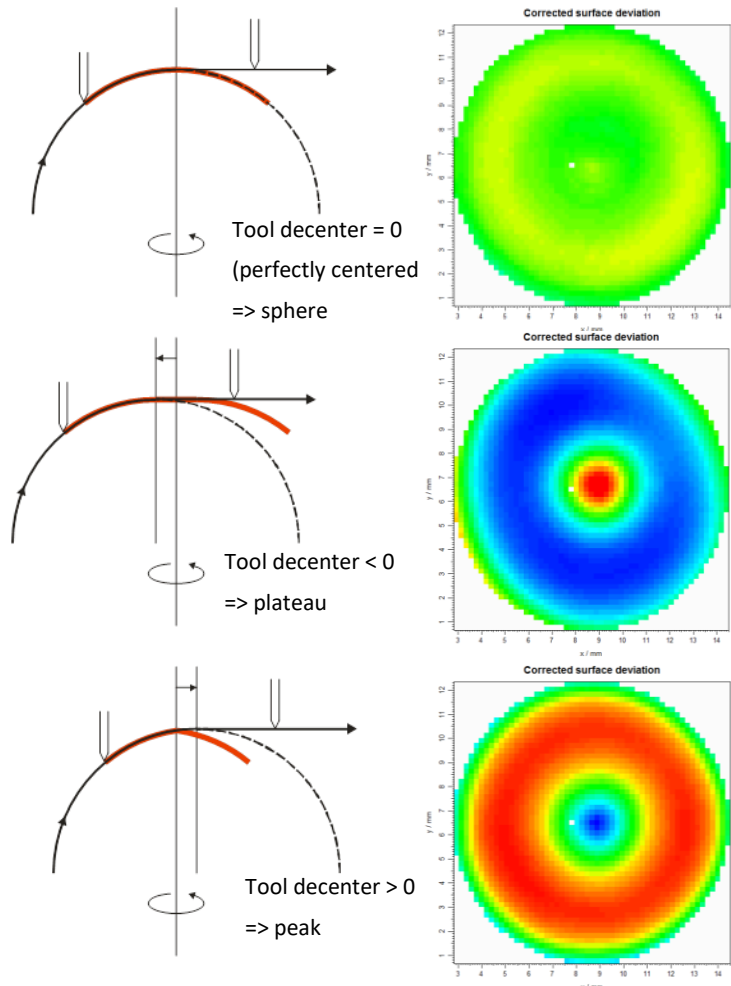
Measurements can be taken within 5-30 seconds, depending on the particular measurement process.

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3 SHSOpthalmic autoROC for lathe calibration

For lathe calibration, typically spherical parts are cut (e.g. with a ROC=8mm) and measured. By analyzing the amount of asphericity in the surface deviation, the amount of lateral deceleration of the tool coordinate system to the axis of rotation of the sample can be calculated. The rationale is the following: In case the tool is well centered to the axis of rotation of the part, an almost perfect sphere will be cut. However, in case the tool is decentered by a small negative amount, the result would be an almost spherical surface with a plateau in the center and accordingly, a small positive tool decenter will yield a peak in the center. Even though the effects are usually quite small, on an optical scale they are significant enough to degrade the image quality of such optical surfaces.



In the color plots one can clearly see the effect of tool decenter on the measured surface deviation of a spherical surface of 8mm. For the two cases (decenter <0 and >0) there is a clearly visible change in the sign of the deviation.

The SHSOpthalmic autoROC is a reliable tool for lathe calibration. The result of the measurement is the amount of decentration of the tool in micrometers, so the operator has a direct number by how much the lathe needs to be adjusted. After setting up the measurement process and calibrating the instrument with known samples, it provides an accuracy of about 1micron and a repeatability of 0.2micron.

4 Additional functionality

As an additional benefit, the high-quality imaging camera of the SHSOpthalmic autoROC shows a high resolution image of the measured area. Thus, the operator can also observe the quality of the lathe tool itself and decide whether it may still be used or needs to be exchanged.

