SiTek® ELECTRO OPTICS
Non-Contact
2/98
PEOPLE, PRODUCTS & NEWS

Self-tonometer OCUTON S

In Germany roughly 1,2 million people suffer from the eye disease glaucoma. This disease, which the patient is often unaware of, may lead to loss of sight if not treated in time. Glaucoma is one of the most common reasons for losing one's sight in the industrialised countries.

Intraocular pressure - which can be determined by means of a so-called tonometer - is an important parameter in recognition and treatment of this disease. Until now a measurement of the intraocular pressure has only been possible by an ophthalmologist. The measurement of this parameter is quite expensive and consequently large sections of the population can hardly be examined regularly.

The intraocular pressure may vary significantly over a short time scale, which may cause considerable damage to the eye. Thus, tight control of this parameter is a precondition for an optimum treatment. For the first time the OCUTON S self-tonometer allows the patient to measure the intraocular pressure of his eyes by himself to provide important data for diagnosis and therapy to his ophtalmologist. Of course the measurement has to be carried out under the ophthalmologist´s guidance and control.

For measuring the intraocular pressure the automatic self-tonometer OCUTON S operates as follows: a defined force moves a body with an even surface perpendicular to the spherical cornea and flattens it (applanation) in order to generate a counter pressure equivalent to the intraocular pressure.

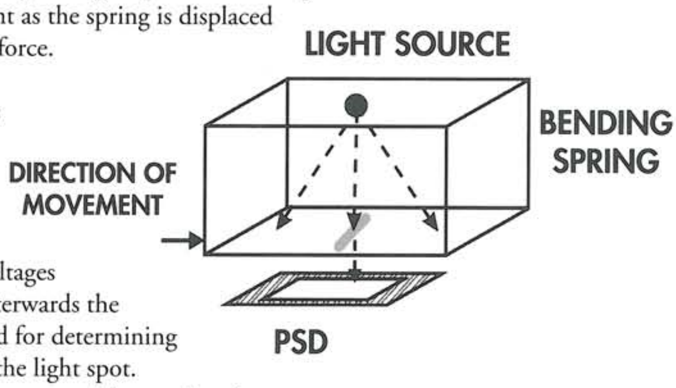
The pressure is determined as $Pi = F/Ap$ by measuring the applanation surface (Ap) and the exerted force (F). The force necessary for applanation is controlled by a d.c.-drive which operates a movable carrier. The body to be moved against the eye - a prism - is connected to the carrier via a bending spring so that the rising counter-force leads to an elastic deformation of the spring.

As a result the spring displacement is indirectly proportional to the drive direction:

$F = D \times s$, where
F = back driving force (mW),
s = spring displacement (mm) and
D = spring constant (mN/mm).

In this way the measurement of the force may be reduced to a measurement of the displacement, which is accomplished by means of a SiTek linear Position Sensing Detector (PSD); namely 1L5SP.

In detail, a parallel spring guide is used which is connected to a slit with the dimensions 2,0 x 0,4 mm. An IR-source (LED) is situated at a defined distance from the slit. In this way the light spot moves along the PSD element as the spring is displaced by the counter-force.



In processing the PSD signals the partial currents Y1 and Y2 are converted to proportional voltages U1 and U2. Afterwards the voltages are used for determining the position of the light spot.
The following two quantities are therefore calculated

sum voltage $Us = U1 + U2$ and
differential voltage $Ud = U1 - U2$.

The differential signal Ud, which is the real position-sensitive value, is supplied to an AC/DC-converter which uses the sum signal Us as a reference voltage. Both signal levels are matched to each other so that the differential voltage is equal to, or lower than, the sum voltage.

Sitek at exhibitions

There will be a number of exhibitions taking place this summer in Europe where the latest electro-optical components and products will be presented. SiTek products will be displayed at four exhibitions referred to below where SiTek staff will also be available. If you are interested in seeing our products - or meeting us - you are very welcome to the exhibitions. You are also welcome to book a meeting with us if you have any questions to discuss. Contact us directly or via your local distributor, see below.

Optatec

The 4th International Trade Fair for Optics and Optoelectronics - Applications and Technology, 16 - 19 June at the Fairground Frankfurt on Main, Germany.
SiTek products will be exhibited at the stand of our German distributor, Laser Components GmbH. SiTek will be represented at the exhibition by one of our company's most experienced members of staff.

Salon de la Physique

Between 15 - 17 September at the Porte de Versailles south-west of Paris. SiTek will exhibit together with our distributor in France, Geti Services. SiTek will have both commercial and technical expertise available at the exhibition.

CLEO/Europe Technical Exhibition '98

Conference on Lasers and Electro-Optics/Europe, 15 - 17 September at the Scottish Exhibition and Conference Centre in Glasgow, Scotland. SiTek products will be exhibited at the stand of our UK distributor, Optilas Ltd. SiTek will be represented by one of our company's most experienced members of staff.

Instruments

The exhibition will take place 5-9 of October in Utrecht, The Netherlands. SiTek products will be exhibited at the stand of our Dutch distributor, Landré - Intechmij BV.

Optatec

PHYSIQUE 98

CLEO EUROPE 98

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Closing for vacation

SiTek will be closed for a two-week holiday period from 13th to 24th July. During these two weeks no deliveries will be made. When placing orders with us for delivery in July, please state your requested delivery date either before or after this period.

Madeleine Fritzner

My name is Madeleine Fritzner, I'm 29 years old and started work at SiTek in February. My job is on the administrative side which involves handling a wide variety of tasks.
I studied economics at High School and have also taken additional courses. I have worked as an au pair in Germany, in food stores and in different office jobs. My previous job was in a tax office.
In my free time I like to socialise with friends and go out into the country. My latest project is learning to skate in-lines which is easier said than done but it's good fun!
I very much enjoy being here at SiTek both on account of my colleagues at work and the challenge of my job.

SiTek´s PSD-school

SECTION 11 by Lars Stenberg

In section 10 we studied the shift in the position of the 'light gravity centre' due to the aberrations introduced when we used a simple biconvex lens as main lens. In this section we shall investigate how we can reduce the aberrations and thereby reduce the shift of the light gravity centre by changing the form of the biconvex lens and thereafter investigate what occurs when we use a main lens that comprises more than one lens. The reader is recommended to have at hand section 10 of the PSD school when reading this section. For all the examples below the parameters are used which were calculated in section 3 of the PSD school such as the focal length of the main lens being f_E = 33,5 mm, DE = 156,649 mm, α = 40° and β = 5,25°.

Figure A shows where the different image field points lie for the image field angles that are used in this section of the PSD school, namely -5,25, -2,625, 0, 2,65 and 5,25 degrees. Figure 2 from section 10 defines what is the chief ray and what are axial rays.

Single lenses

The shift in the position of the 'light gravity centre' for different lens types is presented with the aid of tables according to the example below that relates to one simple biconvex lens. The spot radii that are specified relate to the radius of the smallest circle that covers the spot diagram and has the chief ray as reference. It is always true that this radius is greater than the radius of the smallest circle that covers the spot diagram that has the centre point of the centroid * as reference point. Table 1 shows the data for a simple biconvex lens. To each table there is a figure that shows the lens or lens system's appearance.

Image field angels (degrees)	Geometric spot radius (µm)	Y-position: main beam (mm)	Y-position: Centroid (mm)	Differential main beam-centroid
-5.25	746	-3.883	-3.987	-0.104
-2.625	448	-1.905	-1.957	-0.052
0	255	0	-0.002	-0.002
2.625	384	1.847	1.894	+0.047
5.25	622	3.647	3.744	+0.097

Table 1. Simple biconvex lens of BK7 glass.

Let us now investigate what happens if we allow the optical program to optimise the form of the lens. The result appears from the figure and table 2 below.

Image field angels (degrees)	Geometric spot radius (µm)	Y-position: main beam (mm)	Y-position: Centroid (mm)	Differential main beam-centroid
-5.25	418	-3.933	-3.946	-0.013
-2.625	267	-1.929	-1.936	-0.007
0	200	0	-0.001	-0.001
2.625	219	1.868	1.874	+0.006
5.25	336	3.688	3.704	+0.016

Table 2. Simple BK 7 lens with optimised form.

Lars Stenberg

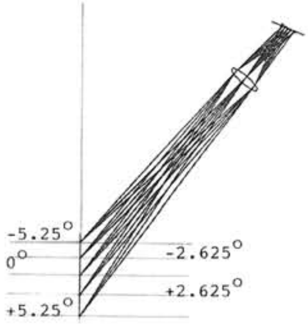


Figure A.

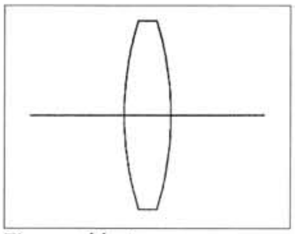


Figure table 1.

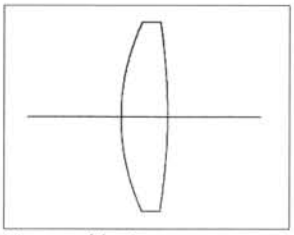


Figure table 2.

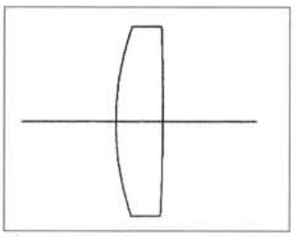


Figure table 3.

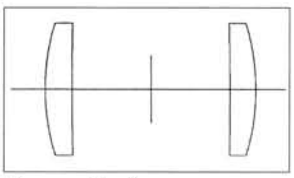


Figure table 4.

From table 2 it is clear that both the spot radius and the distortion have been reduced considerably when we had the computer optimise the form of the lens.

We shall now investigate what happens if we replace the glass that in the first two cases were BK7 with SFL6 and at the same time optimise the form of the lens. The result appears from the figure and table 3 below.

Image field angels (degrees)	Geometric spot radius (µm)	Y-position: main beam (mm)	Y-position: Centroid (mm)	Differential main beam-centroid
-5.25	246	-4.013	-4.014	-0.001
-2.625	122	-1.968	-1.969	-0.001
0	75	0	0	0
2.625	101	1.906	1.908	+0.002
5.25	208	3.763	3.770	+0.007

Table 3. Simple SFL6 lens with optimised form.

From table 3 it appears that both the spot radius and the distortion were further reduced when we used a high refractive index glass and had the computer optimise the form of the lens.

In order to reduce the distortion and further enhance the image definition we have to make use of a composite lens system.

Lens systems

A lens system comprising two lenses is called a duplex. If there is an air gap between the lenses the duplex is termed separated and if the lenses are stuck together the duplex is called cemented. A duplex that is corrected so that the image location for two wave-lengths coincide and - at the same time - meet the aplanatic requirements ** is called achromatic ***.

The next system that we should examine is therefore a separated duplex. The result appears from the figure and table 4 below.

Image field angels (degrees)	Geometric spot radius (µm)	Y-position: main beam (mm)	Y-position: Centroid (mm)	Differential main beam-centroid
-5.25	227	-3.854	-3.864	-0.090
-2.625	140	-1.890	-1.895	-0.005
0	88	0	-0.001	-0.001
2.625	84	1.835	1.838	+0.003
5.25	122	3.632	3.640	+0.008

Table 4. Separated duplex comprising 2 SFL6 lenses.

It appears from the table that the distortion is greater but the spot radii are somewhat smaller than for the optimised SFL6-lens.

* *For explanation of the term centroid, see section 10.*

** *A lens meets the aplanatic requirements if it is corrected for spherical aberration and meets Abbe's sinus requirements.*

*** *It was the English lawyer Chester M. Hall who worked out an achromatic lens for the first time in 1729.*

We shall now test a cemented duplex that consists of two cemented lenses of two different optical glass types i.e. in principle an achromatic lens system. Since a triangulation probe operates most frequently on a single wave-length this means that we do not need to think of carrying out colour correction of the achromatic lens system when having the computer optimise it. The result appears from figure and table 5 below.

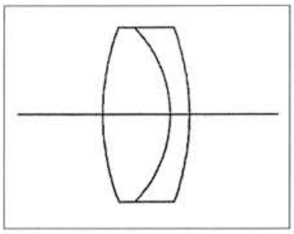


Figure table 5.

Image field angels (degrees)	Geometric spot radius (µm)	Y-position: main beam (mm)	Y-position: Centroid (mm)	Differential main beam-centroid
-5.25	90	-4.082	-4.070	+0.012
-2.625	117	-2.000	-1.995	+0.005
0	114	0	0.001	+0.001
2.625	107	1.935	1.934	-0.001
5.25	75	3.820	3.818	-0.002

Table 5. Cemented achromatic lens comprising glass types BK10 and SF5.

From table 5 it appears that the distortion is relatively small but the different spot radii are still very large.

Cooke triplet

We shall now examine a three-lens lens system - to be more precise a so-called Cooke triplet. The Cooke triplet is by no means the only conceivable three-lens lens system. There are in fact some thirty or so different three-lens systems described in the technical literature relating to optics. I have only chosen it as being a very commonly occurring lens. The Cooke triplet was designed in 1893 by Dennis Taylor who was employed as chief engineer by Cooke of York. Since this company was not interested in manufacturing photographic lenses Taylor arranged for another optical company to produce the lens but out of respect for Taylor's employer the lens has frequently been called a Cooke triplet ever since. The Cooke triplet is the simplest lens system that allows - at the same time - the correction of third order aberrations but this does not mean that the aberrations can be reduced right down to zero. A Cooke triplet comprises a negative flint glass lens in the centre with a crown glass lens on each side. The aperture is most frequently placed as in figure 6.

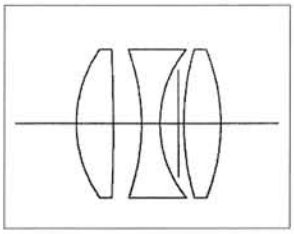


Figure table 6.

The result for a Cooke triplet appears in the figure and from table 6 below.

Image field angels (degrees)	Geometric spot radius (µm)	Y-position: main beam (mm)	Y-position: Centroid (mm)	Differential main beam-centroid
-5.25	204	-4.222	-4.222	0.000
-2.625	123	-2.065	-2.065	0.000
0	78	0	0.001	0.001
2.625	123	1.990	1.990	0.000
5.25	215	3.920	3.915	0.005

Table 6. Cooke triplet comprising SK16, F2 and SK16 lenses.

It appears from table 6 that the distortion is low except at the field angle + 5,25° but it is also evident that the Cooke triplet is overstrained due to the requirement that the entrance aperture shall be 15 mm.

Let us therefore reduce the entrance aperture to 10 mm and examine what happens. The result appears from the figure and table 7 below.

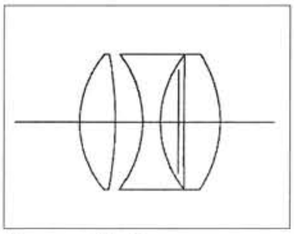


Figure table 7.

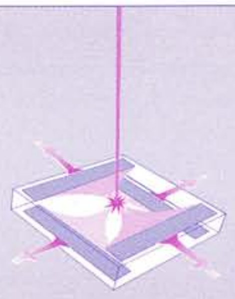
Image field angels (degrees)	Geometric spot radius (µm)	Y-position: main beam (mm)	Y-position: Centroid (mm)	Differential main beam-centroid
-5.25	40	-4.408	-4.410	-0.002
-2.625	41	-2.145	-2.143	+0.002
0	15	0	0	0
2.625	42	2.057	2.055	-0.002
5.25	41	4.054	4.055	+.001

Table 7. The same Cooke triplet as in table 6 but the solution is optimised for an entrance aperture of 10 mm.

We now see that both the spot radii and the distortion have been considerably reduced. We now have spot diameters of the magnitude of 80 µm and the distortion has been reduced to approx. 2µm.

If we wish to retain the requirement that the entrance aperture shall be 15 mm we must introduce a lens system that comprises at least 4 lenses.

In section 12 of the PSD-school we will investigate a few other lens systems and also give some general considerations regarding mechanics.



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