See in the Dark

See what is hidden to the human eye: the UCM.

The monitor displays the surrounding area.

The new *UCM* thermal imager camera makes invisible infrared radiation visible

A gray-brown blanket seamlessly covers unending grooves and craters. Thick dust absorbs the sunlight. Oversized excavators with their heavy buckets rumble around the mining site like giant toys, scraping off the top layer of rock and freeing the layers of coal. The fossil fuel lies near the surface, making strip mining possible. The world's enormous hunger for coal forces the monster excavators and dump trucks to work nonstop, 24 hours a day, 365 days a year: South Africa is in a rush for resources. More than 28.2 million tons of coal reserves have been verified in the country, with estimates reaching up to 115 billion tons. South Africa is the world's sixth largest producer of coal and the fourth largest exporter. Mining conditions are favourable: strip mining and shallow depths make the local coal an internationally important export commodity – when the conditions are right. Darkness, dirt, dust and fog rob the sight of the drivers of the giant excavators and 200-ton dump trucks. This is not only dangerous but inefficient. The giant machines must be able to safely maneuver, and excavate and transport the coal. The uncooled *UCM* (uncooled module) thermal imager from Carl Zeiss has been recently integrated into the driver's compartments in a box no larger than a hand to make

visible what the human eye cannot see. The *UCM* detects minute temperature differences and displays them as a visible image. Uncooled in this sense means that the infrared detector in the *UCM* does not have to be cooled and is immediately ready for use.

The miniature camera features thermal resolution of 0.06° C and optionally displays the thermal images in black/white or false color in real time. The high sensitivity of the 200 g device enables it to generate informative images even when normal cameras are blind: at night or under poor lighting and weather conditions. Unlike x-rays that penetrate objects, the infrared radiation used by the *UCM* captures the spectral region between 7-14 micrometers and thus even the minutest, invisible thermal differences between every object. A meaningless raw image is transformed into a picture and displayed on the screen. The *UCM* uses so little energy that it can be powered by a battery.

More information at:
www.zeiss.com/innovation

Discovering Complex Defects in Vision

View of a road without i.Scription® lens optimization.

With new measuring techniques and a totally new type of lens optimization for practically all ZEISS eyeglass lenses, it is now possible to reduce complex defects in vision.

Everything appears to be crystal-clear in daylight. However, when the light starts to fade, things begin to blur. This is something that quite a large number of eyeglass wearers experience, especially when driving. The reason: normal eyeglasses can correct only simple visual defects, and this is primarily due to the fact that only these can be detected by standard eye exams. A technique incorporating wavefront measurement and the *i.Scription*® lens optimization developed from it makes it possible to also detect complex visual defects, allowing eye care professionals to provide their patients with considerably better correction than in the past.

From the scientist's viewpoint, the eye is a truly abysmal visual instrument. "If someone offered me an optical instrument with such errors, I would certainly turn it down," said Hermann von Helmholtz. In the 19th century the doctor and natural scientist invented the ophthalmoscope for examining the retina and the ophthalmometer for measuring the curvature of the cornea, and therefore knew exactly what he was talking about. Eyeglasses had already been invented a long time before in 1750. They were used to correct shortsightedness, farsightedness and astigmatism, an abnormal change in the corneal curvature. These are simple visual defects which can be effectively corrected with eyeglasses.

About half of humankind does not enjoy optimal vision. Most of these people are shortsighted or farsighted, but not every visual defect can be explained with excessively long or short eyeballs or a malformed cornea. More complex refractive errors, so-called higher order aberrations, exist in all optical systems. They also occur in the eye and are specific to each individual person. Traditional (subjective) refraction, the process used to determine what lens powers are required, reveals simple defects only. Here, the patient is required to

Vision is always multidimensional: a comparison with and without i.Scription.

The same road with i.Scription® – with considerably sharper definition.

identify increasingly smaller numerals and letters on a brightly lit chart which is responsible for making the pupils smaller. Therefore, only visual performance in optimal light conditions is taken into account. Higher order aberrations are of major importance when the pupil is fully open. This explains why eyeglass wearers may have no problems during the daytime, but see everything blurred or feel dazzled in poor light or at night when their pupils dilate.

In wavefront measurement, Carl Zeiss scientists found the key to a considerably more detailed method of determining visual performance. This paved the way to more precise eyeglass correction. With the *i.Profiler*® measuring system, eye care professionals can use wavefront measurement for lens optimization. The *i.Profiler* projects low intensity light rays onto the retina which scatters them back again. If the system identifies a deformed wavefront, this indicates aberrations in the eye. The *i.Profiler* determines the distribution of the aberrations across the entire aperture of the pupil. The visual defect, or ametropia, is measured to the nearest one hundredth of a diopter – 25 times more precise than in the past. These measured values also reveal what the conditions are like in poor light and darkness and what higher order aberrations the eye displays. The *i.Profiler* data and the values obtained in traditional refraction are used to calculate *i.Scription* lens optimization. Lens designers at Carl Zeiss have developed a special algorithm for this purpose: *i.Scription* provides eyeglass wearers with a considerably enhanced visual experience in many cases. For example, the happy owner of a pair of glasses featuring *i.Scription* optimization expresses her satisfaction in the "Besser sehen" blog as follows: "Especially now when it's starting to get dark earlier, I can see with astounding clarity. I would recommend it to anyone: it was well worth it." Looking back at his three months of using the new technology, her eye care professional Niels Rebin, who operates a Relaxed Vision Center in Liechtenstein – *i.Scription* is only available in these centers – writes the following: "I must say I'm really impressed." Impressed, as he then adds, at how impressed his patients are.

You can find eye care professionals who offer *i.Scription* at:
www.zeiss.de/i.scription

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