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Cartesian lenses and the human eye

physikalisches

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Optical lenses are essential in science and engineering, for microscopes, telescopes, magnifying glasses, eye glasses, camera objectives etc. The imaging quality of our own eyes, taken for granted until diminishing due to age or disease, is a marvel of natural, evolutionary engineering. Des Pudels Kern is the exact form of the lenses, be they natural or not.

Spherical lenses are easy to grind and hence very widely used even today. Due to their inherent spherical errors, the imaging qualities of single spherical lenses are limited.

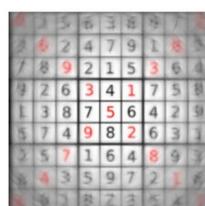
There is ongoing, avid (re)search to find better lenses, generally called aspherical. By combining spherical surfaces with aspherical ones, the optical quality of resulting lens systems can be further improved. Actual mobile phone cameras for instance take remarkable pictures, at the expense however of using at least 6 individual lenses.

The human eye in contrast uses only 2 lenses, the cornea and the eye lens, to achieve its time proven optical excellence. With spherical lenses and even with state of the art aspherical lenses, this is impossible to accomplish. Since good eyesight brings evolutionary (survival) advantages, Mother Nature invented the inherently aspherical Cartesian lenses long ago. Their analytical form is given by the Cartesian ovals described by Descartes in his La Géométrie (Leiden, 1637).

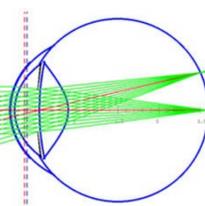
We found the analytical recipe for the choice, out of literally an infinite number of possibilities, of the ovals giving the best images. We call them optimized ovals. Paraphrasing René Descartes famous philosophical proposition: I see therefore I am.

In this talk we proudly present some of Mother Natures Cartesian lens secrets. Actually, once the underlying rules are understood and implemented, building excellent optical systems can be done with a decent laptop on a rainy afternoon.

This is seen by a Spherical eye,



a Cartesian eye



sees this

