SMARTCOOK PROJECT

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PHOTO OPTICS

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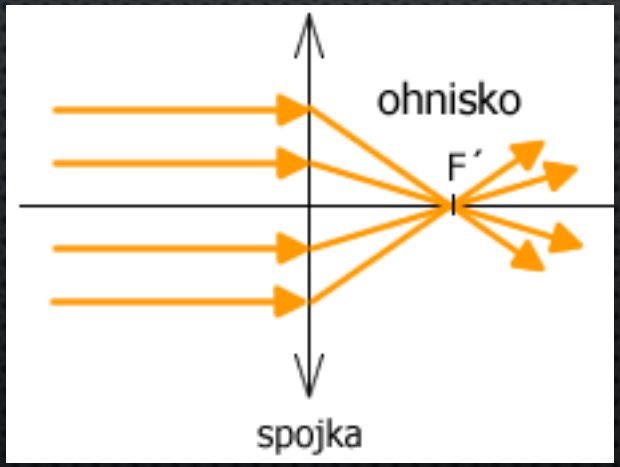
OPTICS

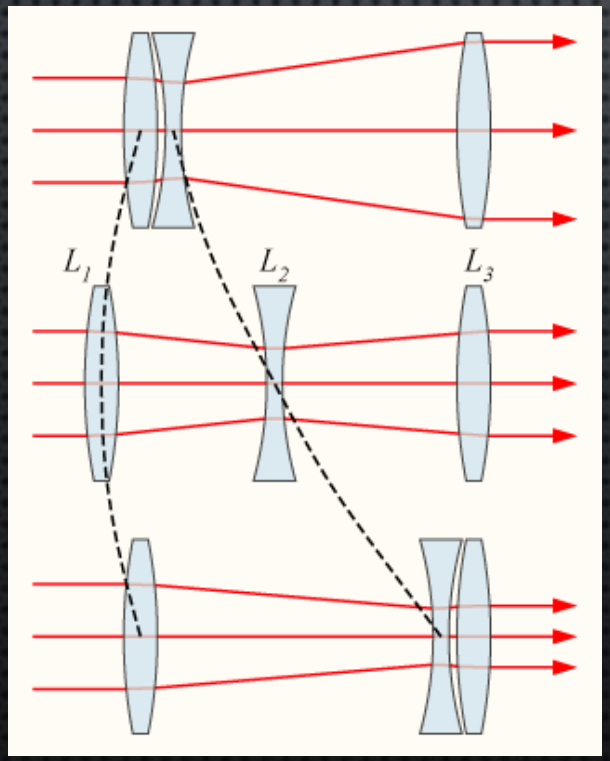
A lens is a set of optical elements to ensure the best possible image.

Lenses are divided into:
- fixed focal length - high luminosity and sharpness of images, but composition cannot be easily changed
- zoom lenses (up to 18 lenses) - you can easily change the composition but at a cost
reduced sharpness and luminosity (many lenses absorb some of the light)



VARIABLE FOCAL LENGTH(ZOOMS)

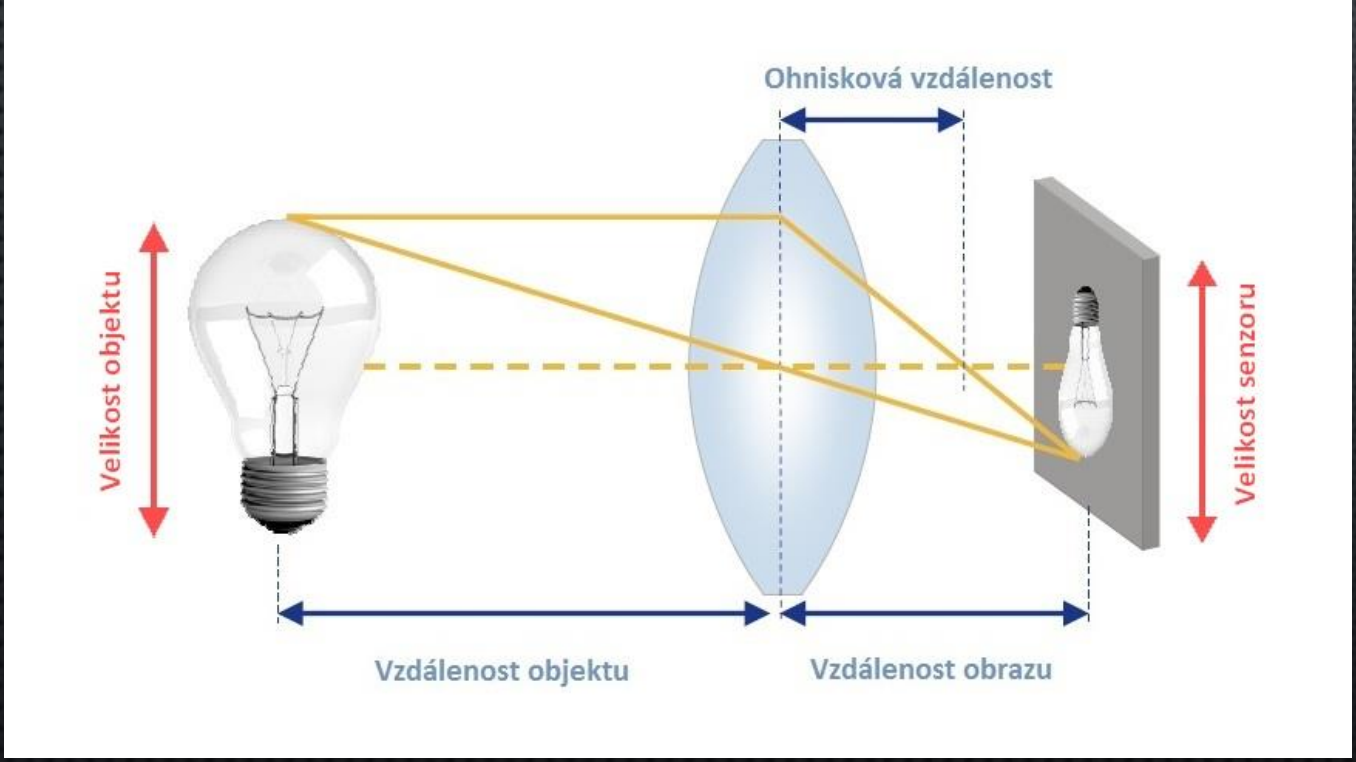
Very practical are lenses with a variable focal length (zoom lenses), which can change the focal length and thus the angle of view by precisely changing the relative position of the lenses.



Princip zoomu

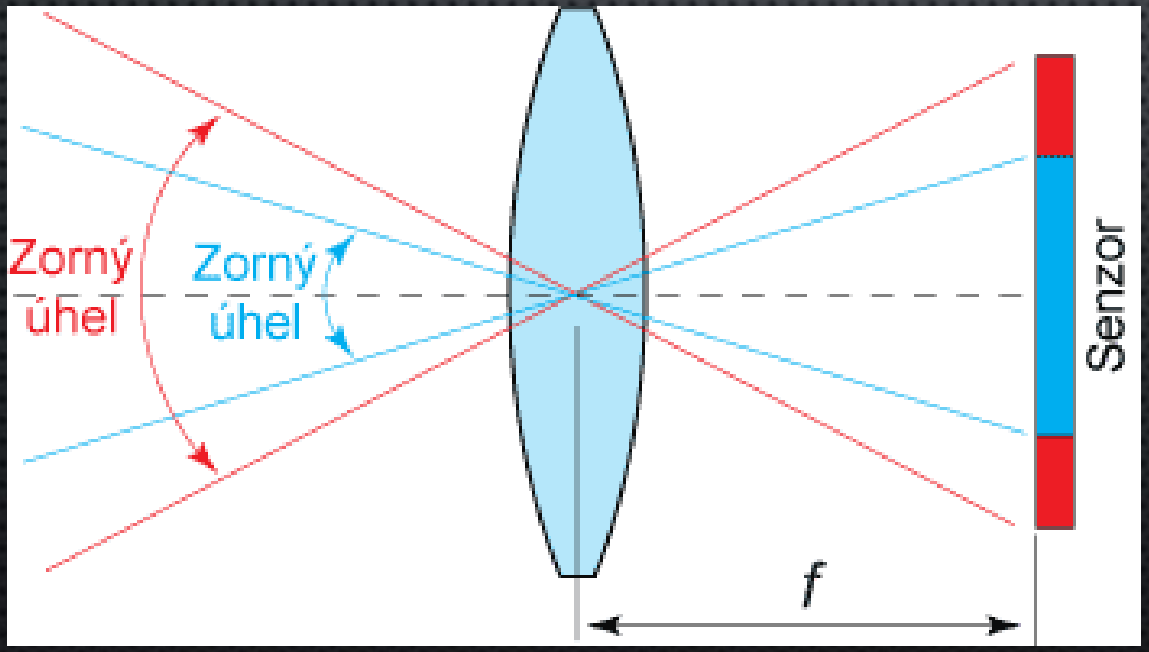
FOCAL LENGTH

The focus of a lens is the point at which a system of parallel rays. The distance of the focal point from the centre of the lens is called the focal distance. Lenses are designed to give a sharp image of objects is created in the focal plane, so an image sensor must be placed there.

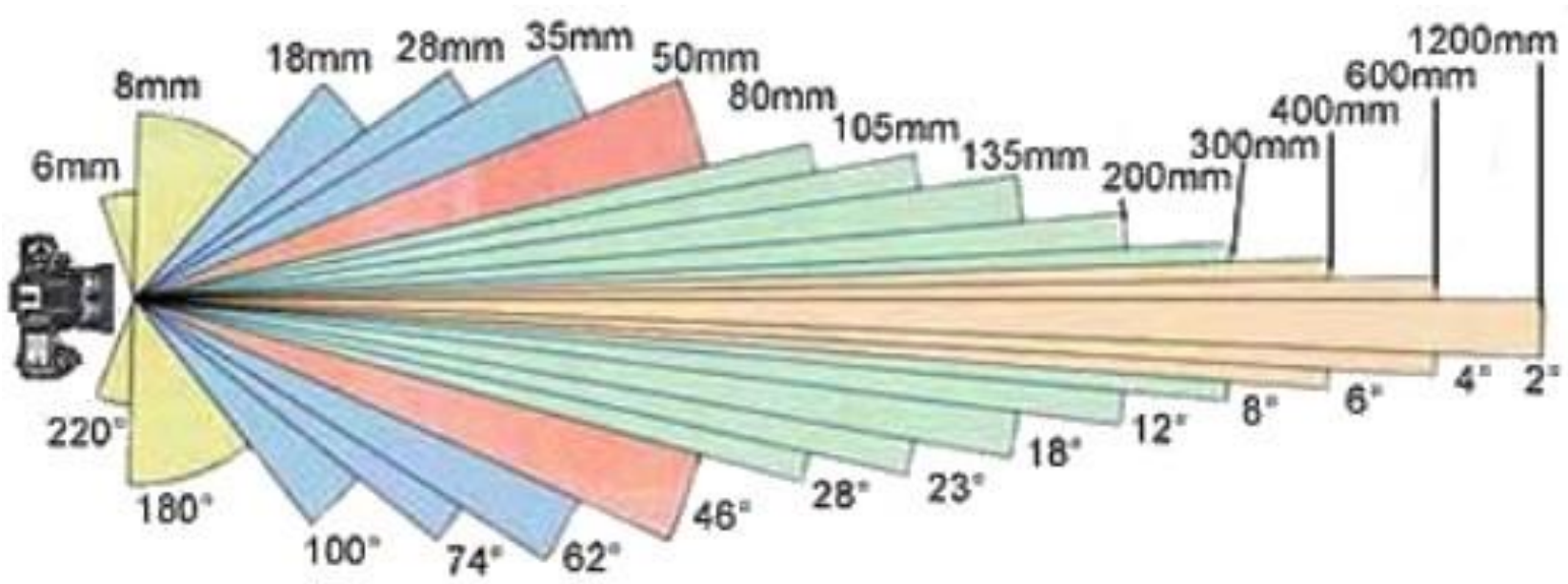


ANGLE OF VISION

The image sensor dimensions and focal length significantly affect the angle of view (field of view), as illustrated in the following figures. The larger the focal length, the smaller the angle of view and vice versa.
Focal length is therefore one of the basic parameters of a lens. It determines what types of photographs can be taken with it.



LENSES



18 mm

24 mm

42mm

55 mm

LENSES

Fish eye

Wide-angle lens

Lens with variable focal length

Telephoto

LENS FOCAL POINTS

Medium focal lengths (more than 50 mm) have a small angle of view and are used for:
- portraits, close-ups (50 - 100 mm)
Lenses with a focal length of 100 - 300 mm are called telephoto lenses.
- Photographing distant objects (birds, animals, football players...)

Lenses with a short focal length are called wide-angle lenses.

Short focal length lenses (less than 50 mm) have a large angle of view and are used for:
- landscapes (17 - 35 mm) - interiors - where space is limited

Extremely short focal lengths (8 - 12 mm) are called fisheye lenses.

Luminosity

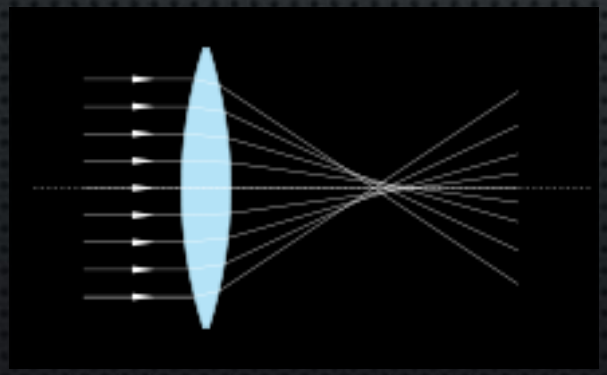
- Aperture refers to the largest possible aperture diameter that a lens is capable of.
- The aperture is usually written in the form of an aperture number, e.g. f/2.8.
- A good aperture will allow you to shoot in low light conditions.
- Zoom lenses often specify their aperture for the start and end focal lengths - for example, 28-105mm/3.5-4.5. This means that at 28mm the lens has an aperture of 3.5, whereas at 105mm it has an aperture of 4.5.
- Conversely, the 28-105mm/2.8 marking means that the lens maintains its aperture throughout the zoom range. However, these lenses are more expensive, larger and heavier.

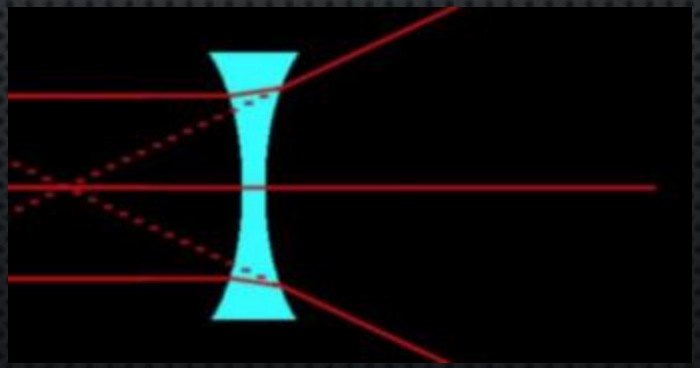
The lens aperture is usually revealed by looking at the diameter of the rear (exit) lens. On the left is an f/1.2 lens, on the right an f/4 lens.

TYPES OF LENSES

The connecting lenses, or couplers, change the beam to a converging beam so that the rays intersect behind them at a point called the focus. This produces a true image of the object in front of the lens.

On the other hand, scattering lenses or scatterers change the beam to a divergent beam that appears to come from a focal point in front of the lens - they produce an apparent image.





CONJUNCTIVE LENS

Conjunctions (also conjunctive lenses, convex lenses) are always thicker in the middle than at the edges and always have one convex surface

They are divided into:
biconvex - the second surface is also convex
plano-convex (planconvex) - the second surface is planar
hollow-convex (convex-convex, concaveconvex) - the second surface is hollow.

DISPERSING LENS

Scattering lenses (also scattering lenses, concave lenses), on the other hand, are thinner in the middle than at the edges and have one hollow surface.
Scattering lenses reduce the image of the observed object.

They are divided into:
biconcave - the second surface is also hollow
plano-concave - the second surface is planar
convex (convex-concave) - the second surface is convex

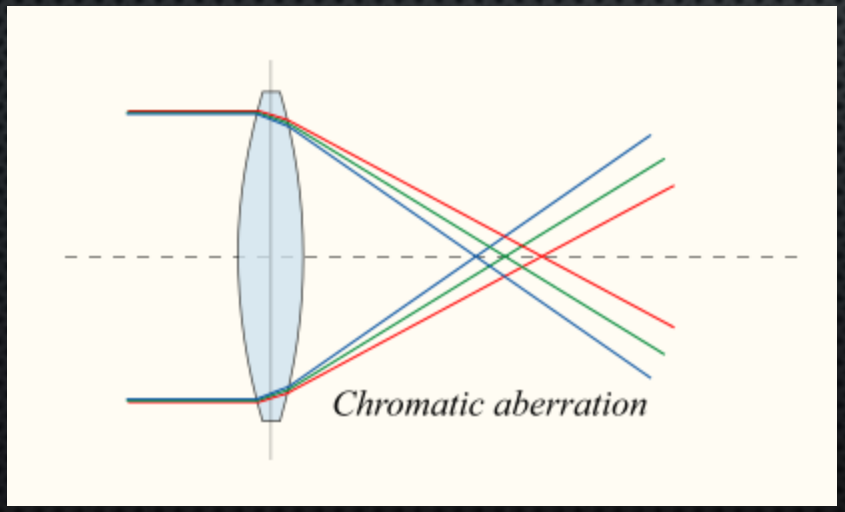
LENS DEFECTS

The vast majority of optical defects in professional lenses are suppressed by complex construction and the use of special lenses made from different types of glass.

However, there are three defects that are most commonly found in prime and kit lenses. Fortunately, these are not major and can easily be eliminated at the image processor level in the camera or in post-production on the computer.

CHROMATIC DEFECT

Chromatic aberration, or colour aberration, is a term for a defect caused by different refractive indices of different wavelengths of light. In other words, rays of different wavelengths (different colors) refract at different angles. This results in purple and green contours at contrast transitions (transitions between the shadow and high brightness areas). This effect is magnified away from the optical axis of the lens, i.e. it tends to be strongest at the edges of the image.



VIGNETTING

Vignetting is very common, especially with wide-angle lenses, and is manifested by a drop in illumination towards the corners, which are visibly darker than the rest of the image. The reason for this is usually due to the design and the desire to achieve good luminosity and the design length of the lens.

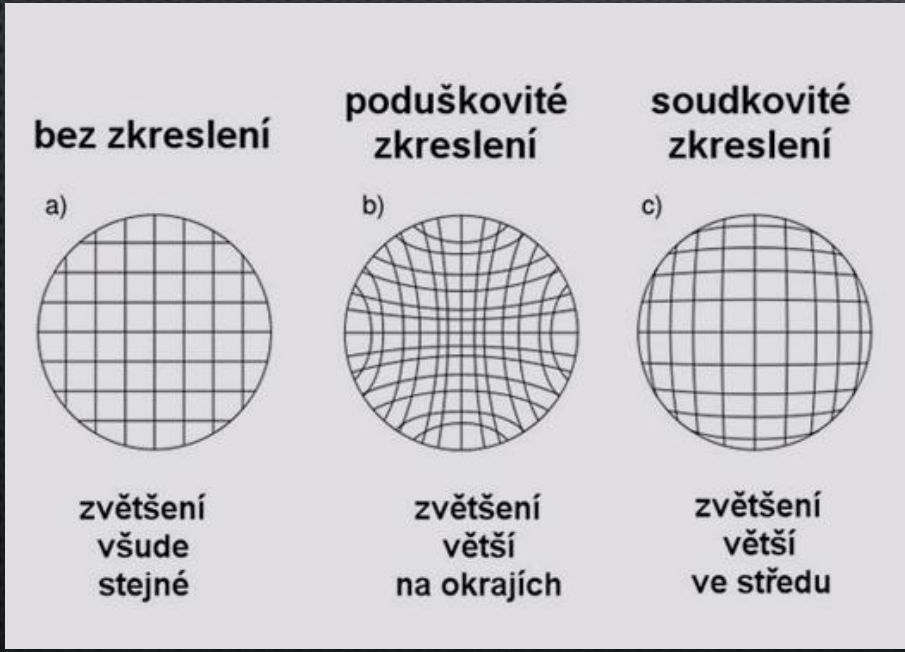
The more lenses the more susceptible to vignetting.

IMAGE DISTORTION

It is most noticeable towards the edges of the image field, it occurs due to different magnification of the object in the centre and at the edge of the image. The most common distortions are barrel-shaped and pod-shaped - in the first case the horizontal lines are curved like a hill, in the second like a valley.

IMAGE DISTORTION

The distortion is especially bad for very wide-angle (barrel-shaped) and very long (zoom lenses. Correction of this defect is usually in the hands of manufacturer and the use of different types of lenses and combinations of lenses is necessary.



HOW TO GET RID OF LENS DEFECTS?

In most cases, the described defects are eliminated by the lens manufacturer, but if some of them become apparent during photography and you do not want to use them in your creative work, then it is advisable:

use higher aperture numbers - aperture 1 to 3 stops higher than the aperture
avoid strong light sources in the frame + have a sun hood on
check the camera's defect removal activation
use editing software that can automatically remove defects based on lens information

THANK YOU