3.3: The Camera

In Figure 3.3.1 a single-lens reflex (SLR) camera is shown. The name does not mean that there is only one lens in the optical system, but that the photographer looks through the same lenses that the picture is taken with, instead of looking through a separate parallel optical system as in the twin reflex camera. After traversing the first few lens elements, the light passes through an iris diaphragm with adjustable diameter with which the f-number can be changed. After the lenses the light is reflected by a movable mirror tilted at 45^{o}, passes through a prism and exits the camera through the finder eyepiece. When the shutter is released, the diaphragm closes to a preset value, the mirror swings up and the CCD is exposed. To focus the camera, the entire lens is moved toward or away from the detection plane. The autofocus is based on maximising the contrast of the images. The **angular field of view** (AFOV) is defined for scenes at large distances and is equal to the angle subtended at the lens by the detector when the image distance is the **focal length** f, i.e. the object is at infinity. The AFOV decreases when f increases. A standard SLR has a focal length of around 6 cm and the AFOV is then between 40° and 50°.

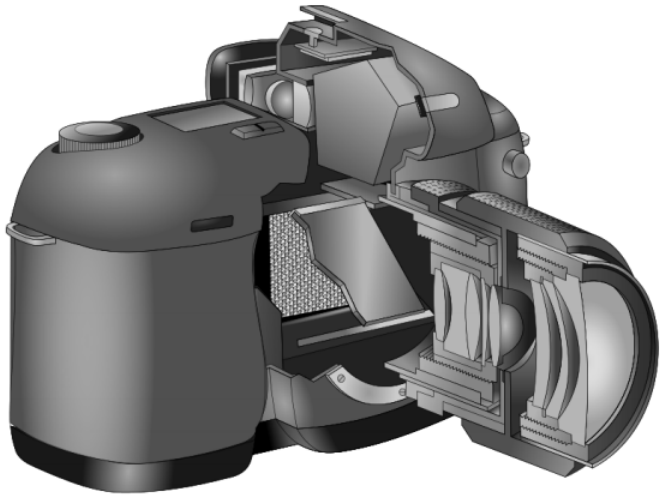

Figure 3.3.2: Digital SLR camera. The pixelated digital sensor is behind a movable mirror (from Wikimedia Commons by Jean François WITZ / CC BY-SA 3.0).

More complex systems can have a variable focal length by changing the distance between the lenses, i.e. they are able to zoom into a scene.

The **depth of focus** is a range of object distances around a given distance for which the images on the sensor are sharp. The depth of focus depends on the diaphragm. When the aperture is wide open, rays forming the image will make larger angles with the optical axis. When these rays come from objects at various distances they will for a large diaphragm cause more blurred images on the sensor (see Figure 3.4.2). When the aperture is reduced, this effect is less and therefore a smaller diaphragm implies a larger depth of focus. The drawback is that less light reaches the sensor, therefore a longer exposure time is needed.

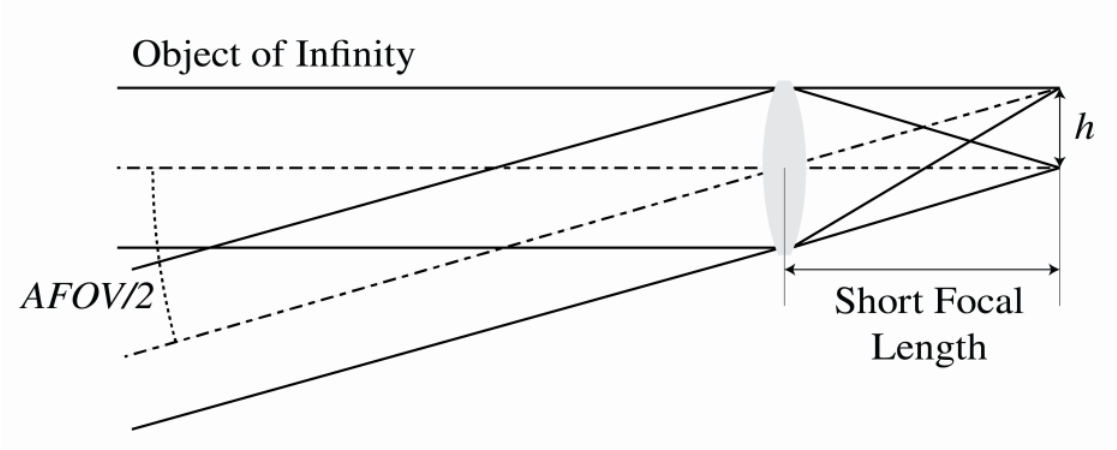

Figure 3.3.1: Angular field of view

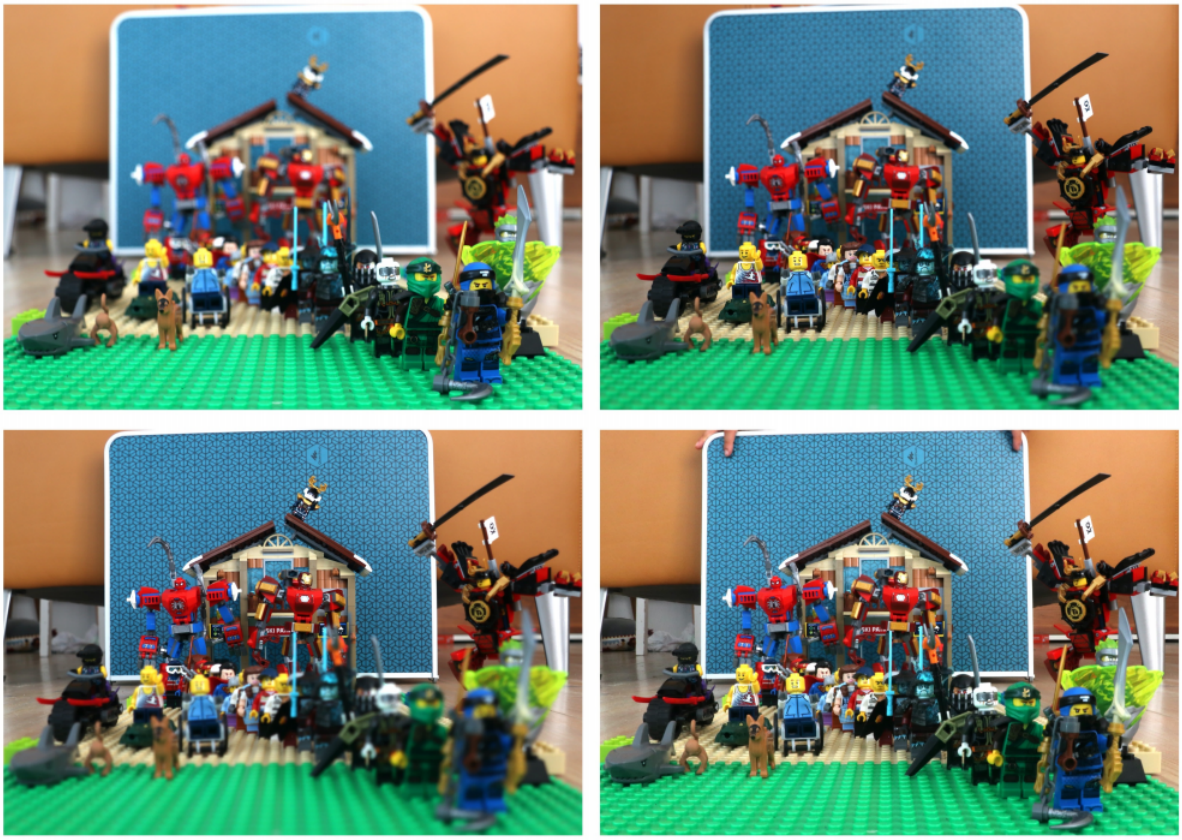

Figure 3.3.2: Four images taken with different diaphragm and different focal plane. The image on bottom right is taken with a small diaphragm and all the image appears clear (photos taken by Aurèle J.L. ADAM / CC BY-SA).