# Field of view

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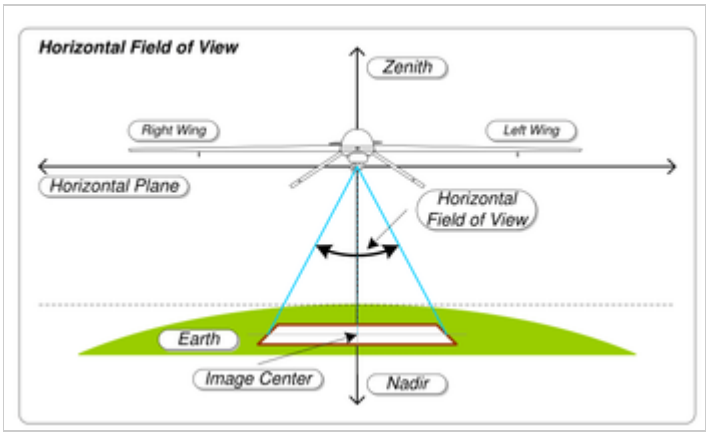
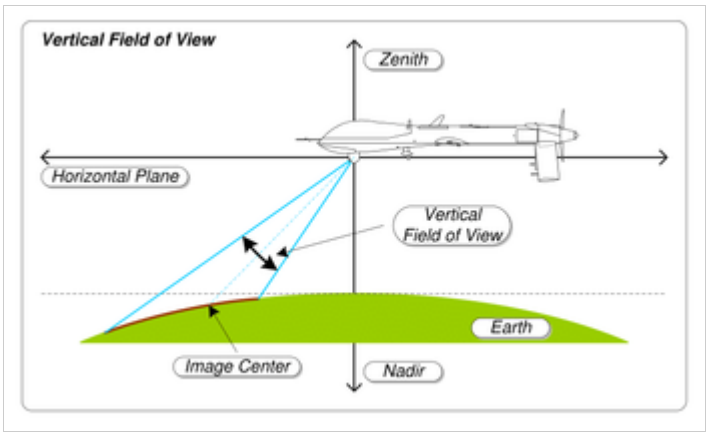
The **field of view** (also **field of vision**, abbreviated **FOV**) is the extent of the observable world that is seen at any given moment. In case of optical instruments or sensors it is a solid angle through which a detector is sensitive to electromagnetic radiation.




Horizontal Field of View




Vertical Field of View

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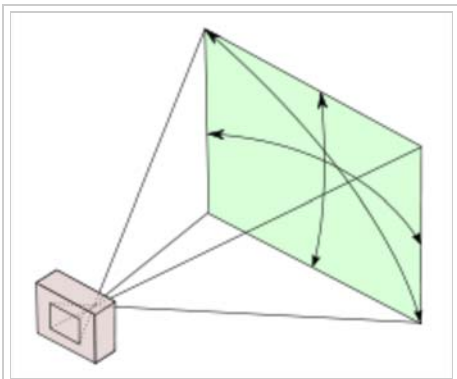
## Humans and animals

In the context of human vision, the term “field of view” is typically used in the sense of a restriction to what is visible by external apparatus, like spectacles[2] or virtual reality goggles. Note that eye movements do not change the field of view.



**Angle of view** can be measured horizontally, vertically, or diagonally.

If the analogy of the eye’s retina working as a sensor is drawn upon, the corresponding concept in human (and much of animal vision) is the *visual field*. [3] It is defined as “the number of degrees of visual angle during stable fixation of the eyes”.[4]. Note that eye movements are excluded in the definition. Different animals have different visual fields, depending, among others, on the placement of the eyes. Humans have an almost 180-degree forward-facing horizontal diameter of their visual field, while some birds have a complete or nearly complete 360-degree visual field. The vertical range of the visual field in humans is typically around 135 degrees.

The range of visual abilities is not uniform across the visual field, and varies from animal to animal. For example, binocular vision, which is the basis for stereopsis and is important for depth perception, covers only 114 degrees (horizontally) of the visual field in humans;[5] the remaining peripheral 60–70 degrees have no

binocular vision (because only one eye can see those parts of the visual field). Some birds have a scant 10 or 20 degrees of binocular vision.

A 360-degree panorama of the Milky Way at the Very Large Telescope. Such a panorama shows the entire **field of view** (FOV) in a single image. An observer would perceive the Milky Way like an arc of stars spanning horizon to horizon – with the entire FOV mapped on a single image this arc appears as two streams of stars seemingly cascading down like waterfalls.[1]

Similarly, color vision and the ability to perceive shape and motion vary across the visual field; in humans the former is concentrated in the center of the visual field, while the latter tends to be much stronger in the periphery. The physiological basis for that is the much higher concentration of color-sensitive cone cells and color-sensitive parvocellular retinal ganglion cells in the fovea – the central region of the retina – in comparison to the higher concentration of color-insensitive rod cells and motion-sensitive magnocellular retinal ganglion cells in the visual periphery. Since cone cells require considerably brighter light sources to be activated, the result of this distribution is further that peripheral vision is much more sensitive at night relative to foveal vision.[3]

# Conversions

Many optical instruments, particularly binoculars or spotting scopes, are advertised with their field of view specified in one of two ways: angular field of view, and linear field of view. Angular field of view is typically specified in degrees, while linear field of view is a ratio of lengths. For example, binoculars with a 5.8 degree (angular) field of view might be advertised as having a (linear) field of view of 305 ft per 1000 yd or 102 mm per meter. As long as the FOV is less than about 10 degrees or so, the following approximation formulas allow one to convert between linear and angular field of view. Let $A$ be the angular field of view in degrees. Let $L$ be the linear field of view in feet per 1000 yd. Let $M$ be the linear field of view in millimeters per meter. Then, using the small-angle approximation:

$$A \approx \frac{360^\circ}{2\pi} \cdot \frac{L}{3000} \approx 0.0191 \times L$$

$$A \approx \frac{360^\circ}{2\pi} \cdot \frac{M}{1000} \approx 0.0573 \times M$$

$$L \approx \frac{2\pi \cdot 3000}{360^\circ} \cdot A \approx 52.36 \times A$$

$$M \approx \frac{2\pi \cdot 1000}{360^\circ} \cdot A \approx 17.45 \times A$$

# Machine vision

In machine vision the lens focal length and image sensor size sets up the fixed relationship between the field of

view and the working distance. Field of view is the area of the inspection captured on the camera's imager. The size of the field of view and the size of the camera's imager directly affect the image resolution (one determining factor in accuracy). Working distance is the distance between the back of the lens and the target object.

## Remote sensing

In remote sensing, the solid angle through which a detector element (a pixel sensor) is sensitive to electromagnetic radiation at any one time, is called *instantaneous field of view* or IFOV. A measure of the spatial resolution of a remote sensing imaging system, it is often expressed as dimensions of visible ground area, for some known sensor altitude.[6][7] Single pixel IFOV is closely related to concept of *resolved pixel size*, ground resolved distance, ground sample distance and modulation transfer function.

## Astronomy

In astronomy the field of view is usually expressed as an angular area viewed by the instrument, in square degrees, or for higher magnification instruments, in square arc-minutes. For reference the Wide Field Channel on the Advanced Camera for Surveys on the Hubble Space Telescope has a field of view of 10 sq. arc-minutes, and the High Resolution Channel of the same instrument has a field of view of 0.15 sq. arc-minutes. Ground based survey telescopes have much wider fields of view. The photographic plates used by the UK Schmidt Telescope had a field of view of 30 sq. degrees. The 1.8 m (71 in) Pan-STARRS telescope, with the most advanced digital camera to date has a field of view of 7 sq. degrees. In the near infra-red WFCAM on UKIRT has a field of view of 0.2 sq. degrees and the forthcoming VISTA telescope will have a field of view of 0.6 sq. degrees. Until recently digital cameras could only cover a small field of view compared to photographic plates, although they beat photographic plates in quantum efficiency, linearity and dynamic range, as well as being much easier to process.

## Photography

In photography, the field of view is that part of the world that is visible through the camera at a particular position and orientation in space; objects outside the FOV when the picture is taken are not recorded in the photograph. It is most often expressed as the angular size of the view cone, as an angle of view. For normal lens, field of view can be calculated FOV = 2 arctan(SensorSize/2f), where $f$ is focal length.

## Video games

The field of view in video games refers to the part you see of a game world, which is dependent on the scaling method used.[8]

## See also

- Panorama
- Perimetry
- Peripheral vision
- Visual perception
- Useful field of view

# References


1. "Cascading Milky Way" (http://www.eso.org/public/images/potw1224a/). *ESO Picture of the Week*. Retrieved 11 June 2012.
2. Alfano, P.L.; Michel, G.F. (1990). "Restricting the field of view: Perceptual and performance effects". *Perceptual and motor skills* **70**: 35–45.
3. Strasburger, Hans; Rentschler, Ingo; Jüttner, Martin (2011). "Peripheral vision and pattern recognition: a review" (http://www.journalofvision.org/content/11/5/13). *Journal of Vision* **11** (5): 1–82.
4. Strasburger, Hans; Pöppel, Ernst (2002). Visual Field. In G. Adelman & B.H. Smith (Eds): *Encyclopedia of Neuroscience*; 3rd edition, on CD-ROM. Elsevier Science B.V., Amsterdam, New York.
5. Howard, Ian P.; Rogers, Brian J. (1995). *Binocular vision and stereopsis* (http://books.google.com /books?id=I8vqITdETe0C&lpg=PA32&ots=JhaI-4InNv&pg=PA32). New York: Oxford University Press. p. 32. ISBN 0-19-508476-4. Retrieved 3 June 2014.
6. Oxford Reference. "Quick Reference: instantaneous field of view" (http://www.oxfordreference.com/view/10.1093 /oi/authority.20110803100005771). Oxford University Press. Retrieved 13 December 2013.
7. Wynne, James B. Campbell, Randolph H. (2011). *Introduction to remote sensing* (http://books.google.com /books?id=NkLmDjSS8TsC&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false) (5th ed. ed.). New York: Guilford Press. p. 261. ISBN 160918176X.
8. Feng Zhu School of Design – Field of View in Games (http://artsygamer.com/fov-in-games/)

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