Aperture

The aperture of an optical system is a hole that primarily limits light propagated through the system.

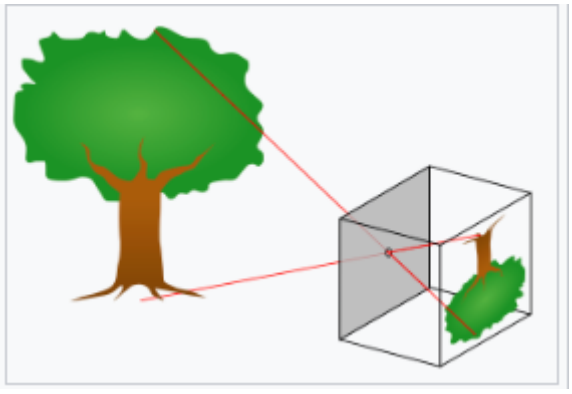
The

Pinhole cameras

A pinhole camera is a simple camera without a lens but with a tiny aperture (pinhole).

Light from a scene passes through the aperture and projects an inverted image on the opposite side of the box, known as the camera obscura effect.

The size of the images depends on the distance between the object and the pinhole.

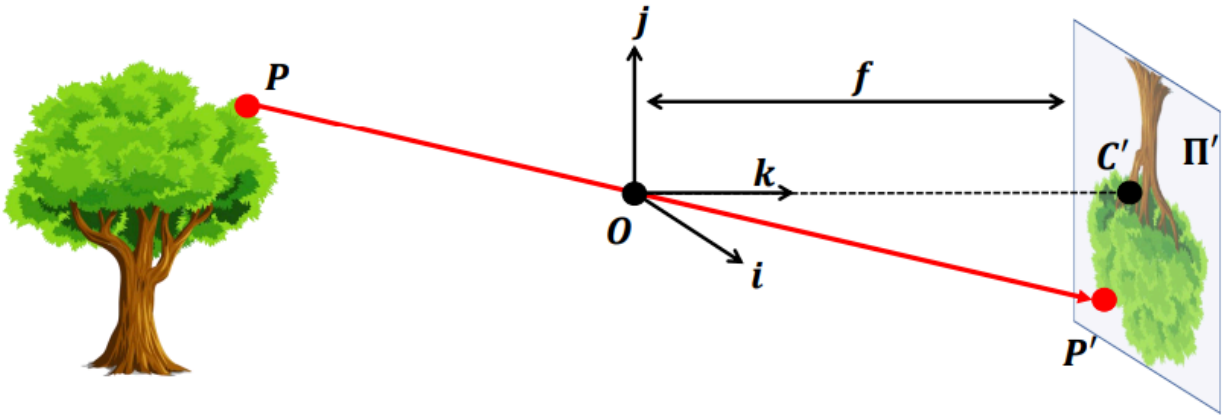


Pinhole camera model

The pinhole camera model describes the mathematical relationship between the coordinates of a point in 3D space and its projection onto the image plane of an ideal pinhole camera, where the camera aperture is described as a point and no lenses are used to focus light

This model is a reasonable description of how a camera depicts a 3D scene.

Consider the following geometry:



The distance between the image plane and the pinhole is known as the focal length f

Under the pinhole camera model, a point

$$P = [x \quad y \quad z]^T$$

is some 3D object visible to the pinhole camera.

P will be projected onto the image plane Π' resulting in:

$$P' = [x' \quad y']^T$$

Similarly, the pinhole itself can be projected onto the image plane, giving a point C'

We define a camera coordinate system or camera reference system

$$[i \quad j \quad k]$$

centred at the pinhole O such that the axis k is perpendicular to the image plane and points toward it. The line defined by C' and O is called the optical axis of the camera system.

Using the law of similar triangles, we find that

$$P' = [x' \quad y']^T = \left[f\frac{x}{z} \quad f\frac{y}{z}\right]^T$$

Stereo vision