Ray Optics problem n°4
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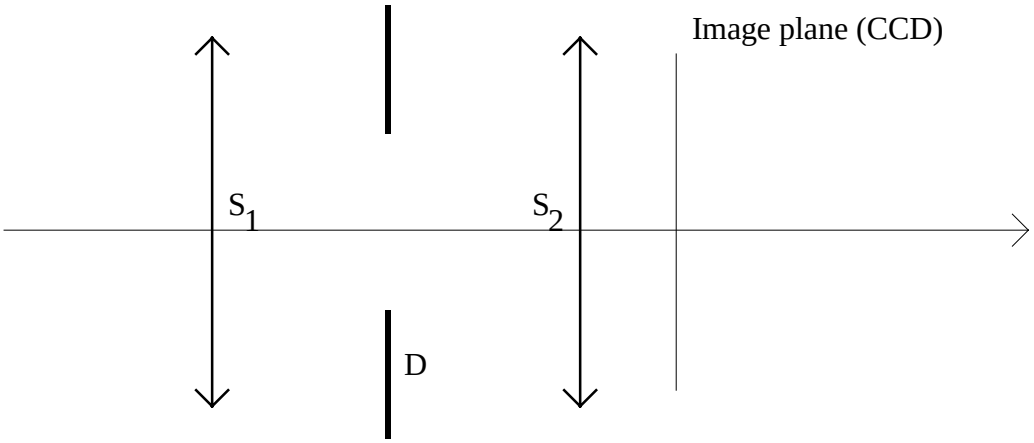
Symmetric lens for video camera

- ✓ *Content : Pupils, field of view, depth of field, hyperfocal distance*

The video camera lens is a symmetric system made of 2 identical converging systems S_1 and S_2, considered as thin lenses, located symmetrically with respect to the aperture D, aperture stop of the whole system. This lens is used with a CCD matrix of 512 x 512 pixels, each pixel is a 20µm wide square. The converging lenses S_1 and S_2 are separated by 40 mm and have a focal length f' = 60 mm . The diameter of the aperture D is equal to 11.25 mm.



In the first part of the problem, the system is ajusted to observe an object at infinity.

1. Calculate the focal length of the whole video camera lens and determine the position of cardinal points H, H', F, F'.
2. Calculate the positions and diameters of the entrance pupil and exit pupil of the system. Determine the f-number of the system.
3. Determine the diameters of S_1 and S_2 so that the bright field of view (no vignetting) covers entirely the CCD matrix.
4. Represent the whole camera lens on a drawing to scale (x1 along the axis, x4 in the transverse direction). Construct a bundle of rays coming from a point at infinity on axis, then from a point at infinity whose image is located at the edge of the bright field.
5. Determine the hyperfocal distance of the video camera lens.

We now want to image an object located at a finite distance, 5 meters from the camera lens.

6. How far should we move the whole camera lens with respect to the plane of the detector in order to image this object at 5 m?
7. For this position, what is the depth of field in the object space?