Calculation of Depth of Field in the Visual DOF Calculator

The variables

- f: focal length in mm
- b: image distance in mm
- v: object distance in mm
- c: circle of confusion in mm
- f_n: aperture number (focal lenght divided by aperture diameter)
- L: longest side of chip or film in mm
- K: longest horizontal or vertical dimension of the frame around the object in mm
- DOF: depth of field in mm
- λ: the wavelength of light (0.00055 mm for green light)
- R_{eye}: resolution of human eye in degrees (0.02° is good vision)
- P: longest size of the final print of the photograph in mm
- D: viewing distance of the final print in mm

Lens formula

$$\frac{1}{f} = \frac{1}{v} + \frac{1}{b} \tag{1}$$

Depth of Field
The boundary of DOF beyond the object at which sharp focus is achieved

$$v_{far} = \frac{f * v}{f - c * f_n * v / f + c * f_n} \tag{2}$$

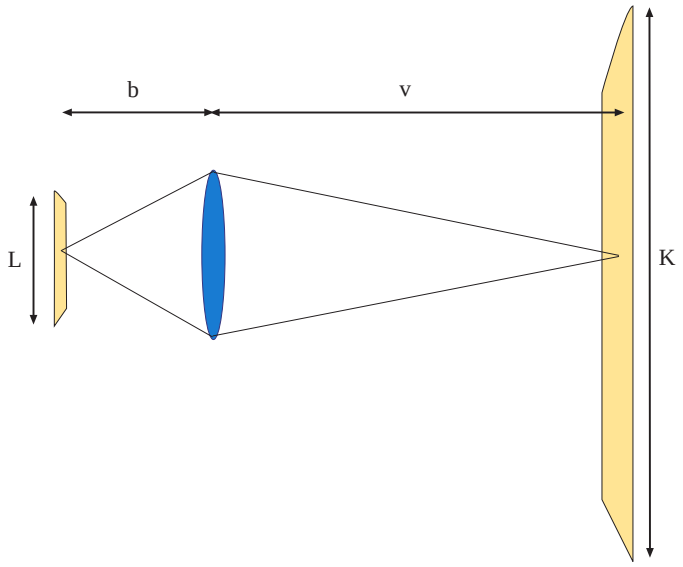

Figure 1: Variables used in the formulae to calculate DOF

The boundary of DOF in front of the object at which sharp focus is achieved

$$v_{near} = \frac{f * v}{f + c * f_n * v / f - c * f_n} \tag{3}$$

Total DOF:

$$DOF = v_{far} - v_{near} = \frac{f * v}{f - c * f_n * v / f + c * f_n} - \frac{f * v}{f + c * f_n * v / f - c * f_n} \tag{4}$$

Calculate the focal length from the object distance v, film lengte L and objectframe length K

$$f = \frac{L.v}{K + L} \tag{5}$$

Approximation of formula (4) :

$$DOF = 2 * \left(\frac{K^2 + K * L}{L^2} \right) * f_n * c \tag{6}$$

This approximation is not used in the calculator, but shows that by approximation depth of field depends only on object frame size, film length, aperture and circle of confusion.

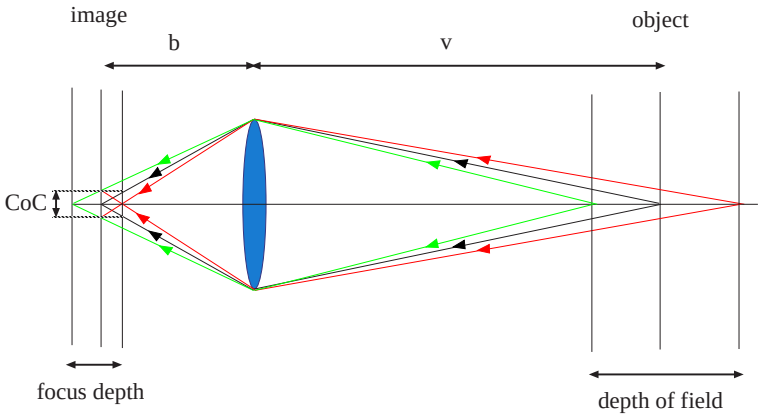

Figure 2: Circle of Confusion

The limit of diffraction is calculated using

$$c_{dif} = \frac{1.22 * \lambda * b * f_n}{f} \tag{7}$$

which is the size of the Airy disc in a diffraction limited image. The value of c_{dif} is used in formulae 2, 3 and 4 as soon as it is larger than that of c
The limitation by resolution of the human eye is calculated using

$$c_{eye} = R_{eye} * \frac{180}{\pi} * D * \frac{L}{P} \tag{8}$$

Again, as soon as it is larger than either c_{dif} or c it is used in formulae 2, 3 and 4.