Chapter 8 Optics

8.1 Lens Equation

$$\frac{1}{z'} - \frac{1}{z} = \frac{1}{f}$$

8.2 Image resolution

spacing between pixels in images plane; △
resolution limit; 2△

$$RP = \frac{1}{RL}(\text{lines/mm}) = \frac{1}{2\triangle}(\text{lines/mm})$$

Photographic film; spacing b.w. grains; 5 ㎛
size in cross section; 0.5 $㎛^2$

Human vision (eye); space b.w. cones in fovea; 30 arc seconds (1/120 도)
resolution; 1/60도 -> $0.3\text{x}10^{-3}$ rad.

8.3 Depth of field
diameter of the circle (blurring) ; b
diameter of the lens aperture ; d

$$b = \frac{d(z' - z'_1)}{z'}$$

$$b = \frac{df(z - z_1)}{z(f + z_1)}$$

$$z_1 = \frac{fz(d-b)}{df + bz}$$

$$b = \frac{df(z'_2 - z')}{z'}$$

The depth of field $D = z_2 - z_1$

$$D = \frac{2bdfz(f+z)}{d^2 f_2 - b^2 z^2}$$

8.4 View Volume

six bounding plane

8.5 Exposure

F number

$$F = \frac{f}{d}$$

F number on camera lens; multiples of $\sqrt{2}$

8.3 Depth of field

diameter of the circle (blurring) ; b
diameter of the lens aperture ; d

$$\frac{1}{z'} - \frac{1}{z} = \frac{1}{f}$$

near plane; z1

$$z'_1 : z'_1 - z' = \frac{d}{2} : \frac{b}{2}$$

$$\frac{1}{z'_1} - \frac{1}{z_1} = \frac{1}{f}$$

$$b = \frac{d}{z_1}\frac{f(z_1 - z)}{(f+z)} \quad => \quad z_1 = \frac{dfz}{(b-d)f + bz}$$

far plane: z2

$$z'_2 : z' - z'_2 = \frac{d}{2} : \frac{b}{2}$$

$$\frac{1}{z'_2} - \frac{1}{z_2} = \frac{1}{f}$$

$$b = \frac{d}{z_2}\frac{f(z - z_2)}{(f+z)} \quad => \quad z_2 = \frac{dfz}{(b+d)f + bz}$$

The depth of field $D = z_1 - z_2$

$$D = \frac{2d^2 f^2 z}{b^2 (f+z)^2 - d^2 f^2}$$