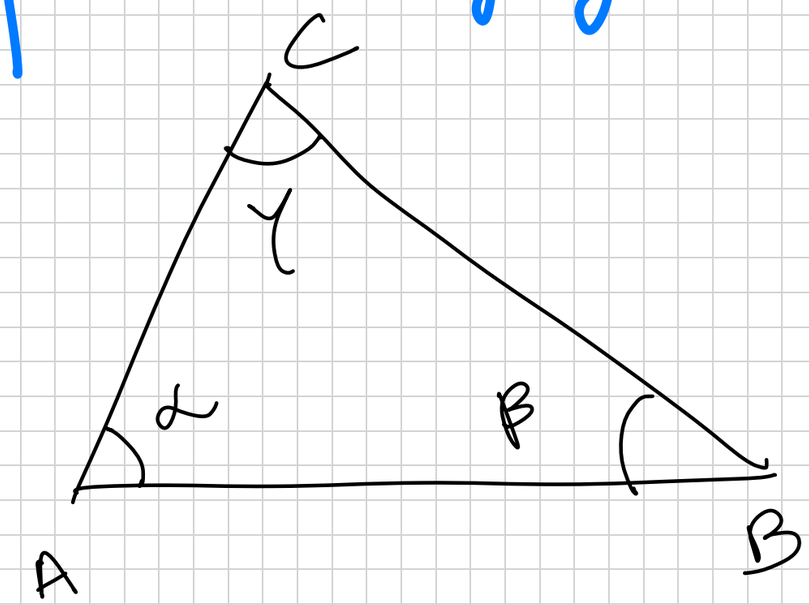
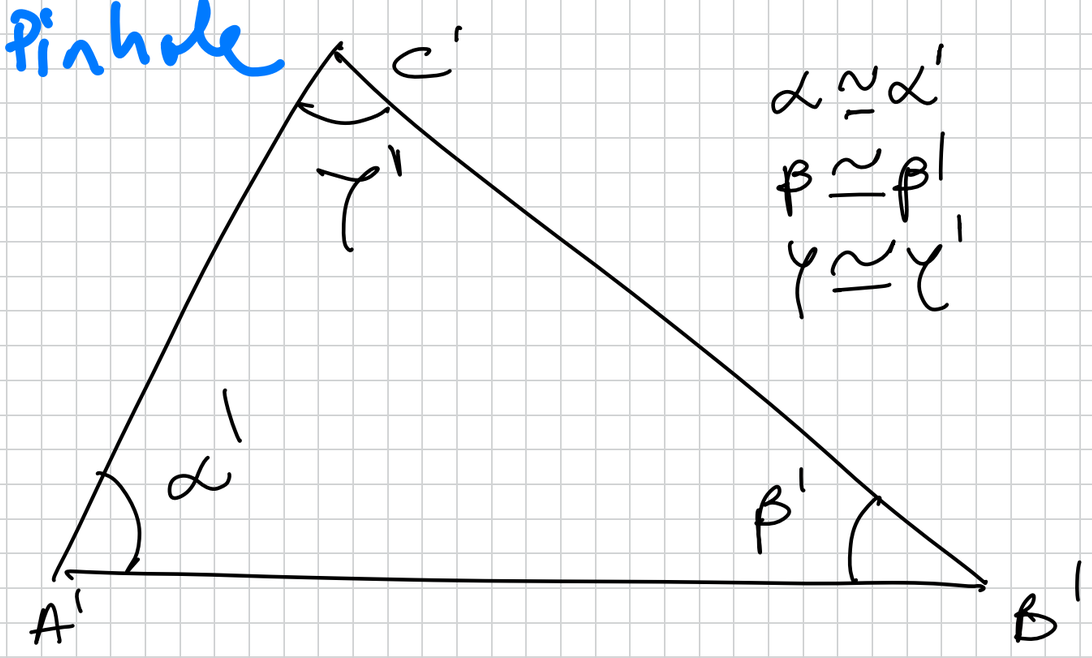
Prespective Imaging With Pinhole





$$\alpha \cong \alpha'$$
$$\beta \cong \beta'$$
$$\gamma \cong \gamma'$$

$$k = \frac{\overline{A'B'}}{AB} = \frac{\overline{A'C'}}{AC} = \frac{\overline{B'C'}}{BC}$$

In Perspective imaging with Pinhole

$$\frac{\vec{r_i}}{\vec{r_o}} = \frac{f}{z_o} \rightarrow \boxed{\frac{\vec{r_i}}{f} = \frac{\vec{r_o}}{z_o}} \rightarrow \frac{x_i}{f} = \frac{x_o}{z_o}, \frac{y_i}{f} = \frac{y_o}{z}$$

Image Magnification

$$\frac{x_i}{f} = \frac{x_0}{z_0} \quad \text{and} \quad \frac{y_i}{f} = \frac{y_0}{z_0} \qquad (A)$$

$$\frac{x_i + \delta x_i}{f} = \frac{x_0 + \delta x_0}{z_0} \quad \text{and} \quad \frac{y_i + \delta y_i}{f} = \frac{y_0 + \delta y_0}{z_0} \qquad (B)$$

$$\frac{x_i}{f} + \frac{\delta x_i}{f} = \frac{x_0}{z_0} + \frac{\delta x_0}{z_0} \rightarrow \frac{\cancel{x_0}}{\cancel{z_0}} + \frac{\delta x_i}{f} = \frac{\cancel{x_0}}{\cancel{z_0}} + \frac{\delta x_0}{z_0} \rightarrow$$

$$\rightarrow \boxed{\frac{\delta x_i}{f} = \frac{\delta x_0}{z_0} \quad \text{and} \quad \frac{\delta y_i}{f} = \frac{\delta y_0}{z_0}}$$

$$\boxed{m = f/z}$$

$$m = \frac{\|\vec{d_i}\|}{\|\vec{d_0}\|} = \frac{\sqrt{\delta x_i^2 + \delta y_i^2}}{\sqrt{\delta x_0^2 + \delta y_0^2}} = \frac{\sqrt{\left(f\frac{\delta x_0}{z_0}\right)^2 + \left(f\frac{\delta y_0}{z_0}\right)^2}}{\sqrt{\delta x_0^2 + \delta y_0^2}} = \frac{f}{z_0}\frac{\sqrt{\delta x_0^2 + \delta y_0^2}}{\sqrt{\delta x_0^2 + \delta y_0^2}} = \boxed{\frac{1}{z_0}}$$

Image Plane to Image Sensor Mapping:

$$u = m_x f \frac{x_c}{z_c} + o_x \rightarrow \text{m.m}$$

u (pixels)

$$v = m_y f \frac{y_c}{z_c} + o_y$$

pixel/m.m

$$x_i = f \frac{x_c}{z_c} \quad \text{(m.m)}$$

m_x (number of pixels per m.m)

$$\boxed{u = f_x \frac{x_c}{z_c} + o_x \qquad v = f_y \frac{y_c}{z_c} + o_y}$$

$$(f_x, f_y) = (m_x f, m_y f)$$

(f_x, f_y, o_x, o_y): Intrinsic parameters