Camera Parameters

$$P = \begin{bmatrix} P_{11} & P_{12} & P_{13} & P_{14} \\ P_{21} & P_{22} & P_{23} & P_{24} \\ P_{31} & P_{32} & P_{33} & P_{34} \end{bmatrix} = M_{int} \times M_{ext}$$

$$= \begin{bmatrix} f_x & 0 & o_x & 0 \\ 0 & f_y & o_y & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} r_{11} & r_{12} & r_{13} & t_x \\ r_{21} & r_{22} & r_{23} & t_y \\ r_{31} & r_{32} & r_{33} & t_z \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

K

R

$$\begin{bmatrix} P_{11} & P_{12} & P_{13} \\ P_{21} & P_{22} & P_{23} \\ P_{31} & P_{32} & P_{33} \end{bmatrix} = K \times R$$

$$\begin{bmatrix} P_{14} \\ P_{24} \\ P_{34} \end{bmatrix} = K \times t \Rightarrow t = K^{-1} \begin{bmatrix} P_{14} \\ P_{24} \\ P_{34} \end{bmatrix}$$

$$K = \begin{bmatrix} f_x & 0 & O_x \\ 0 & f_y & O_y \\ 0 & 0 & 1 \end{bmatrix} = \text{Upper Triangular Matrix}$$

R = Orthogonal Matrix.

QR Decomposition

$A = B \times C$ — Linear Algebra

↑ ↑ ↑

Can we find 3D-point in the Real World from 2D-point in an image.

← No

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

$$x = \frac{z}{f_x}(u - o_x) \,, \quad y = \frac{z}{f_y}(v - o_y)$$

$$z > 0$$

In the left image

$$\begin{cases} u_l = f_x \cdot \frac{x}{z} + o_x, \quad v_l = f_y \cdot \frac{y}{z} + o_y \\ u_r = f_x \cdot \frac{x-b}{z} + o_x, \quad v_r = f \cdot \frac{y}{z} + o_y \end{cases}$$

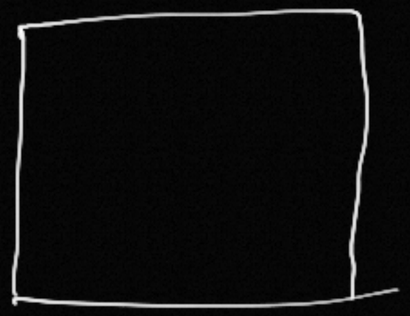
$$x = \frac{b(u_l - o_x)}{u_l - u_r}, \quad y = \frac{b f_x (v_l - o_y)}{f_y (u_l - u_r)}$$

$$z = \frac{b f_x}{u_l - u_r}$$

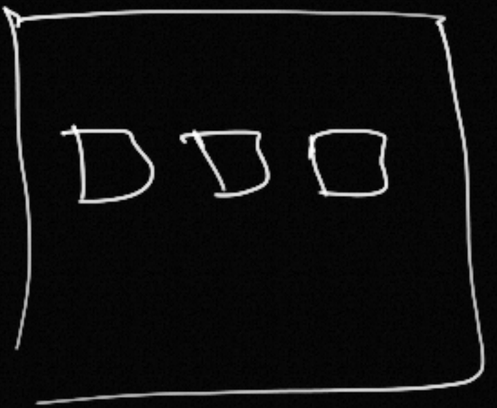
$\rightarrow$ Depth

$u_l - u_r \rightarrow$ Disparity

When Stereo matching may fail?



White paper



- Brightness / warping

Homography for stereo matching?

Geometry → M. V. Geometry

Monday