ASSINGMENT

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Exercise-2 Epipolar geometry

$$P = [I \quad 0] \; ; \; P' = [R \quad t]$$

$$x = (x, y, 1)^T \; ; \; x' = (x', y', 1)^T$$

$$\vec{OP} \cdot (\vec{OO} \times \vec{OP}) = 0$$

$$x' \cdot (t \times Rx) = 0$$

$$x'^T [t]_\times R x = 0$$

Since $E = [t]_\times R$

$$x'^T E x = 0$$

Exercise-3 Stereo Vision

(a) $d = |x_l - x_r|$

$d = 1\,cm$; $b = 6\,cm$; $f = 1\,cm$

$$\frac{X_l}{f} = \frac{X_l'}{Z_p}$$

$$\frac{X_r}{f} = \frac{X_r'}{Z_p}$$

$$X_l' - X_r' = b$$

$$\frac{Z_p}{f} x_l - \frac{Z_p}{f} X_r = b$$

$$|X_l - X_r| = d$$

$$\frac{Z_p}{f} d = b$$

$$Z_p = d \times b \times f$$

$$= 1 \times 6 \times 1 = 6 \text{ cm}$$

(b) $d \leq 0.01 \text{ mm}$

$$\frac{Z_p}{f} d = b$$

$$d = \frac{bf}{Z_p} \leq 0.01 \text{ mm}$$

$$\therefore Z_p \geq 60 \text{ mm}$$

(c) $P_1 = [I \quad 0]$; $P_2 = [I \quad t]$

$t = (-6, 0, 0)^T$: $Q = (3, 0, 3)$

$$x'^T \in R = 0$$

$$X = \begin{bmatrix} I & 0 \end{bmatrix} \begin{bmatrix} 3 \\ 0 \\ 3 \\ 1 \end{bmatrix}$$

$$= \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} 3 \\ 0 \\ 3 \end{bmatrix}$$

$$= \begin{bmatrix} 3 \\ 0 \\ 3 \end{bmatrix}$$

$$E = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 6 \\ 0 & -6 & 0 \end{bmatrix}$$

Epipolar line constraint

$$Ex = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 6 \\ 0 & -6 & 0 \end{bmatrix} \begin{bmatrix} 3 \\ 0 \\ 3 \end{bmatrix}$$

$$= \begin{bmatrix} 0 \\ 18 \\ 0 \end{bmatrix}$$