

Computer Vision Exercise 12

$$\begin{aligned}
 (2) \quad \vec{O}_1 \vec{p}_1 \cdot (\vec{O}_1 \vec{O} \times \vec{O}_1 \vec{p}) &= 0 & \Rightarrow x'^T E x = 0 \\
 x' \cdot (t \times R x) &= 0 & \quad \quad \quad \uparrow E = [t]_{\times} R \\
 x'^T \cdot [t]_{\times} R x &= 0 \\
 x'^T E x &= 0
 \end{aligned}$$

$$\begin{aligned}
 (3) \quad a) \quad d &= 1 \text{ cm} \\
 b &= 6 \text{ cm} \\
 f &= 1 \text{ cm} \\
 d &= \frac{b \cdot f}{2p} \Rightarrow 1 = \frac{6 \cdot 1}{2p} \Rightarrow 6 = 2p
 \end{aligned}$$

$$\begin{aligned}
 b) \quad \text{smallest disparity } 1 \text{ px} & \quad d! \\
 \text{px width} &= 0.01 \text{ mm} = 0.001 \text{ cm} \\
 0.001 &= \frac{6 \cdot 1}{Z} \rightarrow Z = \frac{6}{0.001} = 6000 \text{ cm} \\
 \Rightarrow \text{Range of coordinates: } Z > 6000 \text{ cm}
 \end{aligned}$$

$$\begin{aligned}
 c) \quad Q &= (3, 0, 3) \quad P_1 = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \\
 t &= (-6, 0, 0)^T \quad P_r = \begin{bmatrix} 1 & t \\ 0 & 1 \end{bmatrix} \\
 E &= [t]_{\times} R \\
 Q \text{ on Cam 1:} \\
 P_1 \cdot Q &= \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} 3 \\ 0 \\ 3 \\ 1 \end{bmatrix} = \begin{bmatrix} 3 \\ 0 \\ 3 \end{bmatrix} \\
 R &= I \Rightarrow E = [t]_{\times}
 \end{aligned}$$

$$\begin{aligned}
 E &= \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 6 \\ 0 & -6 & 0 \end{bmatrix} \\
 E x &= \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & -6 \\ 0 & 6 & 0 \end{bmatrix} \begin{bmatrix} 3 \\ 0 \\ 3 \end{bmatrix} = \begin{bmatrix} 0 \\ -18 \\ 0 \end{bmatrix}
 \end{aligned}$$

4.

