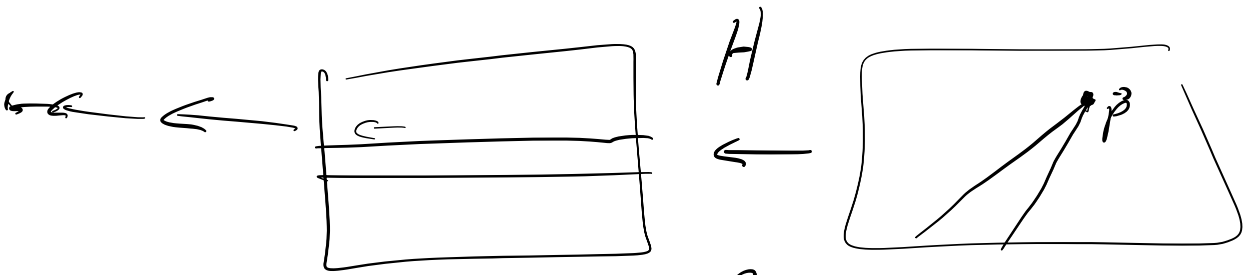
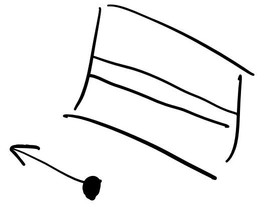
Points at ∞

$H\vec{p}$

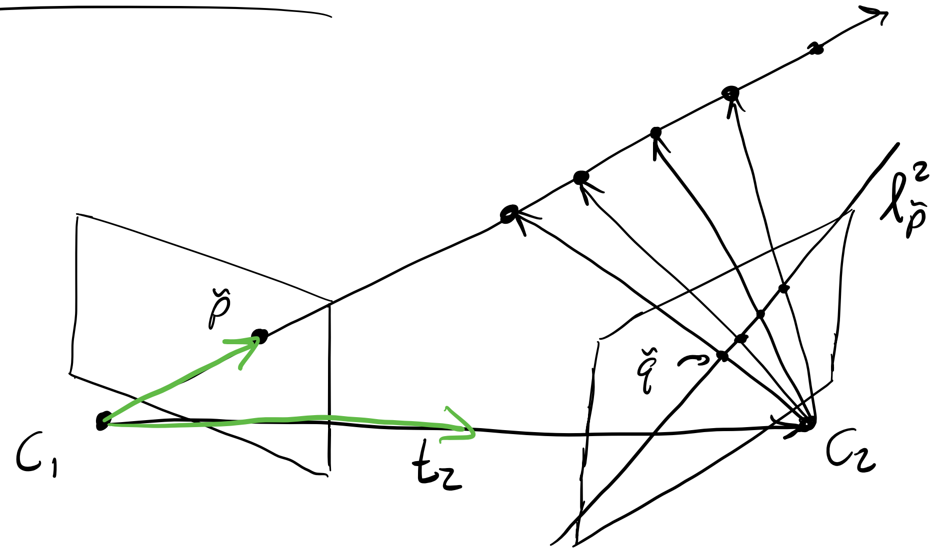




$$\lim_{t\to\infty} t\begin{bmatrix}-1\\0\\1\end{bmatrix} \qquad \begin{bmatrix}-1\\0\\0\end{bmatrix}$$

$$\begin{bmatrix}R & t\\ 00 & 1\end{bmatrix}\begin{bmatrix}d_x\\d_y\\0\end{bmatrix}=\begin{bmatrix}R\begin{bmatrix}d_x\\d_y\end{bmatrix}\\ 0\end{bmatrix}$$

Epipolar Geometry



Assume:

$K_1 = I_{3\times3}$

$K_2 = I_{3\times3}$

$R_1 = I_{3\times3}$

$t_1 = \vec{0}$

$R_2, \vec{t}_2$ known

$$l^1_{\hat{p}} = t_2 \times \vec{p}$$

$$R_2 (t_2 \times \vec{p})$$

$$l^2_{\hat{p}} = R_2 [t_2]_\times \vec{p}$$

Aside:

$$[t]_\times = \begin{bmatrix} & & \\ & & \\ & & \end{bmatrix}_{3\times3}$$

$$[t_2]_\times \vec{p} = t_2 \times \vec{p}$$

$\hat{p}, \hat{q}$ might correspond if $l^2_{\hat{p}} \cdot \hat{q} = 0$

$$\hat{q}^T [R_2 [t_2]_\times] \hat{p} = 0$$

$$\hat{q}^T \mathbf{E} \hat{p} = 0$$ the Essential Matrix

What if $K_1, K_2 \neq I$?

$\hat{p} = K_1^{-1} p$

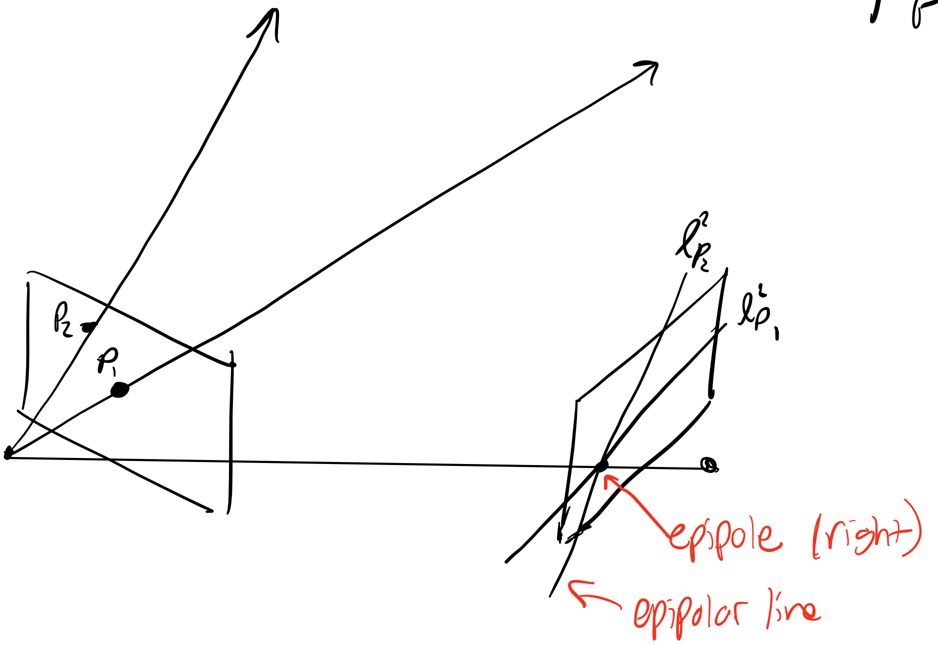
$$q^T [K_2^{-T} \; E \; K_1^{-1}] p = 0$$

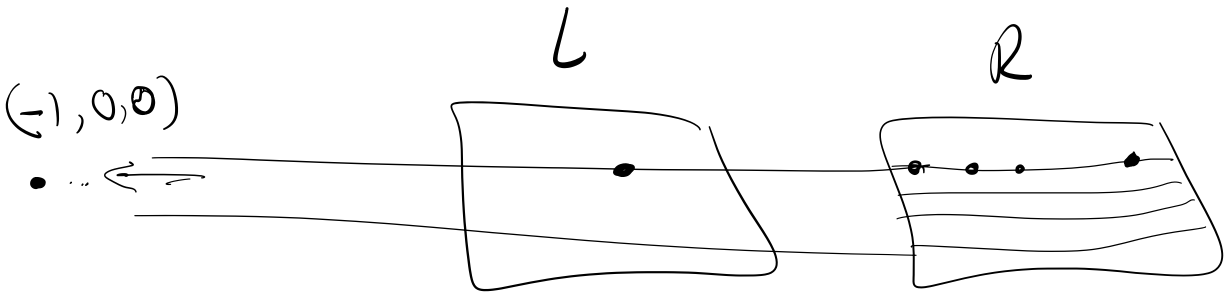
$\hat{q} = K_2^{-1} q$

$$q^T \mathbf{F} p = 0$$ The Fundamental Matrix

$$F = K_2^{-T} R_2 [t_2]_\times K_1^{-1}$$

$$F p = l_p^2$$





	"Structure" (3D scene points)	"Motion" (camera poses)	Measurements Needed
Pose Estimation	Known	?	3D-2D correspondences
Triangulation	?	Known	2D-2D corr.
Structure from Motion	?	?	2D-3D corr

$$(p_{20}X_i + p_{21}Y_i + p_{21}Z_i + p_{23}W_i)X_j - p_{00}X_i + p_{01}Y_i + p_{02}Z_i + p_{03}W_i$$

$$(p_{20}X_i + p_{21}Y_i + p_{21}Z_i + p_{23}W_i)y_i - p_{10}X_i + p_{11}Y_i + p_{12}Z_i + p_{13}W_i$$