① $F = \begin{bmatrix} 0 & 0 & 1 \\ 0 & 0 & 1 \\ -1 & -1 & 0 \end{bmatrix}$

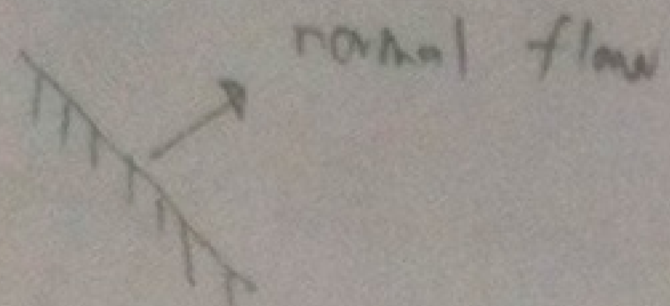
100

For a point (a,b) in the left image, draw the right epipolar ~~point~~ line for this point
where is the right epipole

② Given null$(E) = (3,2,1)^T$, explain how you would solve for translation $\vec{T}$
if you know that $|\vec{T}| = k$?

③ When the scene being viewed by a fixed stereo pair is changed, would F change ?

④



give the locus of the optical flow

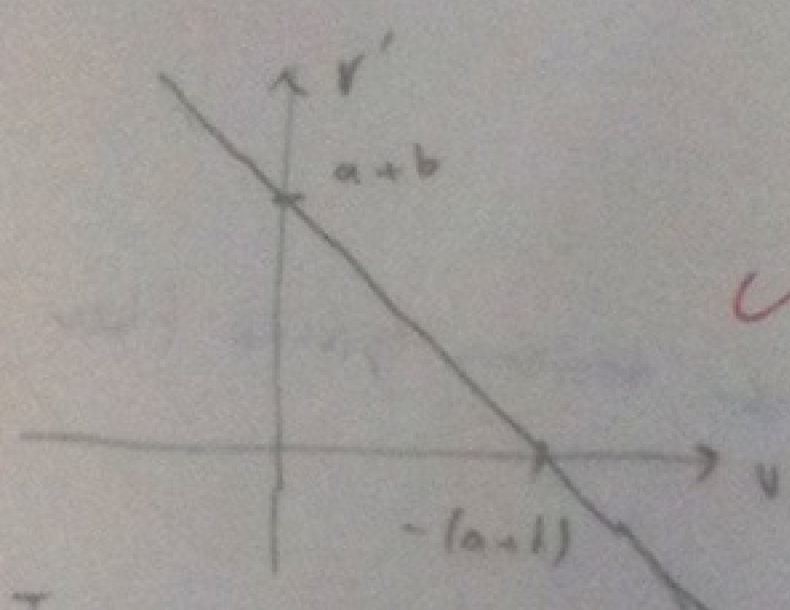
①

$$F\bar{p}_l = \begin{bmatrix} 0 & 0 & 1 \\ 0 & 0 & 1 \\ -1 & -1 & 0 \end{bmatrix} \begin{bmatrix} a \\ b \\ 1 \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ -a-b \end{bmatrix}$$

Equation of the right epipolar line $\quad au' + bv' + c = 0$

$$\begin{bmatrix} a \\ b \\ c \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ -(a+b) \end{bmatrix}$$

$\therefore \quad u' + v' - (a+b) = 0$



The right epipole $\quad e_r = \text{null}(F^T)$ i.e. $F^T e_r = 0$

$$\begin{bmatrix} 0 & 0 & -1 \\ 0 & 0 & -1 \\ 1 & 1 & 0 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$\therefore \quad z = 0, \quad x = -y \qquad \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 1 \\ -1 \\ 0 \end{bmatrix}$

$\therefore$ The right epipole is at infinity, in the direction $(1,-1)$

② Given null $(E) = (3, 2, 1)^T$

$\therefore$ The left epipole is at $(3, 2, 1)^T$

Since T is in the direction of e_L

$$\therefore \vec{T} = k \begin{pmatrix} 3 \\ 2 \\ 1 \end{pmatrix} \frac{1}{|(3\ 2\ 1)^T|} = \frac{k}{\sqrt{14}} \begin{pmatrix} 3 \\ 2 \\ 1 \end{pmatrix}$$

③ $F = M_r^{-T} (R\, S(T))\, M_l^{-1}$

Since only the scene changes, but the intrinsic parameters of the two cameras are not changed (i.e. M_r^{-T} and M_l^{-T} unchanged),

and the stereo pair is fixed, i.e. there is no change in relative rotation and translation of the two cameras (R, T unchanged)

$\therefore F$ is not changed

④