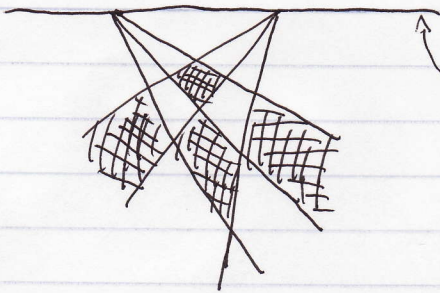


Points and lines at infinity

Flight simulator:
What is the horizon

$$\begin{pmatrix} u \\ v \\ w \end{pmatrix} \sim \begin{pmatrix} f & 0 & 0 \\ 0 & f & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} r_1 & r_2 & T \end{pmatrix} \begin{pmatrix} x \\ y \\ w \end{pmatrix}$$



Why does the horizon give my attitude:

$$r_1, r_2 \quad r_3 = r_1 \times r_2$$

projection of the line at infinity = horizon

ground plane: line connecting $\begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}$ with $\begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}$: line eq: $w=0$
image plane: $l'_{\infty} \sim A \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} \times A \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}$

$$A \sim \begin{pmatrix} fr_{11} & fr_{12} & fT_1 \\ fr_{21} & fr_{22} & fT_2 \\ r_{31} & r_{32} & T_3 \end{pmatrix}$$

$$A \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} \sim \begin{pmatrix} fr_{11} \\ fr_{21} \\ r_{31} \end{pmatrix}$$

1st column

$$A \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} \sim \begin{pmatrix} fr_{12} \\ fr_{22} \\ r_{32} \end{pmatrix}$$

2nd column

$$\text{known is } \begin{pmatrix} fr_{11} \\ fr_{21} \\ r_{31} \end{pmatrix} \times \begin{pmatrix} fr_{12} \\ fr_{22} \\ r_{32} \end{pmatrix}$$

If we know f then we know

$$\begin{matrix} r_{11} & r_{12} & \rightarrow \\ r_{21} & \times & r_{22} = r_3 \\ r_{31} & r_{32} & \end{matrix} \quad \begin{matrix} \\ \\ \text{3rd column of } R \end{matrix}$$

Which means I can recover pitch and roll but no yaw $\frac{\pi}{2}$