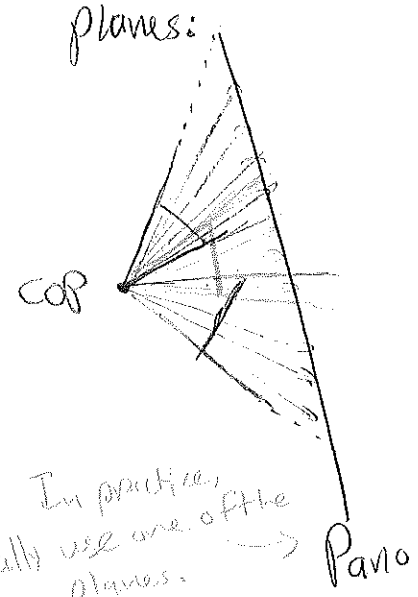
Panoramas: Homography

Each image projects scene onto independent image (projection) planes:



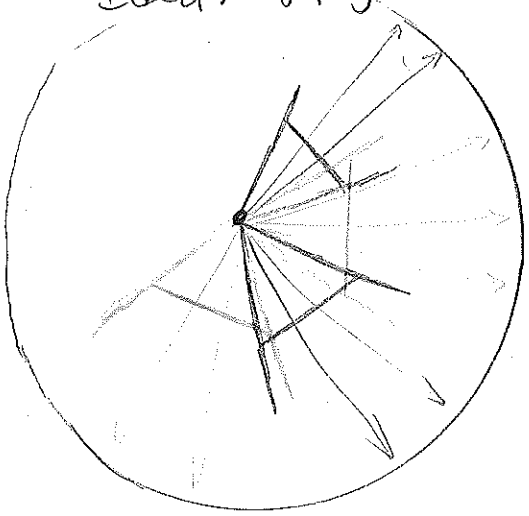
Homographies project images onto a common PP. Homography also known as "planar perspective warp."

This only works when images have a common center of projection!

Also only works when view angle totals $< 180°$.

Panoramas: Spherical

Idea: Project images onto a sphere instead of a plane.

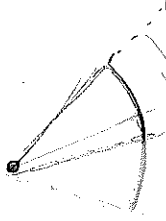


Works up to 360°!

Still requires common COP.

Alignment:

1. Project onto sphere.
2. Align spherically warped images using translational motion model.



Translation in (θ, ϕ) is equivalent to rotation around COP - exactly how we captured the images!

Outline

Pano - common CoP

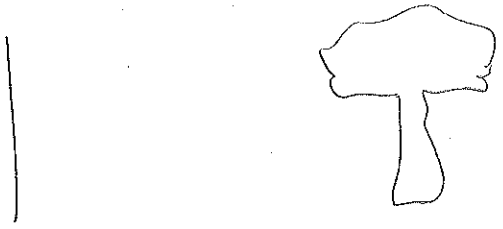
Homog. - can't go beyond 180°

Different location → position depends on depth

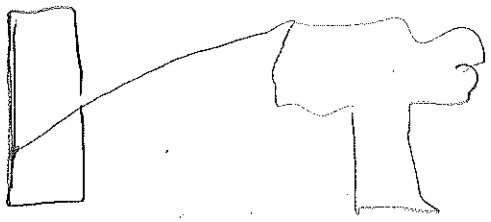
→ can we use that?

Image formation revisited

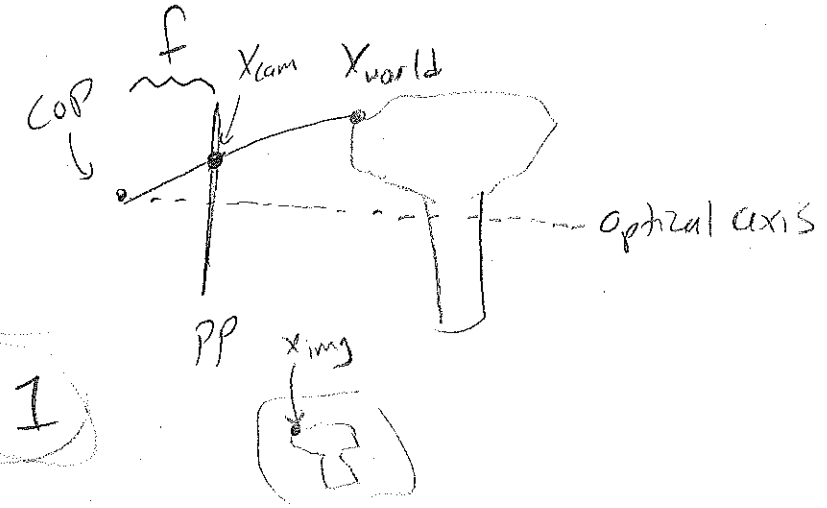
Mk I



Mk II



Mk III (math)



HW1

Preview: Camera Matrix:

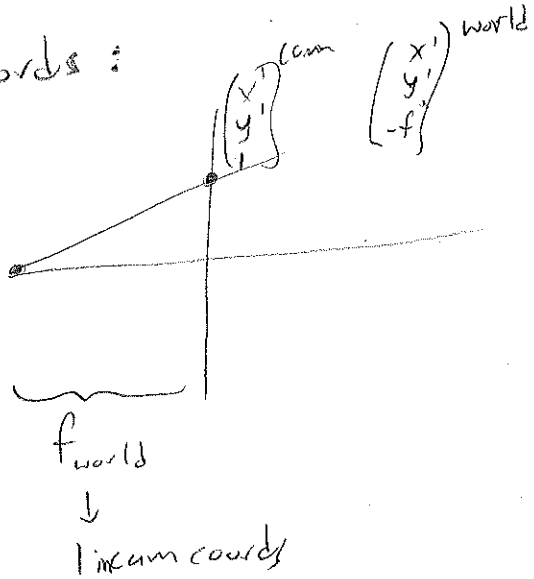
$$x_{img} = \begin{bmatrix} \text{Intrinsics} \end{bmatrix} \begin{bmatrix} \text{Projection} \end{bmatrix} \begin{bmatrix} \text{Extrinsics} \end{bmatrix} X_{world}$$

- Intrinsics: focal, pixels, ...
- Projection: 3D to 2D
- Extrinsics: camera pos + rot
- x_{img}
- often written together
- x_{cam}

Pinhole Projection - HW #2-3

with focal 1

Camera coords:



↓

1 in cam coords

Pinhole with $f_{cal} = f$ - HW 4-5

Depth From Disparity

(Using 10th grade math)

Rectified case:

Shared PP
same f
C_R offset by b in x
↑ baseline

$$\frac{Z_W}{f} = \frac{X_W}{X_L} \qquad \frac{b - X_W}{X_R} = \frac{Z_W}{f}$$

$$\frac{Z_W}{f} X_L = X_W \qquad X_W = b - \frac{Z_W}{f} X_R$$

$$\frac{Z_W X_L}{f} = b - \frac{Z_W X_R}{f}$$

$$\frac{Z_W X_L}{f} + \frac{Z_W - X_R}{f} = fb$$

$$Z_W (X_L - X_R) = fb$$

$$Z_W = \frac{fb}{X_L - X_R}$$