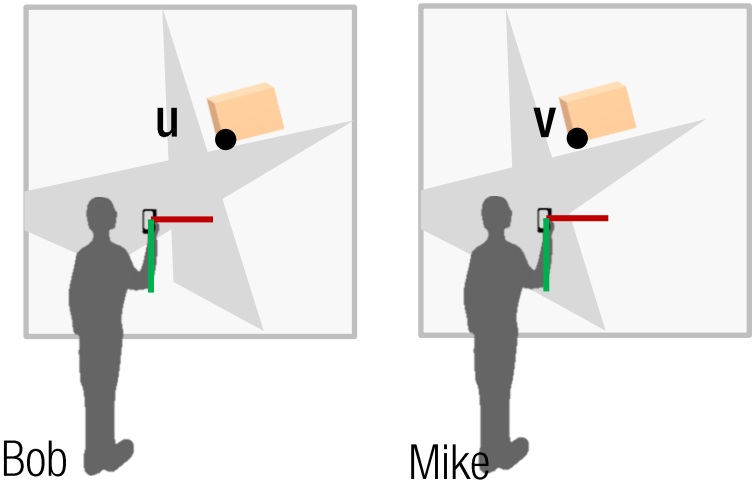
Stereo Reconstruction

Hyun Soo Park

Special Case: Stereo

- Same orientation



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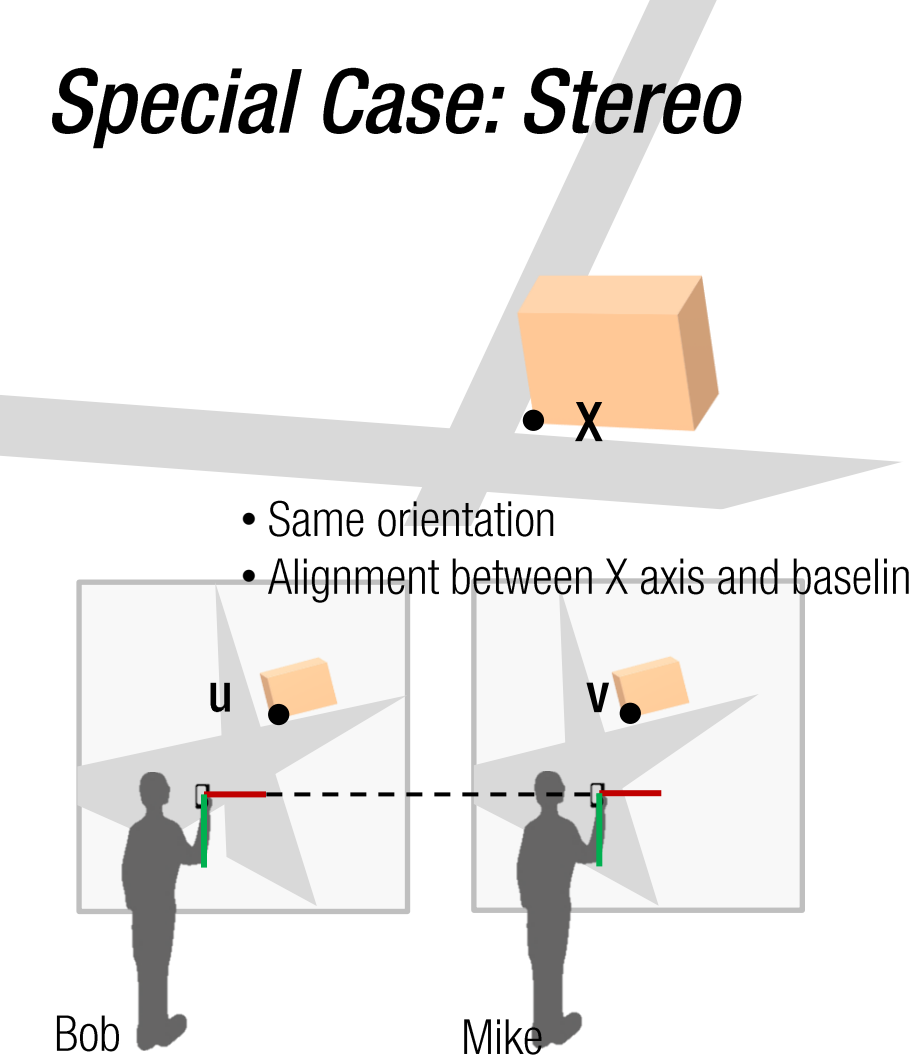
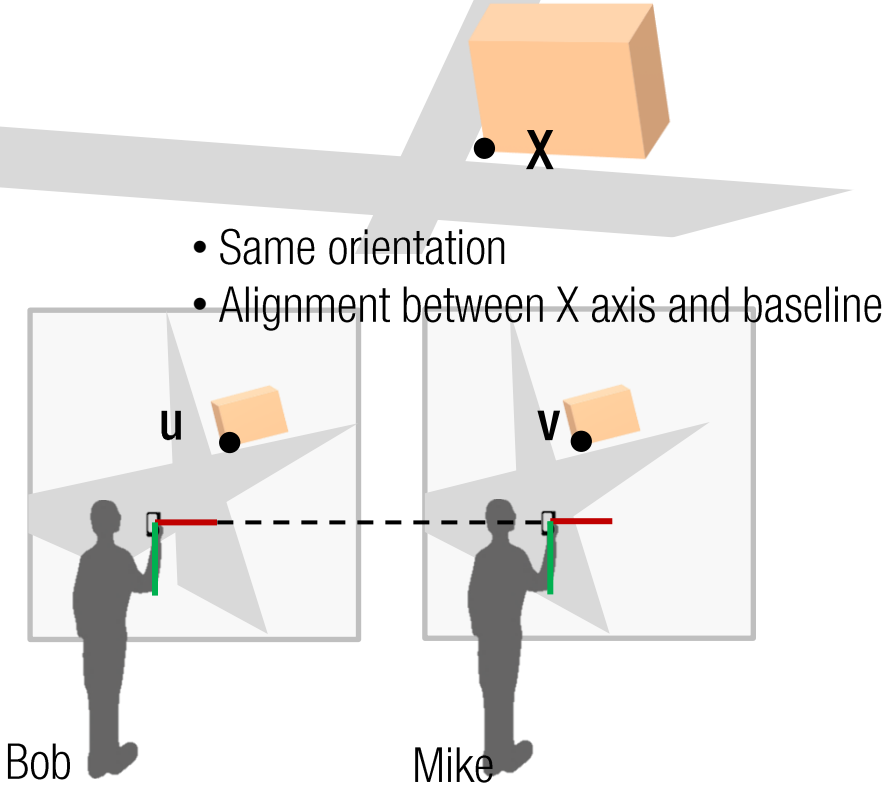


- Same orientation
- Alignment between X axis and baseline

Special Case: Stereo



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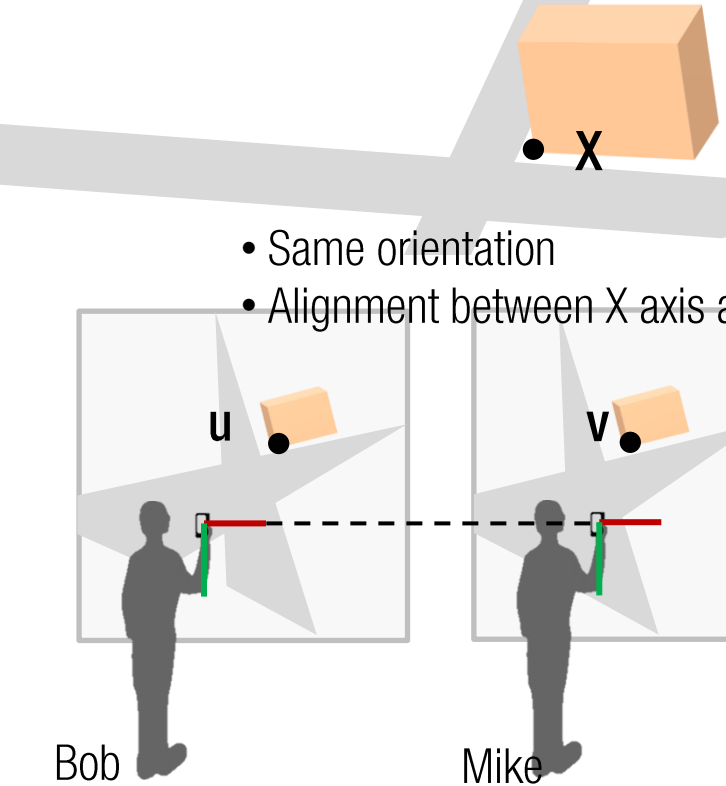
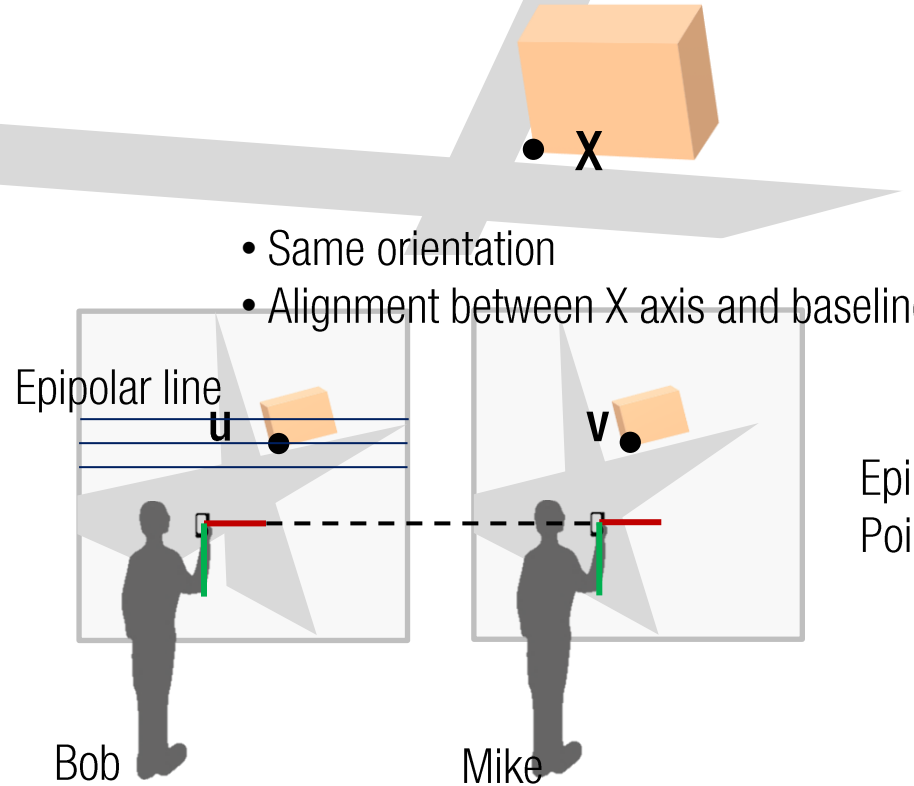


- Same orientation
- Alignment between X axis and baseline

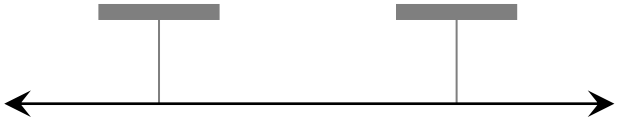
Top view

Special Case: Stereo



- Same orientation
- Alignment between X axis and baseline

Epipole?
Point at infinity



Top view

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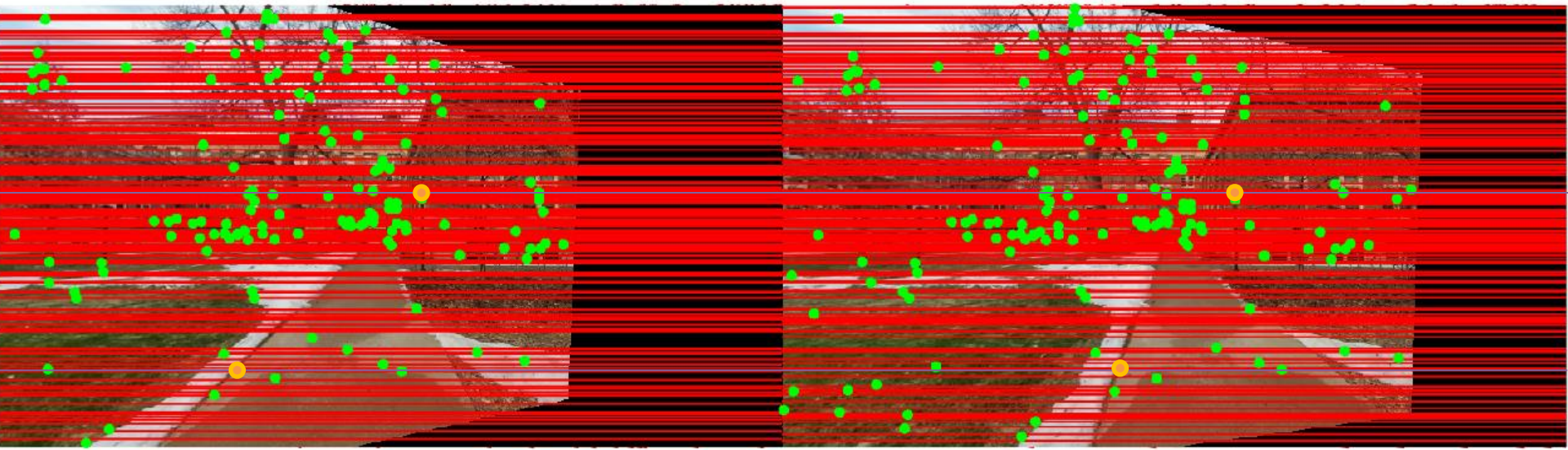

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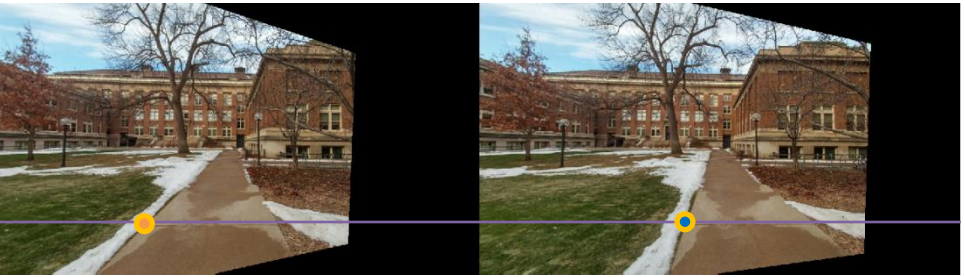

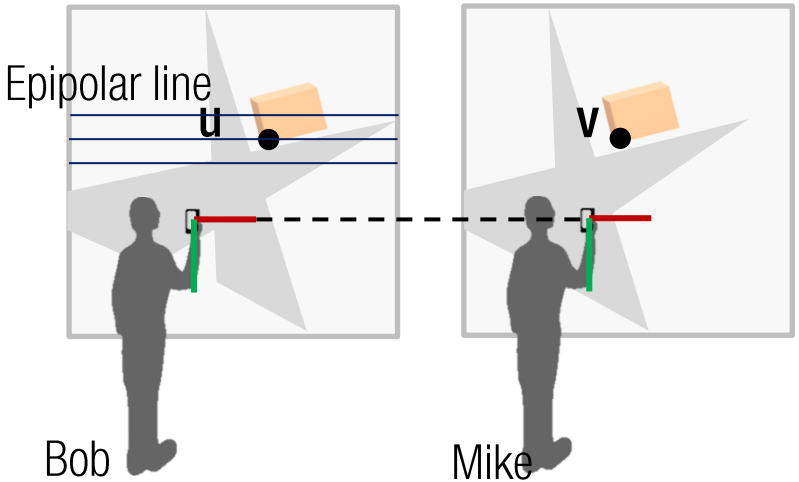

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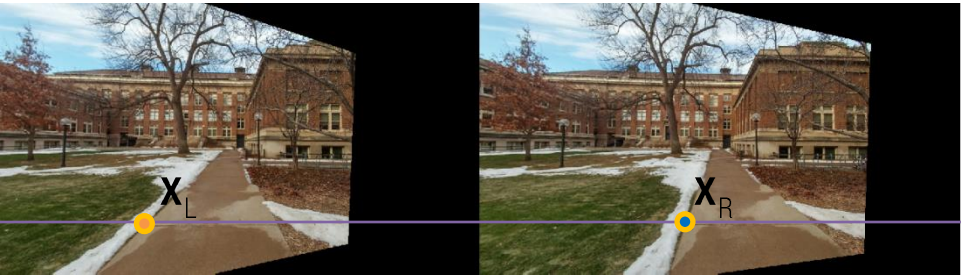

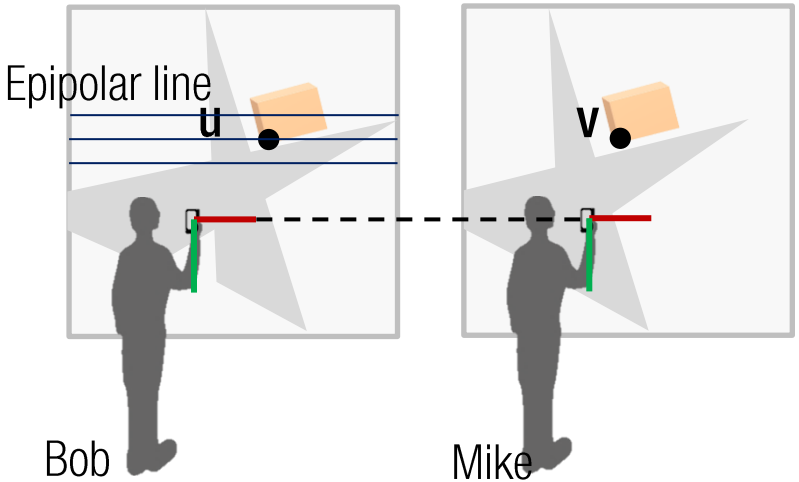

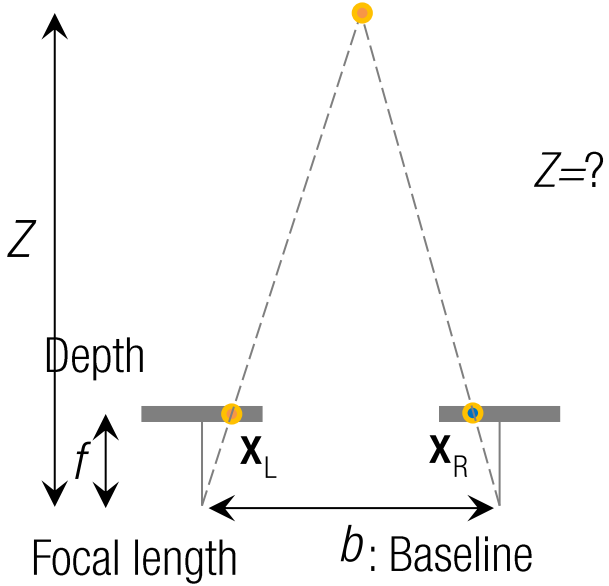

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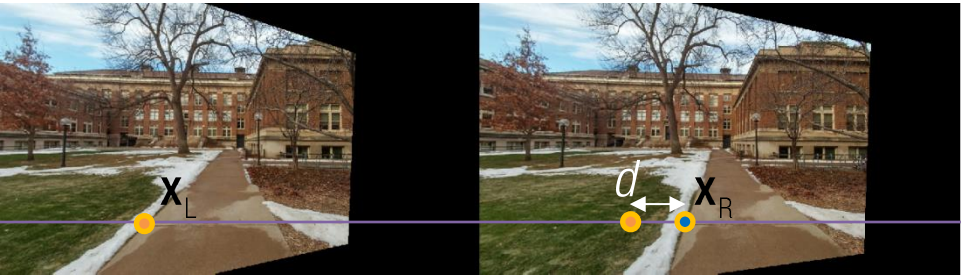

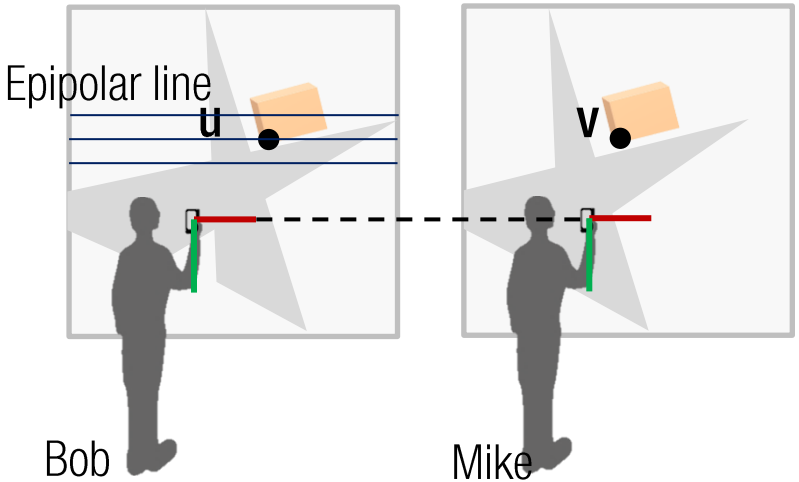

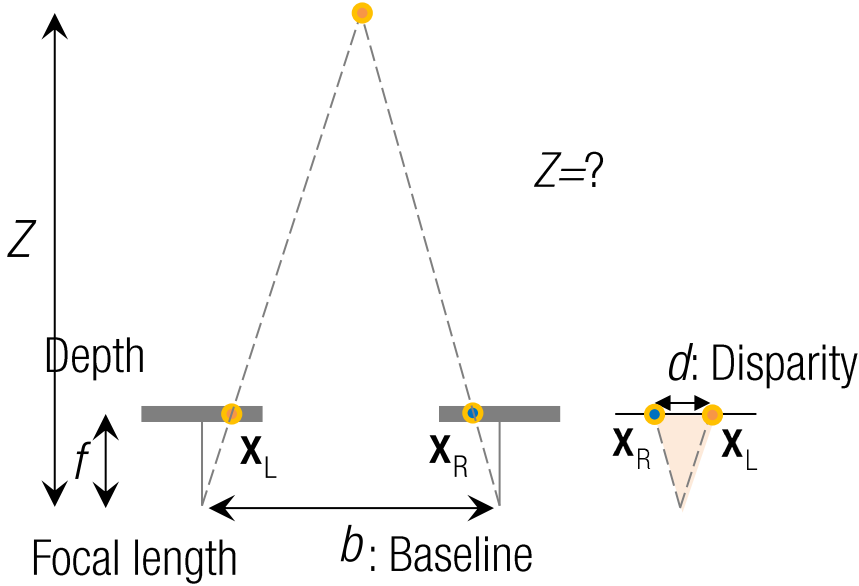

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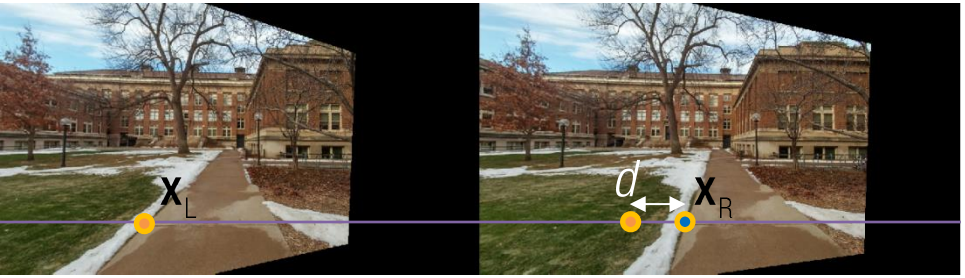

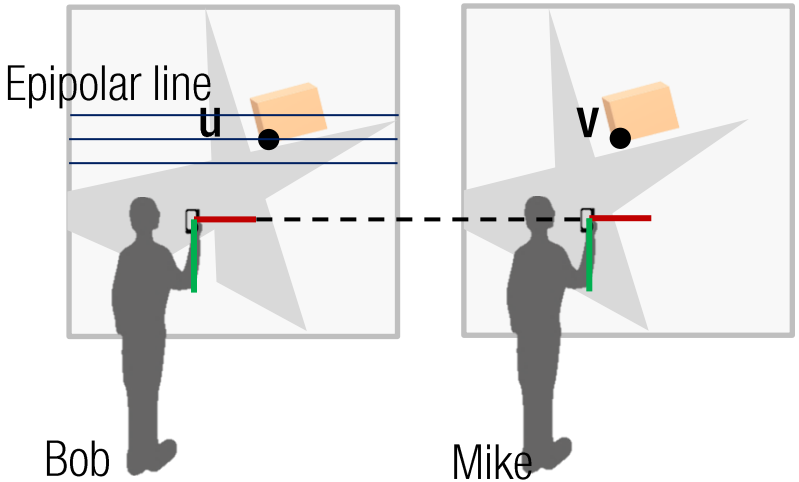

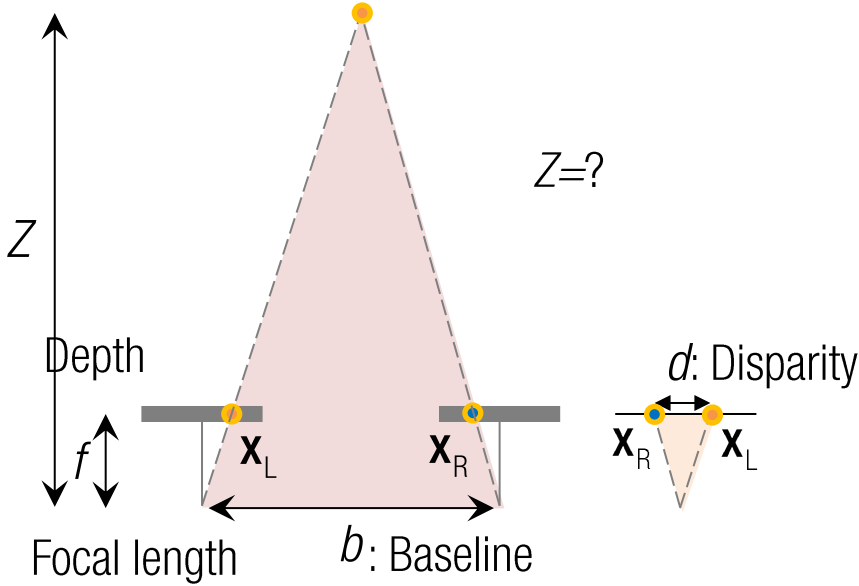

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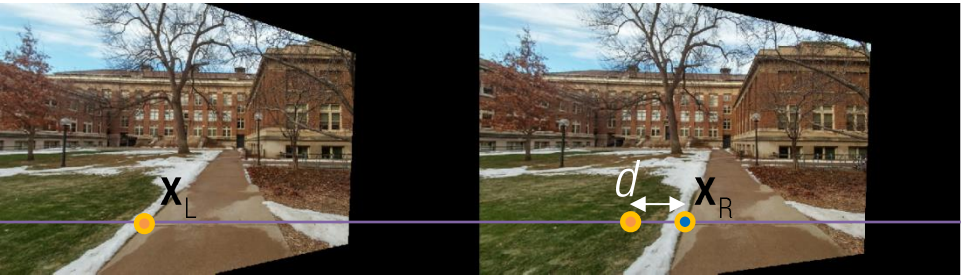

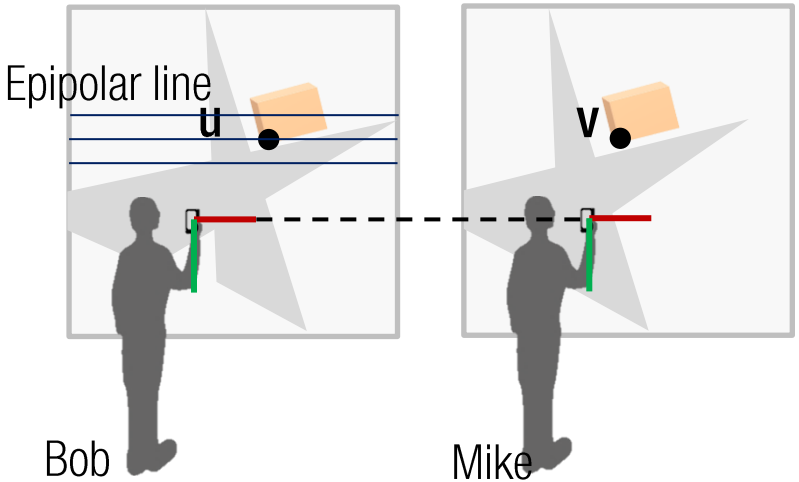

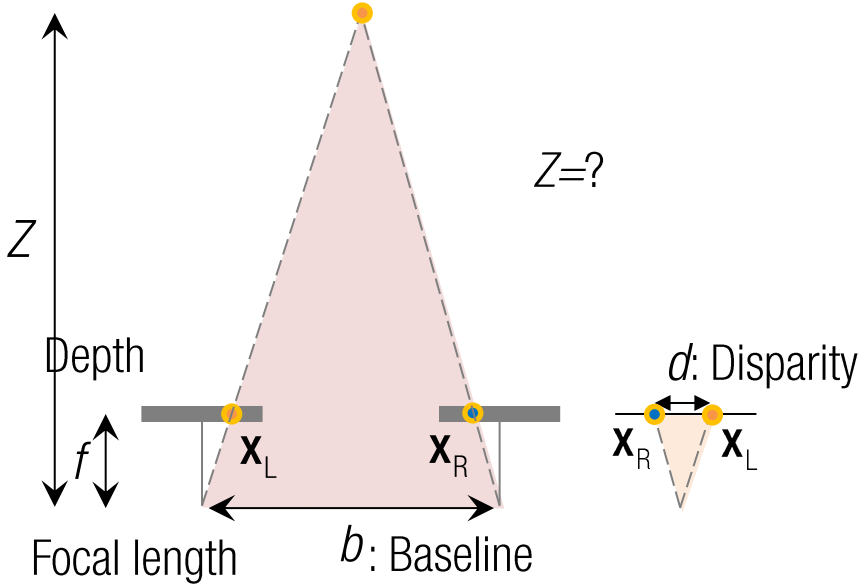

$$\frac{Z}{b} = \frac{f}{d} \rightarrow Z = b\frac{f}{d}$$

Two triangles are similar.

Special Case: Stereo

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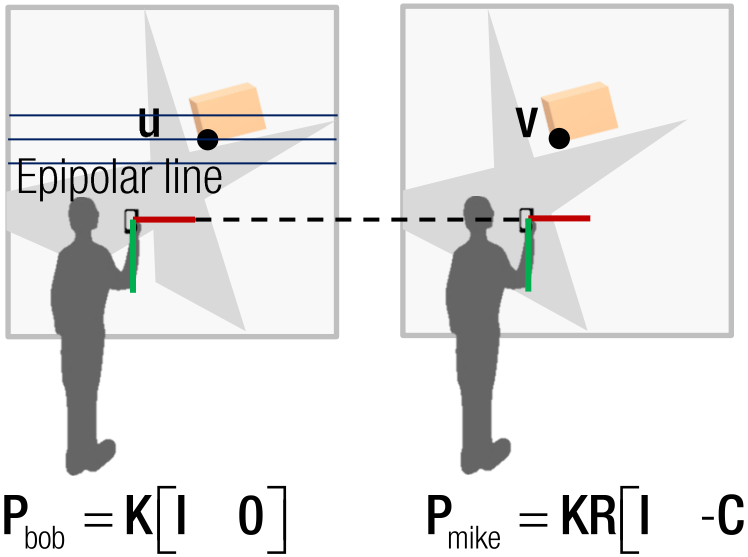


$$P_{bob} = K\begin{bmatrix} I & 0 \end{bmatrix} \qquad P_{mike} = KR\begin{bmatrix} I & -C \end{bmatrix}$$

- Same orientation

$$R_{rect} = \begin{bmatrix} r_x^T \\ r_y^T \\ r_z^T \end{bmatrix}$$

- Alignment between X axis and baseline

$$r_x = \frac{C}{\|C\|}$$

$$r_z = \frac{\tilde{r}_z - (\tilde{r}_z \cdot r_x) r_x}{\left\| \tilde{r}_z - (\tilde{r}_z \cdot r_x) r_x \right\|}$$

: Orthogonal projection

where $\tilde{r}_z = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$

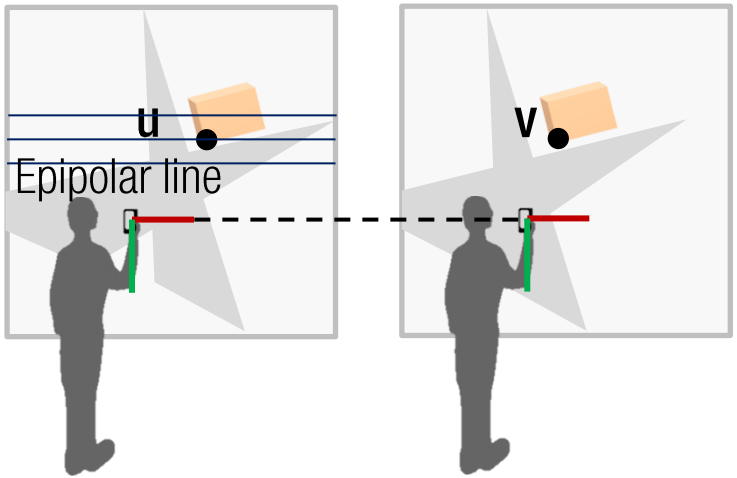
$$r_y = r_z \times r_x$$

Special Case: Stereo

Homography by pure rotation: $\mathbf{R}_{rect}$

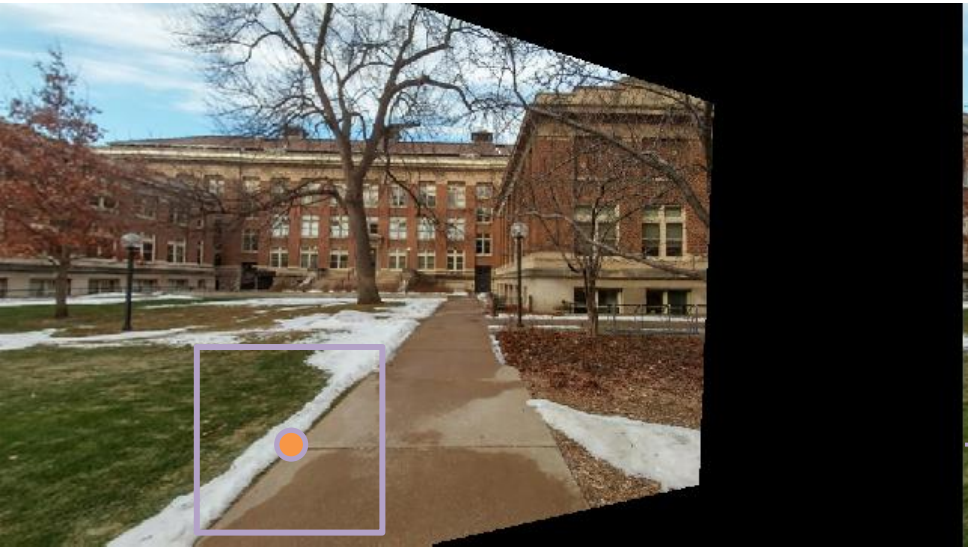
$$\mathbf{H}_{bob} = \mathbf{K}\mathbf{R}_{rect}\mathbf{K}^{-1}$$

$$\mathbf{H}_{mike} = \mathbf{K}\mathbf{R}_{rect}\mathbf{R}^{T}\mathbf{K}^{-1}$$



$$\mathbf{P}_{bob} = \mathbf{K}\begin{bmatrix}\mathbf{I} & \mathbf{0}\end{bmatrix} \qquad \mathbf{P}_{mike} = \mathbf{K}\mathbf{R}\begin{bmatrix}\mathbf{I} & -\mathbf{C}\end{bmatrix}$$

Dense Feature Matching using SIFT Flow



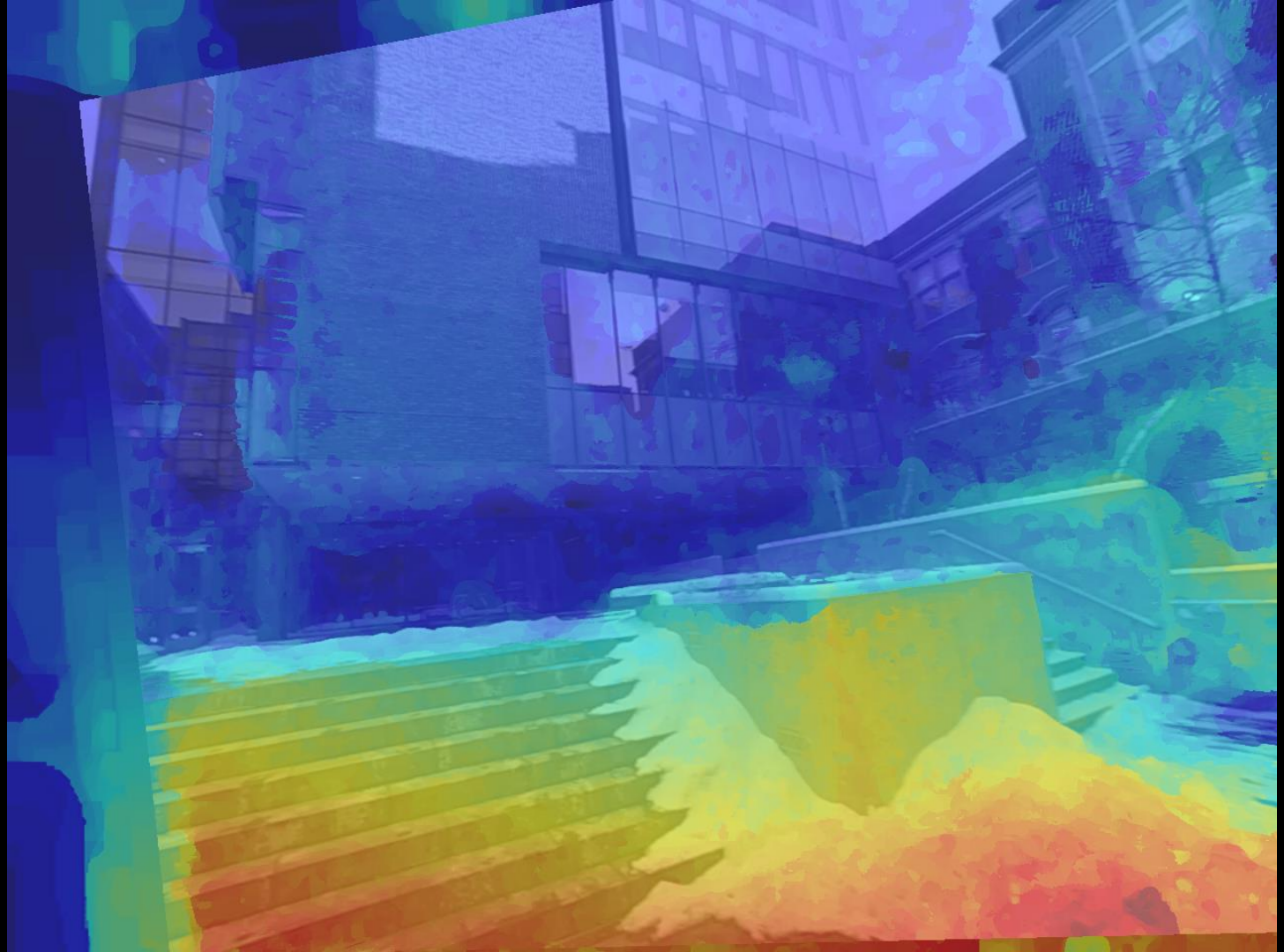
descriptor1

Find a minimum distance over the epipolar line

descriptor2

Disparity Map: Stereo Matching using SIFT Flow

Disparity Map = Inverse Depth




maxell
VHS VIDEOCASSETTE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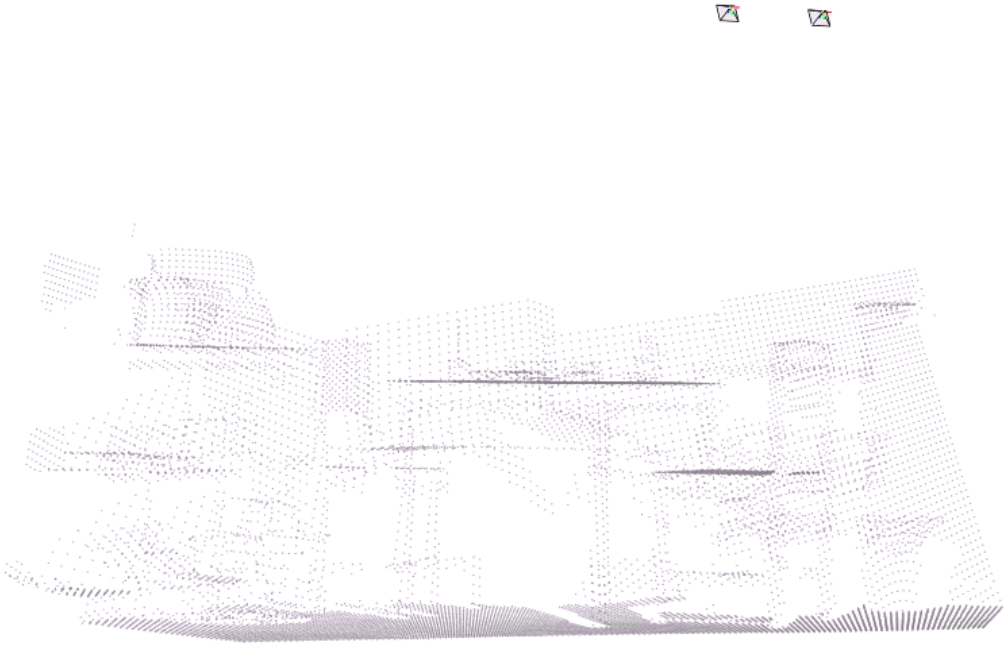


EgoMotion Dataset (outdoor)

Dense Reconstruction using a Monocular Camera