

Image Transform



Panorama Image (Keller+Lind Hall)

360 Panorama

<https://www.youtube.com/watch?v=H6SsB3JYqOg>



Image Transform by Pure 3D Rotation

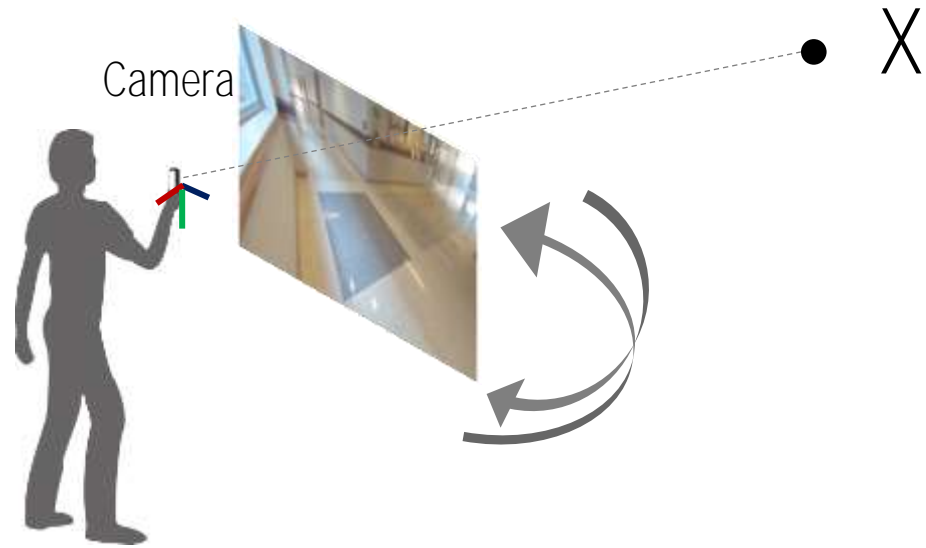


Image Transform by Pure 3D Rotation

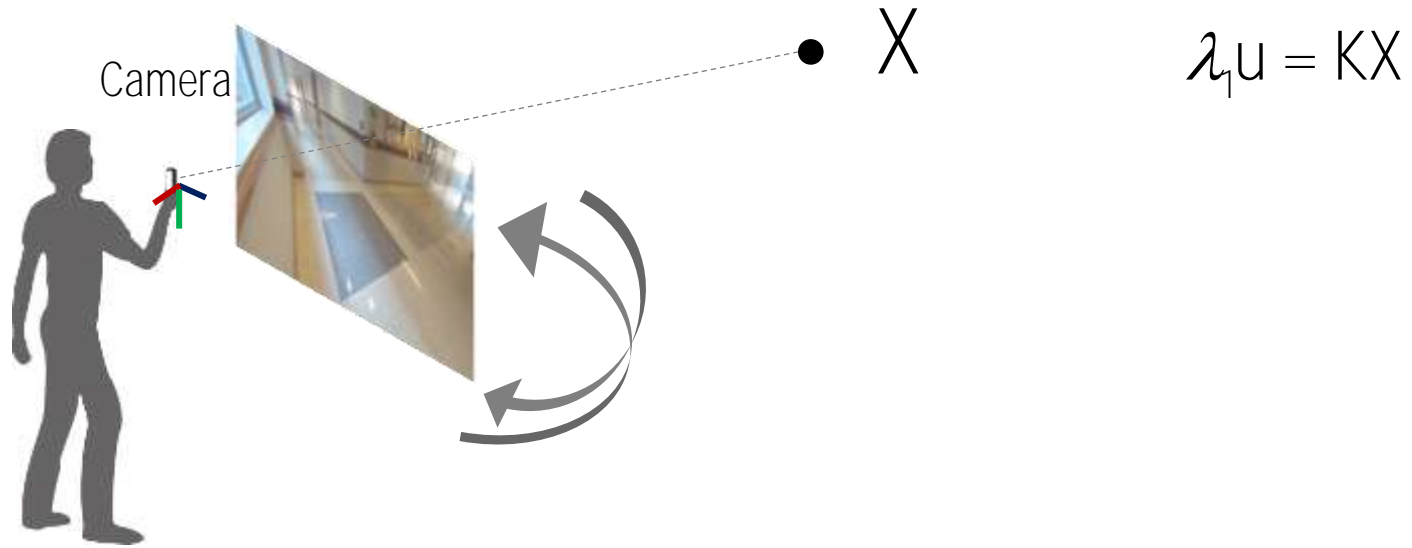
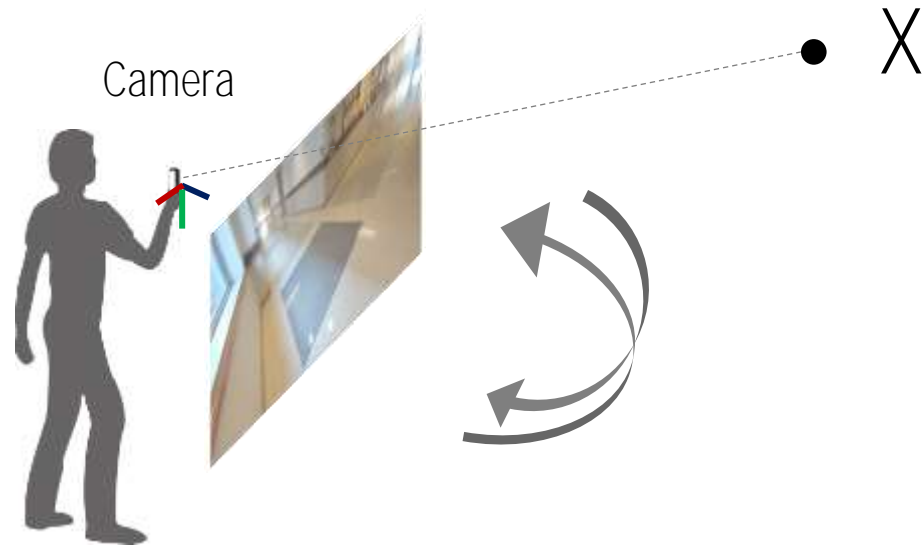


Image Transform by Pure 3D Rotation

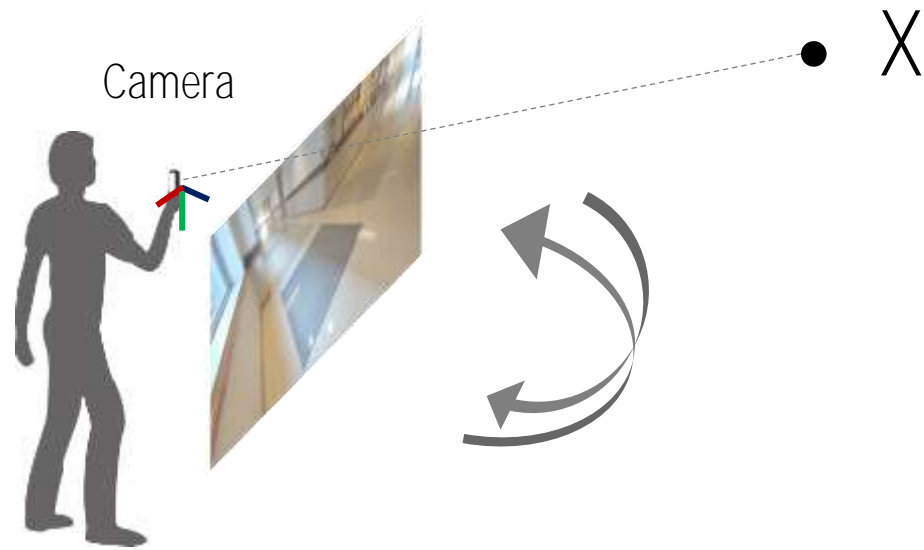


$$\lambda_1 u = KX$$

$$\lambda_2 v = KRX$$

$$t = 0$$

Image Transform by Pure 3D Rotation

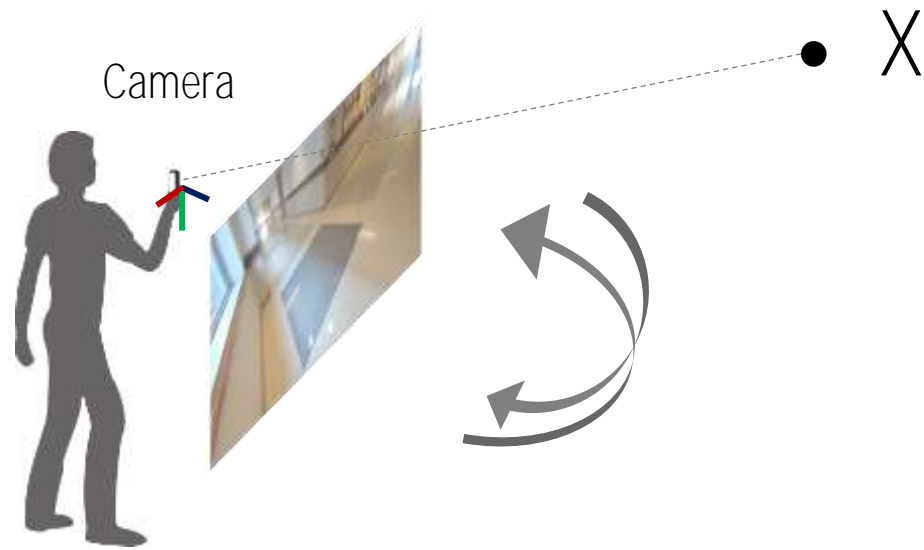


$$\lambda_1 u = KX \quad t = 0$$

$$\lambda_2 v = KRX$$

$$\longrightarrow X = \lambda_1 K^{-1}u = \lambda_2 R^T K^{-1}v$$

Image Transform by Pure 3D Rotation



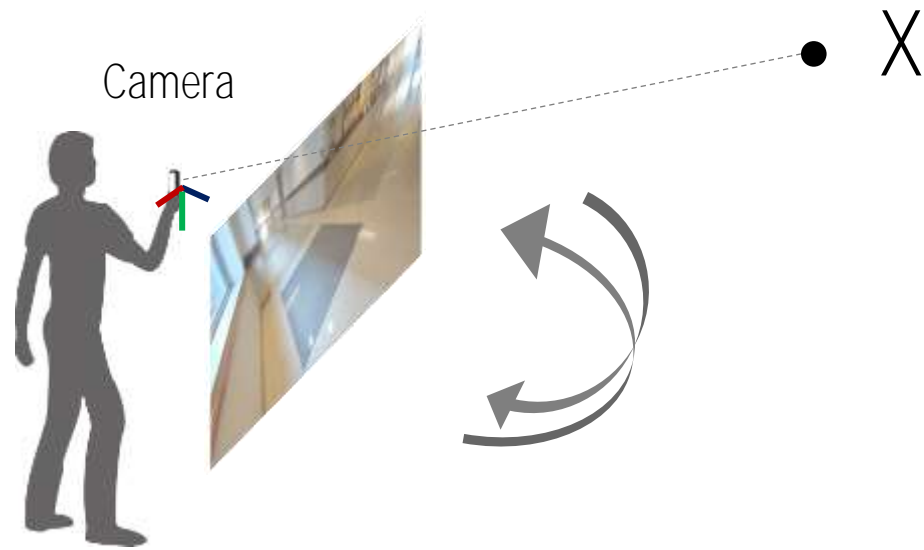
$$\lambda_1 u = KX \quad t = 0$$

$$\lambda_2 v = KRX$$

$$\longrightarrow X = \lambda_1 K^{-1}u = \lambda_2 R^T K^{-1}v$$

$$\longrightarrow \lambda v = KRK^{-1}u$$

Image Transform by Pure 3D Rotation



$$\lambda_1 u = KX \quad t = 0$$

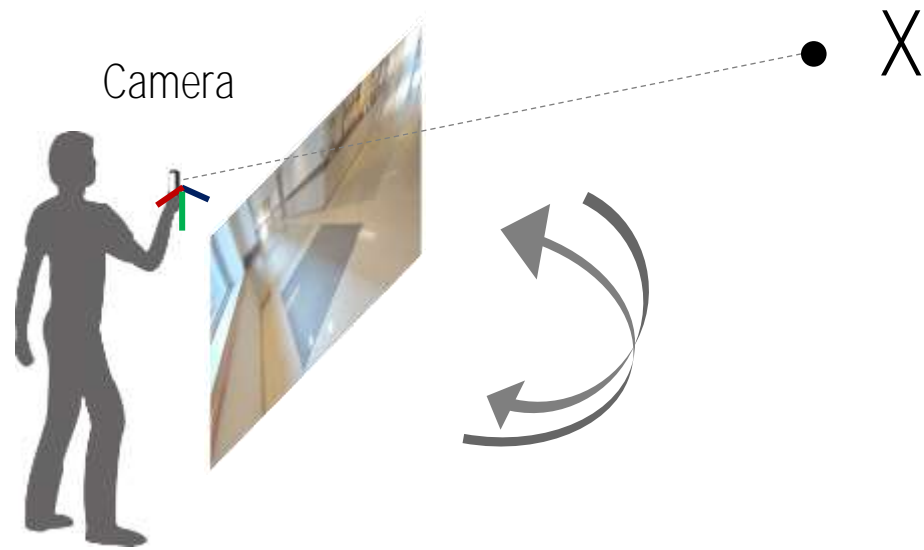
$$\lambda_2 v = KRX$$

$$\longrightarrow X = \lambda_1 K^{-1}u = \lambda_2 R^T K^{-1}v$$

$$\longrightarrow \lambda v = KRK^{-1}u$$

$$\longrightarrow H = KRK^{-1}$$

Image Transform by Pure 3D Rotation



$$\lambda_1 u = KX \quad t = 0$$

$$\lambda_2 v = KRX$$

$$\longrightarrow X = \lambda_1 K^{-1}u = \lambda_2 R^T K^{-1}v$$

$$\longrightarrow \lambda v = KRK^{-1}u$$

$$\longrightarrow H = KRK^{-1}$$

$$\longrightarrow \underline{R = K^{-1}HK}$$

Rotation from homography

$$\lambda u = H\nu$$



Lind Hall Left



Lind Hall Right



Euclidean Transform (Translation)



Homography

LindHallCompositeHomography.m

```
im1 = imread('lindhall_left.png');  
im2 = imread('lindhall_right.png');
```

```
f = 1224;  
px = size(im1,2)/2;  
py = size(im1,1)/2;
```

```
K = [f 0 px; 0 f py; 0 0 1];
```

```
u2 = [1275 1095; 1291 812;  
      400 666; 359 1054];
```

```
u1 = [3564 1205; 3525 817;  
      2624 896; 2629 1184];
```

```
H = ComputeHomography(u1,u2);
```

```
H = H/H(3,3);
```

```
R = inv(K) * H * K;
```

```
detR = det(R)
```

$$H = KRK^{-1}$$

$$\longrightarrow R = K^{-1}HK$$

detR =
0.2059

LindHallCompositeHomography.m

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H = H/H(3,3);
```

```
R = inv(K) * H * K;
```

```
detR = det(R)
```

$$H = KRK^{-1}$$

$$\longrightarrow R = \lambda K^{-1}HK$$

$$\det R =$$
$$0.2059$$

$$\det(\lambda R) = \lambda^3 \det(R)$$

LindHallCompositeHomography.m

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```
H = ComputeHomography(u1,u2);
```

```
H = H/H(3,3);
```

```
R = inv(K) * H * K;
```

```
detR = det(R)
```

```
R = 1/detR^(1/3) * R
```

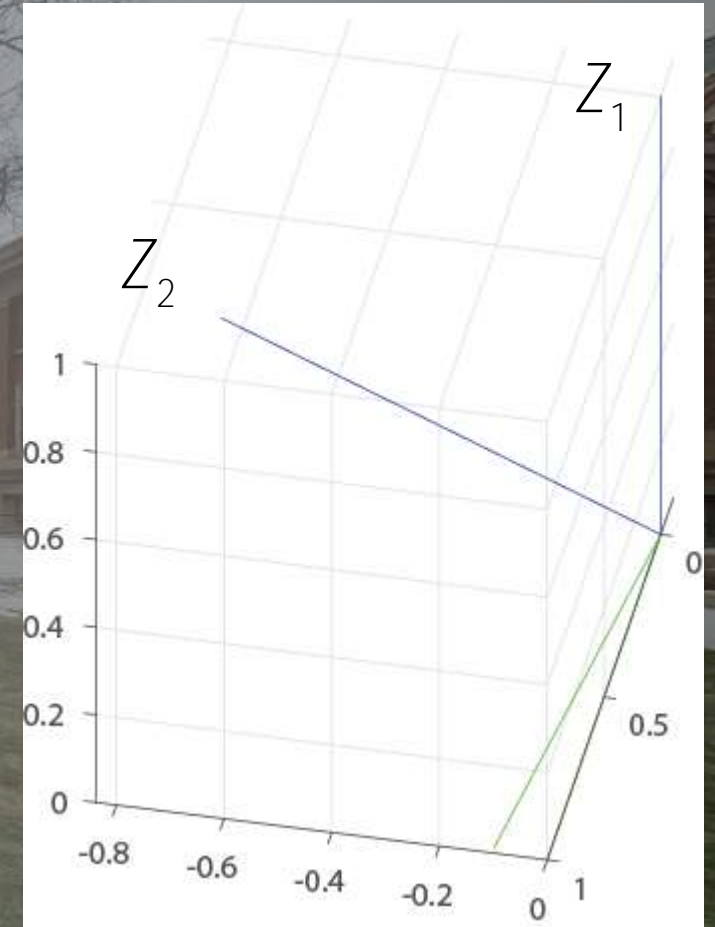
```
det(R)
```

$$H = KRK^{-1}$$

$$\longrightarrow R = \lambda K^{-1}HK$$

$$\det R = 1.000$$

$$\det(\lambda R) = \lambda^3 \det(R)$$



HW #2: Image Panorama (Cylindrical Projection)



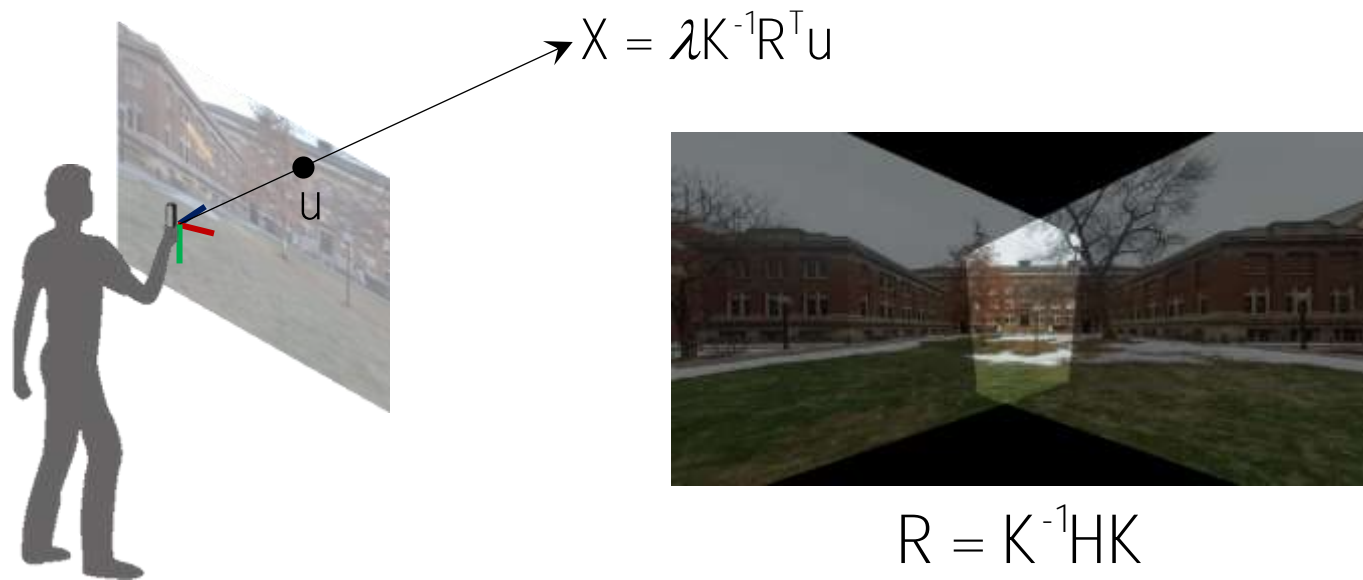
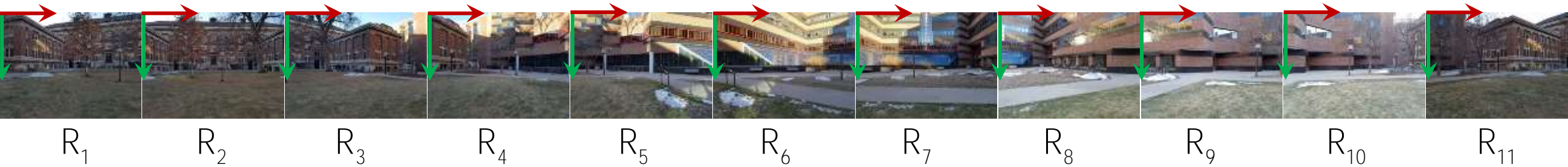
HW #2: Image Panorama (Cylindrical Projection)



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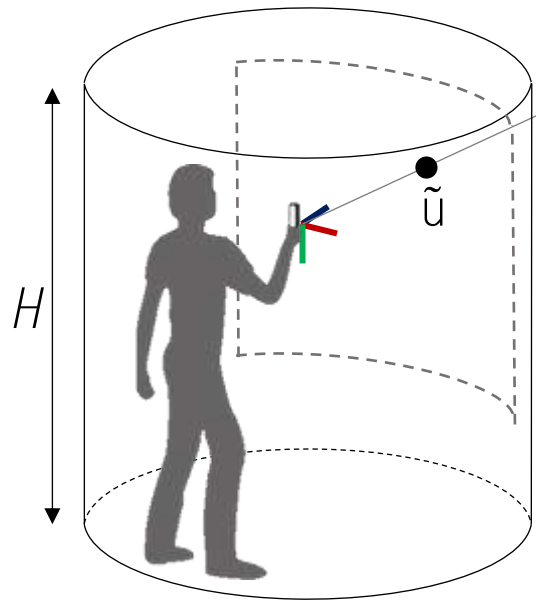


HW #2: Image Panorama (Cylindrical Projection)



HW #2: Image Panorama (Cylindrical Projection)

θ



$$X = \lambda K^{-1} R^T u$$

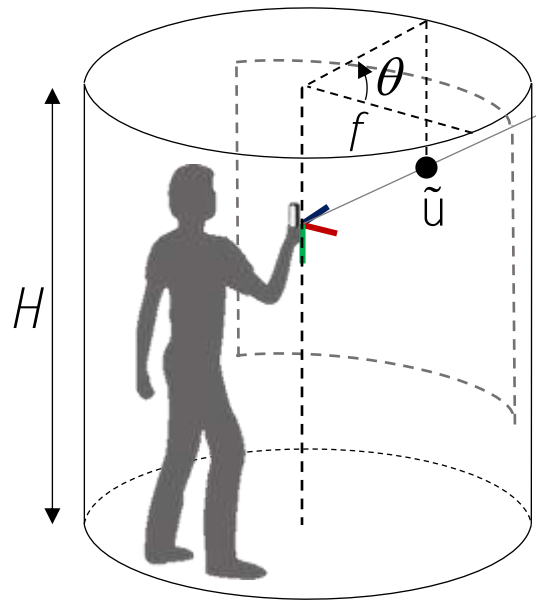


$\tilde{u} =$

$$R = K^{-1} H K$$

HW #2: Image Panorama (Cylindrical Projection)

θ



$$X = \lambda K^{-1} R^T u$$

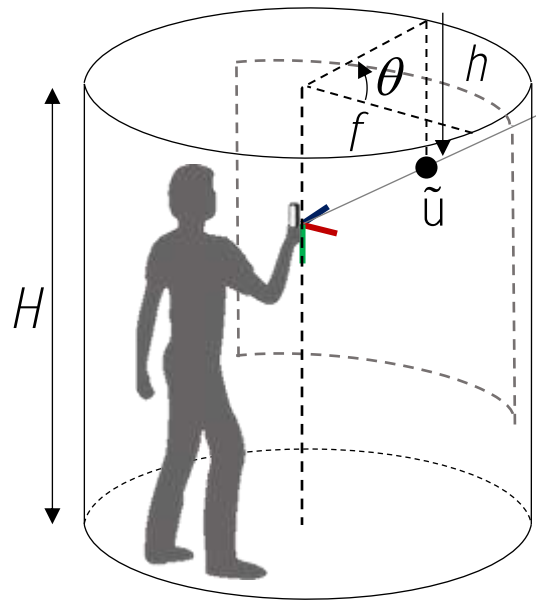


$$R = K^{-1} H K$$

$$\tilde{u} = \begin{bmatrix} f \cos \theta \\ f \sin \theta \end{bmatrix}$$

HW #2: Image Panorama (Cylindrical Projection)

θ



$$X = \lambda K^{-1} R^T u$$

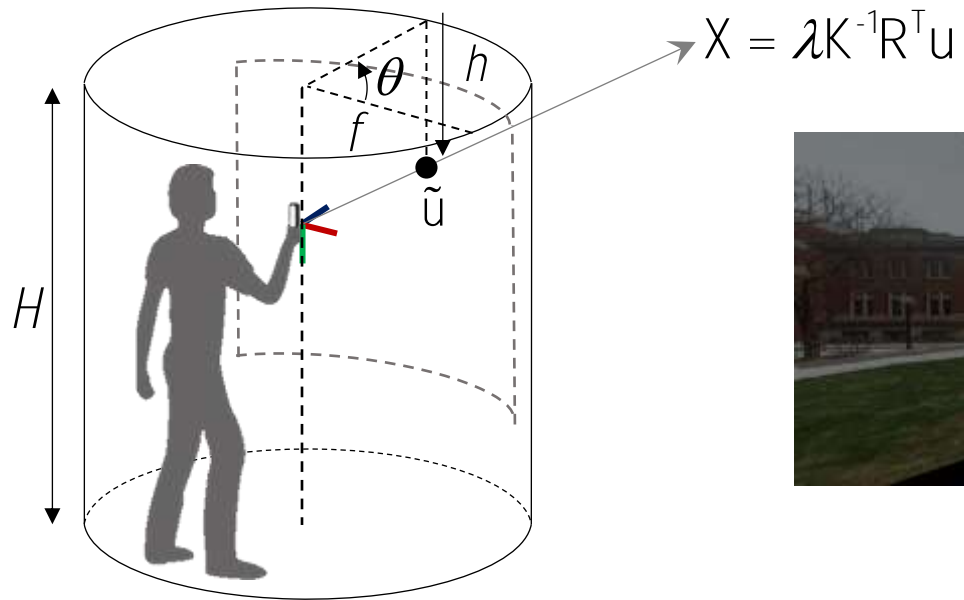


$$R = K^{-1} H K$$

$$\tilde{u} = \begin{bmatrix} f \cos \theta \\ h - \frac{H}{2} \\ f \sin \theta \end{bmatrix}$$

HW #2: Image Panorama (Cylindrical Projection)

θ



$$R = K^{-1} H K$$

$$\tilde{u} = \begin{bmatrix} f \cos \theta \\ h - \frac{H}{2} \\ f \sin \theta \end{bmatrix} = \lambda K^{-1} R^T u$$

HW #2: Image Panorama (Cylindrical Projection)

θ

