Class 1-4

Basic Transformation

3-D rotation

$$rotata-z(\phi)=[cos\phi \quad -sin\phi \quad 0 \sin\phi \quad cos\phi \quad 0\backslash 0 \quad 0 \quad 1]$$

$$rotata-x(\phi)=[1 \quad 0 \quad 0\backslash 0 \quad cos\phi \quad -sin\phi\backslash 0 \quad sin\phi \quad cos\phi]$$

$$rotata-y(\phi)=[cos\phi \quad 0 \quad sin\phi\backslash 0 \quad 1 \quad 0\backslash\text{-}sin\phi \quad 0 \quad cos\phi]$$

because we make z rotates to x the y-rotation is different

Transformation Expansion

Because of translation transformation we need to expand one dimension

$$[1 \quad 0 \quad 1\,0 \quad 1 \quad 1\,0 \quad 0 \quad 1][1\,0\,1]=[2\backslash 1\backslash 1]$$

The x and y all move 1 in this example

Rodrigues Transformation

We can use this transformation to rotate by any given axis

$$R=cos\theta*I+(1-cos\theta)[k1\backslash k2\backslash k3][k1 \quad k2 \quad k3]+sin\theta[0 \quad -k3 \quad k2\backslash k3 \quad 0 \quad k1\backslash\text{-}k2 \quad k1 \quad 0]$$

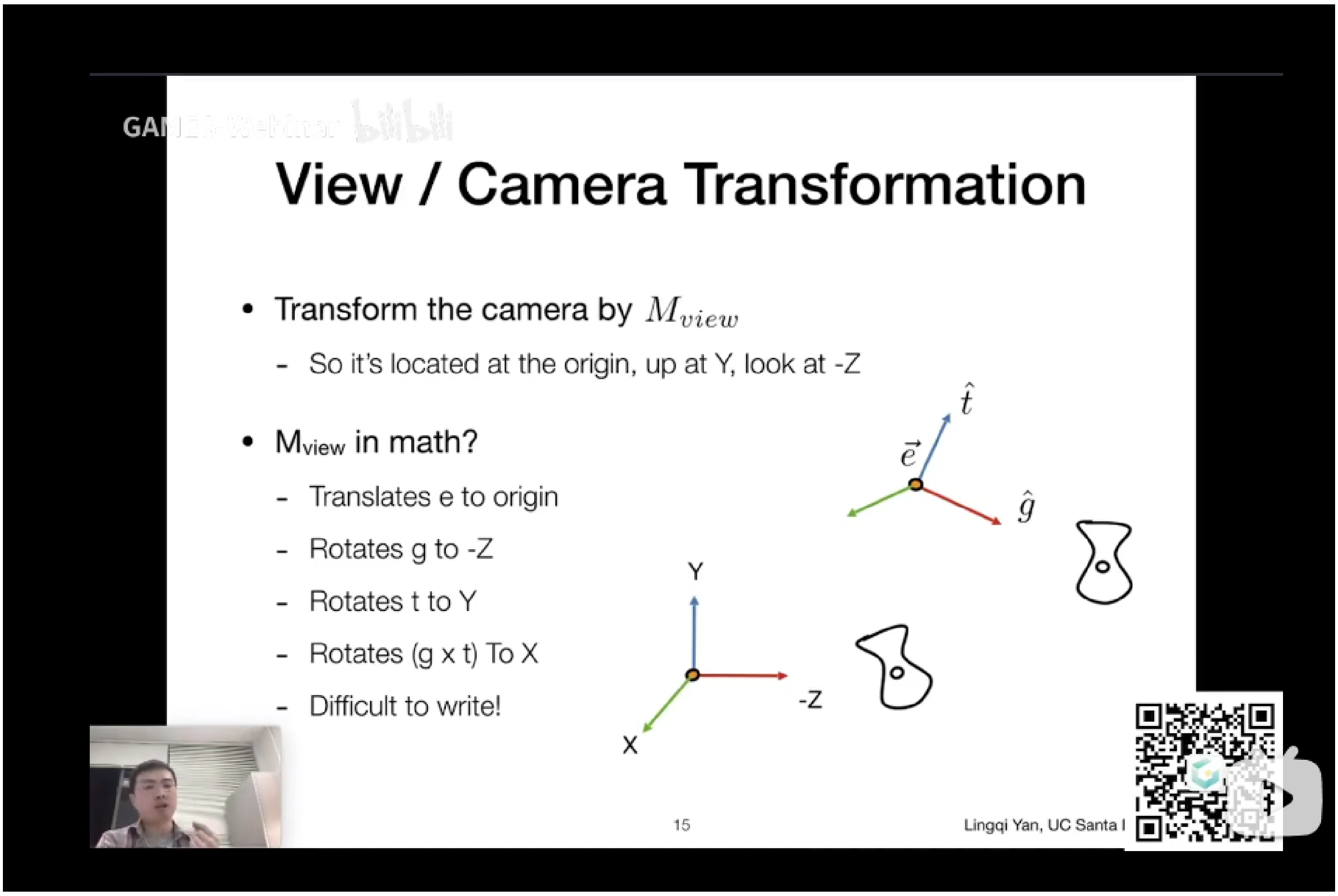
Viewing Transformation

1.Modeling Transformation

The combination of basic transformations(translation,rotation,scaling,shearing)

2.View\Camera Transformation

We need to remove the camera to the global origin



1.Move the camera to the origin

$$T = [1 \quad 0 \quad 0 \quad -x_e \textcolor{red}{\backslash 0} \quad 1 \quad 0 \quad -y_e \textcolor{red}{\backslash 0} \quad 0 \quad 1 \quad -z_e \textcolor{red}{\backslash 0} \quad 0 \quad 0 \quad 1]$$

2.Modify the angle to make three vectors corresponding to three axes

As the transformation is difficult, we can think of the inverse transformation first

$$R_{view}^{-1} = \left[x_{\hat{g}\times\hat{t}} \quad x_t \quad x_{-g} \quad 0\, y_{\hat{g}\times\hat{t}} \quad y_t \quad y_{-g} \quad 0 \textcolor{red}{\backslash z}_{\hat{g}\times\hat{t}} \quad z_t \quad z_{-g} \quad 0 \textcolor{red}{\backslash 0} \quad 0 \quad 0 \quad 1\right]$$

so that the orginial matrix is

$$R_{view} = \left[x_{\hat{g}\times\hat{t}} \quad y_{\hat{g}\times\hat{t}} \quad z_{\hat{g}\times\hat{t}} \quad 0\, x_t \quad y_t \quad z_t \quad 0\, x_{-g} \quad y_{-g} \quad z_{-g} \quad 0 \textcolor{red}{\backslash 0} \quad 0 \quad 0 \quad 1\right]$$

The final result is

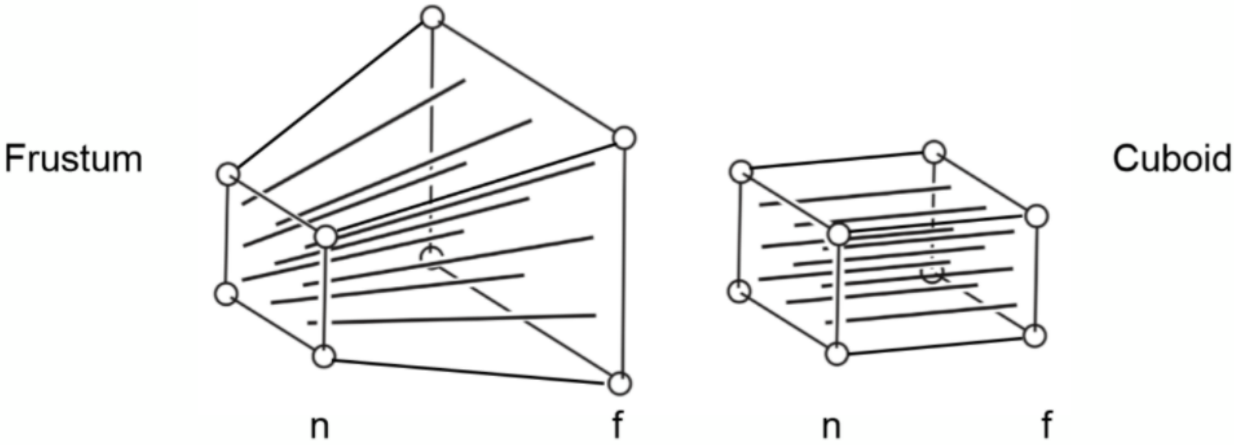
$$V = R_{view}T$$

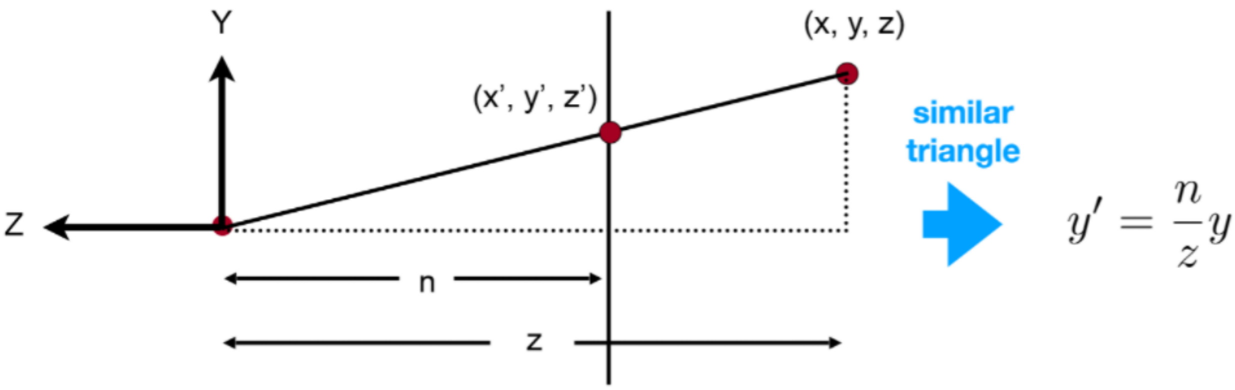
3.Projection Transformation

3.1 Orthographic Projection Transformation

$$M_{ortho} = \left[\frac{2}{r-l} \quad 0 \quad 0 \quad 0\, 0 \quad \frac{2}{t-b} \quad 0 \quad 0\, 0 \quad 0 \quad \frac{2}{n-f} \quad 0 \textcolor{red}{\backslash 0} \quad 0 \quad 0 \quad 1\right]\left[1 \quad 0 \quad 0 \quad -\frac{r+l}{2}\, 0 \quad 1 \quad 0 \quad -\frac{t+b}{2}\, 0 \quad 0 \quad 1 \quad -\frac{n+f}{2} \textcolor{red}{\backslash 0} \quad 0 \quad 0 \quad 1\right]$$

3.2 Perspective Projection Transformation





Now we can get the intial vector

$$M_{persp\to ortho}\left[\, x \; y \; z \; 1 \,\right] = \left[\, \frac{nx}{z} \; \frac{ny}{z} \; unknown \; 1 \,\right] == \left[\, nx \; ny \; unknown \; z \,\right]$$

Then we know that: 1.The coordinate on near plane will not change 2.The z on far plane will not change

Then we can know the intinal matrix:

$$M_{persp\to ortho} = [n \quad 0 \quad 0 \quad 0\,0 \quad n \quad 0 \quad 0\,0 \quad 0 \quad A \quad B\backslash 0 \quad 0 \quad 1 \quad 0]$$

An+B=n^2 Af+B=f^2

$$M_{persp\to ortho} = [n \quad 0 \quad 0 \quad 0\,0 \quad n \quad 0 \quad 0\,0 \quad 0 \quad n+f \quad -fn\backslash 0 \quad 0 \quad 1 \quad 0]$$