CMPEN 497 Week 2 Lab Hongshuo Wang Blender version: 2.83.10

(1)

1. rot $-45°$ in Z
2. rot $-30°$ in X
3. trans $(-15, -15, 12)$

$$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = \underbrace{\begin{bmatrix} 1 & 0 & 0 & -15 \\ 0 & 1 & 0 & -15 \\ 0 & 0 & 1 & 12 \\ 0 & 0 & 0 & 1 \end{bmatrix}}_{(3)} \cdot \underbrace{\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos(-30) & -\sin(-30) & 0 \\ 0 & \sin(-30) & \cos(-30) & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}}_{(2)} \cdot \underbrace{\begin{bmatrix} \cos(-45) & -\sin(-45) & 0 & 0 \\ \sin(-45) & \cos(-45) & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}}_{(1)} \cdot \begin{bmatrix} x \\ y \\ z \end{bmatrix}$$

(2)

1. XYZ scaling $(2, 1, 3)$ in X, Y and Z direction

or: double torus' size in X-axis
triple torus' size in Z-axis
keep torus' size in Y-axis

2. rotation about the Y-axis by $-45°$

3. XYZ Translation of $(5, -4, 2)$

or moving torus in 5 units in X-axis
-4 units in Y-axis
2 units in Z-axis

Transformation

$$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = \underbrace{\begin{bmatrix} 1 & 0 & 0 & 5 \\ 0 & 1 & 0 & -4 \\ 0 & 0 & 1 & 2 \\ 0 & 0 & 0 & 1 \end{bmatrix}}_{(3)} \cdot \underbrace{\begin{bmatrix} \cos(-45°) & 0 & \sin(-45°) & 0 \\ 0 & 1 & 0 & 0 \\ -\sin(-45°) & 0 & \cos(-45°) & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}}_{(2)} \cdot \underbrace{\begin{bmatrix} 2 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 3 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}}_{(1)} \begin{bmatrix} x \\ y \\ z \end{bmatrix}$$

③

1. rotation about X-axis by -60°
2. XYZ scale to (1.5, 3, 2)
3. XYZ translation of (-7, 0, 2)

④ ①. $\begin{pmatrix} \cos(30°) & -\sin(30°) & 0 & 0 \\ \sin(30°) & \cos(30°) & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$ rotation about Z-axis by 30°

② $\begin{pmatrix} 0.5 & 0 & 0 & 0 \\ 0 & 1.5 & 0 & 0 \\ 0 & 0 & 2 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$ XYZ scale to (0.5, 1.5, 2)

③ $\begin{pmatrix} 1 & 0 & 0 & 4 \\ 0 & 1 & 0 & 5 \\ 0 & 0 & 1 & -1 \\ 0 & 0 & 0 & 1 \end{pmatrix}$ XYZ translation of (4, 5, -1)

$$\begin{pmatrix} X \\ Y \\ Z \end{pmatrix} = \underbrace{\begin{pmatrix} 1 & 0 & 0 & 4 \\ 0 & 1 & 0 & 5 \\ 0 & 0 & 1 & -1 \\ 0 & 0 & 0 & 1 \end{pmatrix}}_{③} \cdot \underbrace{\begin{pmatrix} 0.5 & 0 & 0 & 0 \\ 0 & 1.5 & 0 & 0 \\ 0 & 0 & 2 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}}_{②} \cdot \underbrace{\begin{pmatrix} \cos(30°) & -\sin(30°) & 0 & 0 \\ \sin(30°) & \cos(30°) & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}}_{①} \begin{pmatrix} x \\ y \\ z \end{pmatrix}$$