

**Homework Assignment #1**  
**EECS 487**  
**Fall 2003**

Due: September 29th 2003

DO NOT use any electronic devices to do Problem 1.

SHOW ALL YOUR WORK!!

**Problem #1.**

Find the Composite Rotation Matrix given the rotation order: (Just the equations!)

$$[R] = [Yaw][Pitch][Roll]$$

$$\begin{bmatrix} x''' \\ y''' \\ z''' \\ 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos q & -\sin q & 0 \\ 0 & \sin q & \cos q & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \cos f & 0 & \sin f & 0 \\ 0 & 1 & 0 & 0 \\ -\sin f & 0 & \cos f & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \cos l & -\sin l & 0 & 0 \\ \sin l & \cos l & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

Show your work!

**Problem #2.**

If you are given a 4 x 4 Matrix that looks like:

$$\begin{bmatrix} x''' \\ y''' \\ z''' \\ 1 \end{bmatrix} = \begin{bmatrix} \cos I & -\sin I & 0 & \Delta x \\ \sin I & \cos I & 0 & \Delta y \\ 0 & 0 & 1 & \Delta z \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

And we know that this is a composite matrix of Translation and Rotation and order is important.

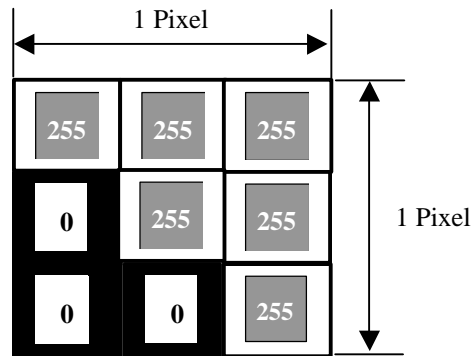
$$R = \begin{bmatrix} \cos I & -\sin I & 0 & 0 \\ \sin I & \cos I & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \qquad T = \begin{bmatrix} 1 & 0 & 0 & \Delta x \\ 0 & 1 & 0 & \Delta y \\ 0 & 0 & 1 & \Delta z \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

- a. What is the order that the Translation and Rotation get multiplied to get this composite Matrix?

- b. What does this tell you about what transform happens First in a Composite Matrix?

**Problem #3.**

1. Given the following sub-sampled pixel,



a) What is the pixel value if an un-weighted filter is used?

b) What is the pixel value with the following weighted filter?

1	2	3
1	2	3
1	2	3