

Homework due – Wednesday, January 16, 2008

1. #2 (a,b,e,f), page 21 in the course notes.
2. #6, page 22 in the course notes.
3. #11, page 25 in the course notes.
4. In the previous exercise (#11 from chapter 1 of the course notes), we utilized rotation matrices in two dimensions. Now, we see the speed of matrix operations in a computer graphics model in three dimensions. In Figure 1, we see a model of Yoda. The tessellation uses 33,862 vertices. Suppose V is a matrix with three columns where row i contains the x , y and z coordinate of the i th vertex in the model. The image can be translated by t units in the y direction by using a translation matrix T where

$$T = \begin{pmatrix} 0 & t & 0 \\ 0 & t & 0 \\ \vdots & \vdots & \vdots \\ 0 & t & 0 \end{pmatrix}.$$

In particular, if $V_t = V + T$ then V_t contains the vertex information of the model after a translation of t units in the y -direction.



Figure 1: A model of Yoda created with 33,862 vertices. Model created by Kecskemeti B. Zoltan. ©Lucasfilm Ltd & TM. All Rights Reserved. Digital Work by Industrial Light & Magic.

Download the files `yoda.m` and `yodapose_low.mat` from the web page for this course. Run the file `yoda.m` in MATLAB. You will see an animation of the model being translated using matrix addition.

- (a) The image can be rotated by θ degrees about the y -axis by multiplying V by R_y where

$$R_y = \begin{pmatrix} \cos \theta & 0 & -\sin \theta \\ 0 & 1 & 0 \\ \sin \theta & 0 & \cos \theta \end{pmatrix}.$$

Edit the code to continuously rotate the image by $\pi/24$ radians until the image has rotated one full rotation about the y axis. Turn in your edited code and a plot of Yoda in one or two different positions.

- (b) The matrix containing the vertices is a $33,862 \times 3$ matrix. How many multiplications are performed when you use matrix multiplication (with R_θ) to rotate the image once by $\pi/24$ radians? Of special note, keep this in mind as you watch how fast MATLAB performs the calculations and displays the results.