Sample Test 2b: 3D Transformations and Light

March 29, 2023

- State any simple, reasonable assumption used to arrive at your answer.

- A 'yes' or 'no' answer without reasoning is worth 0 points.
- Zero points if the writing is hard to decipher. Use a black pen if in doubt.
- Indicate with arrow if you use the back of the previous page (last page for page 1).

1 Quaternion rotation and perspective

a. (2 points)

Give the quaternion operation for rotating the point [x,y,z,2] by an angle $\alpha = 2\pi/6$ about the *x*-axis.

$$\begin{aligned} \|\hat{q}\| &= c^{2} + s^{2} + 0^{2} + o^{2} = 1 \\ \hat{q}\| &= (c_{1} - s(1 \circ 0)) \\ \hat{q}\|^{-1} &= (c_{1} - s(1 \circ 0)) \\ \hat{q}\|^{-1} &\bigcirc \begin{pmatrix} 0 \\ x_{k} \\ y_{k} \\ b_{k} \end{pmatrix} & \hat{q}\| &= \begin{pmatrix} c_{1} \\ -s \\ 0 \\ y_{k} \\ b_{k} \end{pmatrix} & \hat{q}\| &= \begin{pmatrix} c_{1} \\ -s \\ 0 \\ y_{k} \\ b_{k} \end{pmatrix} & \hat{q}\| &= \begin{pmatrix} c_{1} \\ -s \\ 0 \\ y_{k} \\ b_{k} \end{pmatrix} & \hat{q}\| & \hat{q}\| & \hat{q}\| & \hat{q}\| & \hat{q}\| \\ \hat{q}\| &= \begin{pmatrix} c_{1} \\ -s \\ 0 \\ y_{k} \\ b_{k} \end{pmatrix} & \hat{q}\| & \hat{q}\| & \hat{q}\| & \hat{q}\| & \hat{q}\| \\ \hat{q}\| &= \begin{pmatrix} c_{1} \\ -s \\ 0 \\ y_{k} \\ b_{k} \end{pmatrix} & \hat{q}\| & \hat{q}\| & \hat{q}\| & \hat{q}\| \\ \hat{q}\| &= \begin{pmatrix} c_{1} \\ -s \\ 0 \\ y_{k} \\ b_{k} \end{pmatrix} & \hat{q}\| & \hat{q}\| & \hat{q}\| & \hat{q}\| \\ \hat{q}\| & \hat{q}\| & \hat{q}\| & \hat{q}\| & \hat{q}\| & \hat{q}\| \\ \hat{q}\| & \hat{q}\| & \hat{q}\| & \hat{q}\| & \hat{q}\| & \hat{q}\| \\ \hat{q}\| & \hat{q}\| \\ \hat{q}\| & \hat$$

2 Lighting

(4 points) Given is a white diffuse light source at (0, 20, 0, 1), and a unit cube $(\pm 1, \pm 1, \pm 1)$ with vertex normals computed as the <u>average of the surrounding face normals</u>. The scene contains no ambient light (neither from the lighting model nor from the light) and there is <u>no autenuation</u>. Use Gouraud shading. Determine the rgb light intensity at the point (0, 1, 0) of the cube. Why is this lighting model unsatisfactory?

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