

Compsci.373 Tutorial 3

COLOR AND ILLUMINATION

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1. Revision

- a) Given $A = \begin{pmatrix} 1 \\ 2 \\ 1 \end{pmatrix}$, $B = \begin{pmatrix} \sqrt{3} + 1 \\ 3 \\ 1 \end{pmatrix}$ and $C = \begin{pmatrix} \sqrt{3} + 1 \\ 2 \\ 1 \end{pmatrix}$. Find the angle between vector **AB** and vector **AC**.
- b) Find the volume of the parallelepiped consisting of vectors $u = \begin{pmatrix} 3 \\ 2 \\ 1 \end{pmatrix}$, $v = \begin{pmatrix} -1 \\ 3 \\ 0 \end{pmatrix}$ and $w = \begin{pmatrix} 2 \\ 2 \\ 5 \end{pmatrix}$.
- c) Write down the general transforms in 2D for:
- I. Reflection across the x-axis
 - II. Shearing
 - III. Rotation about angle Θ
 - IV. Translation

2. Colour Representation

- a) How is colour typically represented for an image within a computer?
- b) With reference to the RGB colour-space, what significance do the RGB primaries have?
- c) How does the tristimulus theory explain metamers (colours that have different light spectra, but are perceptually indistinguishable for humans)?
- d) Name two problems associated with RGB colour-space.
- e) Given the two above problems – why do you think RGB colour-space is still widely used?

3. Spectral Properties

- a) What is a spectral power distribution?
- b) What is the dominant light interaction type (absorption, transmission, reflection) associated with the following material types:
 - i. An opaque coloured surface
 - ii. A perfect black surface
 - iii. A perfect mirror
 - iv. A perfectly transparent surface
- c) What is the difference between reflection and refraction?

4. Colour Spaces

- a) How do we convert between RGB colour space and XYZ colour space?
- b) What advantages does the XYZ colour space have over the RGB colour space?
- c) If we want to perform linear interpolation with regards to saturation and lightness of a colour represented in RGB colour space, how can we achieve this?

5. Illumination

- a) What is the difference between the Phong reflection model and the Phong shading model?
- b) Which components of the Phong reflection model are sensitive to lighting attenuation?
- c) Phong shading is slower than the other shading models presented in your notes. Why is this not as much of an issue as it was before?
- d) Which component of the Phong reflection model is sensitive to the angle between the viewer and the object?
- e) Which component of the Phong reflection model is sensitive to the angle between the light source and the object?