Graphics 2 Matlab exercise classes

Exercise 5: Surface shading

1. (Pen and paper exercise)

   A surface is of a uniform red colour, defined by the RGB vector [1 0 0].

   Given two vertices

   – V1 = [-80 00 58]

   – V2 = [-65 -47 58]

   their vertex normals

   – N1 = [-0.8083 -0.0421 0.5873]

   – N2 = [-0.6545 -0.4755 0.5878]

   and a vector specifying the direction of light

   – [-0.34 -2.20 2.80]

   compute the colours (RGB vectors) of the 10 points lying on the line joining the

   two vertices V1 and V2 using

   – Gouraud shading

   – Phong shading

   Assume white light colour, diffuse light coefficient of 1.0, specular reflection coefficient of zero and no ambient light.

2. Experiment with Matlab code given in `ex5_shading.m` by selecting different patches on the surface and observing the difference between the Gouraud and Phong shading.

3. Extend the code in `ex5_shading.m` to compute the shading values for the *complete* patch (at present the code computes shading only for one edge of the patch). Consult the lecture notes for guidance.

Hints

- A generic form of a parametric (linear) equation for the given two data points P1 and P2 is:

  $P(u) = P1 + u * (P2 - P1); \quad 0 \le u \le 1$

- Computing cos of the angle between two vectors (**a** and **b**):

$$\cos \varphi = \frac{a_x \cdot b_x + a_y \cdot b_y + a_z \cdot b_z}{|\bar{\mathbf{a}}| \cdot |\bar{\mathbf{b}}|}$$

  (see “Mathematical tools for computer graphics” at the module web page).

- Matlab function for computing the dot product is `dot`, for the cross product is `cross`

- Length of a vector **a** , | **a** |, can be computed using this Matlab expression:

```
sqrt(sum(a.^2));
```

(square root of the sum of the squared components of the vector a, e.g. for a three-dimensional vector **a** = [a_x a_y a_z], | **a** | = sqrt($a_x^2 + a_y^2 + a_z^2$))