HOMEWORK ASSIGNMENT 9 (THEORY)

CO19-320322: COMPUTER GRAPHICS
320322: GRAPHICS AND VISUALIZATION

Fall 2016

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Due: Friday, November 25, 2016, at 8pm.

Problem 9: Shading and Illumination *(6+4+5=15 points)* Given a triangle fan with vertices $\mathbf{v}_1 = (0, 4, 2)$, $\mathbf{v}_2 = (0, 0, 2)$, $\mathbf{v}_3 = (4, 0, 2)$, and $\mathbf{v}_4 = (5, 5, 2)$ in 3D Cartesian coordinates. In the same coordinate system, we define a view point $\mathbf{p} = (0, 0, -10)$, the screen by the quadrilateral $\mathbf{v}_1 = (-2, -2, 0)$, $\mathbf{v}_2 = (2, -2, 0)$, $\mathbf{v}_3 = (2, 2, 0)$, and $\mathbf{v}_4 = (-2, 2, 0)$. The resolution of the screen shall be 2×2 pixels. The triangles have ambient reflectance coefficient $(\frac{1}{3}, \frac{1}{3}, \frac{1}{3})$, diffuse reflectance coefficient $(0, \frac{1}{3}, \frac{2}{3})$, specular reflectance coefficient $(0, 0, 0)$, and specular exponent 42. Finally, we have the light source with full-intensity white light (all components) at location $\mathbf{l} = (5, 5, 1)$. Light attenuation shall follow the function $f(r) = \frac{1}{r}$. Note that the geometric constellations here are identical to those in Problem 3.

(a) *Local Illumination.* Apply the Phong illumination model to the vertices of the triangles.

(b) *Shading.* Assuming a ray casting approach, compute the color at the ray-triangle intersection points (have been computed in Problem 3) by applying Gouraud shading to the RGB colors computed in Part (a).

(c) *Photon Mapping.* Assume that we replace the diffuse and ambient color computed in Part (b) with a photon mapping approach. Assume a fully opaque surface and consider the diffuse reflection coefficients listed above for the stochastic process. Assume that, for each of the color channels, ten white light rays reach the surface from a certain direction (we do not consider attenuation). Rolling a dice shall simulate the computation of random numbers (explain how exactly!). Roll the dice ten times and report back the numbers. Then, apply the respective random numbers to all color channels simultaneously to compute the light that leaves the surface (when assuming a perfectly diffuse surface).

Remarks: The theoretical assignments have to be submitted in paper form into the box labeled “Linsen” in the Research I entrance hall. In case the theoretical part is typed (e.g., using LaTeX), the generated PDF-file can also be uploaded to jGrader.