1 Model based visualization of paper

Model based visualization of paper is done by generating a picture of paper using illumination models introduced by Phong /4/ or Blinn /1/. Both illumination models divide the reflection to ambient, diffuse and specular part. The ambient part of the models is linear combination of diffuse an specular reflection. Illumination models are different in the specular reflection term. In illumination model introduced Blinn the specular reflection is assumed to be composed of a collection of mirror like micro facets. The Phong illumination model is written in following form

$$I = p_a I_A + I_L[p_d(\boldsymbol{N} \bullet \boldsymbol{L}) + p_s(\boldsymbol{R} \bullet \boldsymbol{V})^n] \quad \textbf{(1)}$$

and Blinn

$$I = p_a I_A + I_L\left[p_d(\boldsymbol{N} \bullet \boldsymbol{L}) + p_s \frac{DGF}{\boldsymbol{N} \bullet \boldsymbol{V}}\right] \quad \textbf{(2)}$$

where

I is reflected light,

I_A is ambient light reaching the surface,

I_L is direct light from light source,

p_a, p_d, p_s are material dependent coefficients for ambient diffuse and specular ligth,

N is surface normal,

L is light source direction,

V is viewing direction,

n is power in Phong model which tells the ,

D is distribution of micro facets,

F is fresnel reflection law and

G is the amount in by which the facets shadow and mask each other.

The viewing direction V and the light direction are constants in picture generation.

Paper model is based on the roughness profile. The roughness profile is stored in a matrix. The surface normal is calculated according to the roughness matrix /3/. Color information of paper is stored in three illumination model coefficients. The coefficient are vectors which contains color information of paper over the whole visible spectrum. When the reflected spectrum is calculated the result is converted to RGB coordinates /2/.

The result picture is calculated one pixel at a time and saved to a RGB file.

Literature References

/1/ Blinn, J. F. *Models of Light Reflection for Computer Synthesized Pictures.* SIGGRAPH 1977 Proceedings, Computer Graphics vol. 11, no. 2 (1977), 192-198

/2/ Hall, R., *Illumination and Color in Computer Generated Imagery.* Springer-Verlag, New York, 1989

/3/ Lönnberg, O. , *Modelbased Visualizing of Printed Matter on Computer Screen.* Helsinki University of Technology, Graphic Arts Laboratory. M. Sc. Thesis 1994.

/4/ Phong B. T. *Illumination for Computer Generated Pictures.* Communications of the ACM vol. 18, no. 6 (June 1975), 311-317