

Lighting

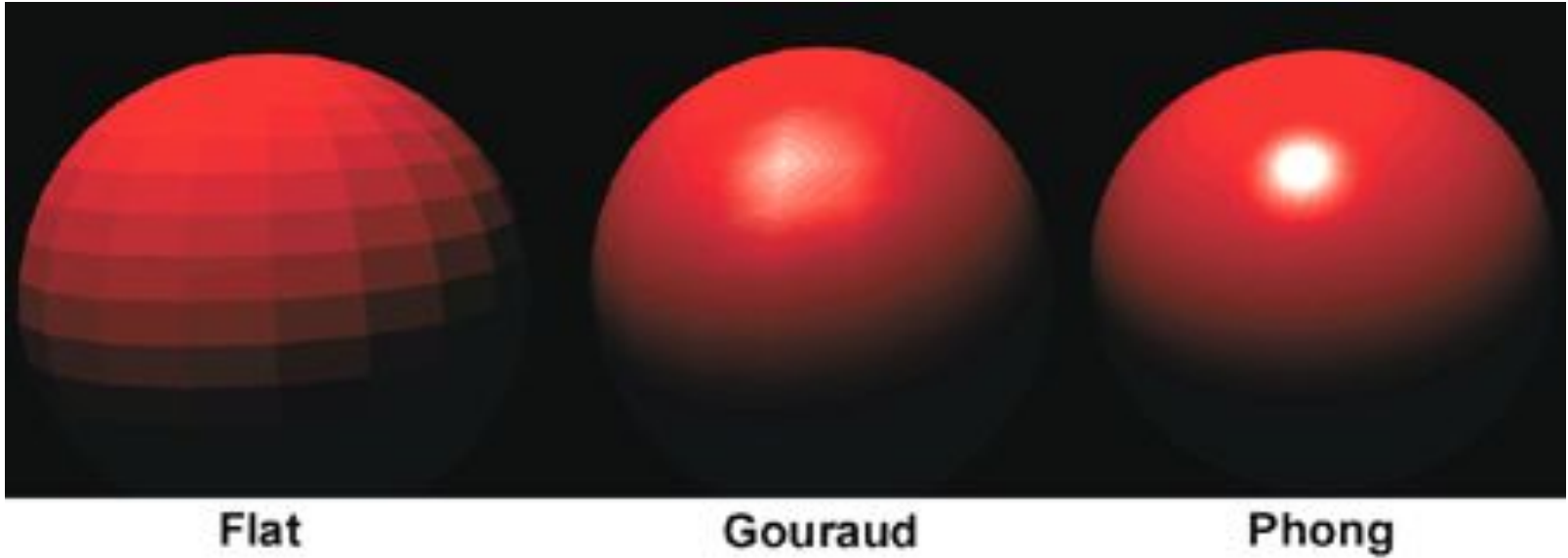
Video Game Graphics AD-011

Lighting models

Lighting models are methods/algorithms used to determine the light reflected by surface of a model. There are many varying methods of computing lighting with shaders. Artists and programmers choose them depending on the level of realism/stylization/performance implications of the model.

All lighting models are approximations of real world light physics. Some are empirical (based on observations), while others are mathematical (based on calculations).

Shading interpolation



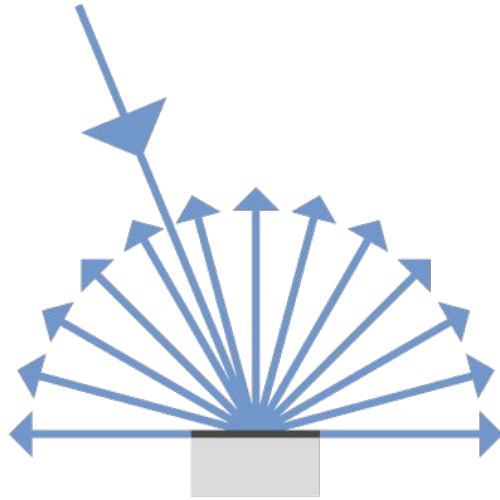
Henri Gouraud

French computer scientist (born 1944)

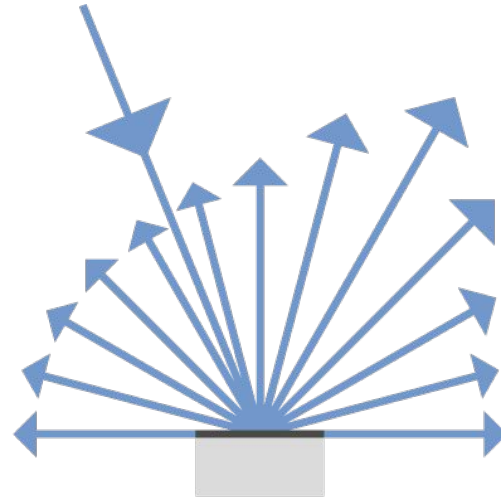
Inventor of **Gouraud Shading** - the method of linear interpolation between light reflection color calculated for vertex points.



Lambertian light reflection



Ideal diffuse reflection
(Lambertian surface)



Diffuse reflection with
directional component

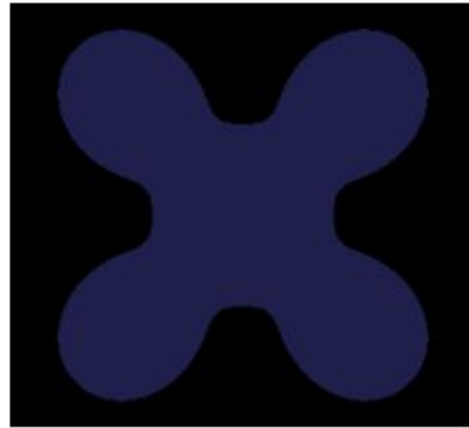
Johann Heinrich Lambert

Swiss mathematician (1728–1777)

Mathematically described ideal diffuse reflection of perfectly matte surfaces, widely named **Lambertian reflection**

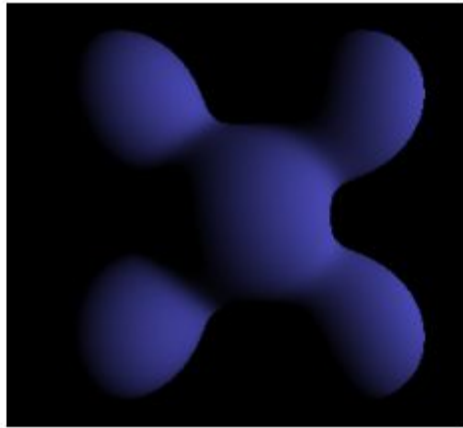


Phong reflection model



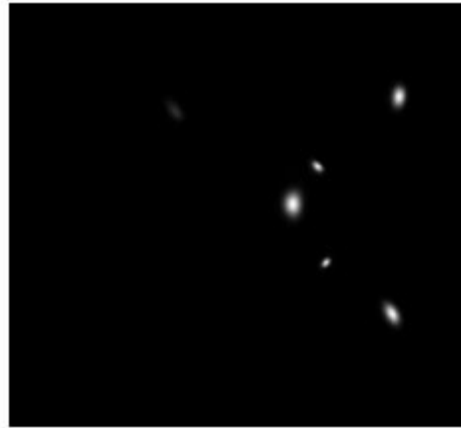
Ambient

+



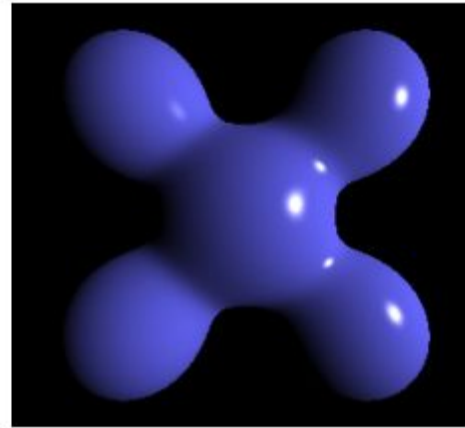
Diffuse

+



Specular

=



Phong Reflection

Bui Tuong Phong

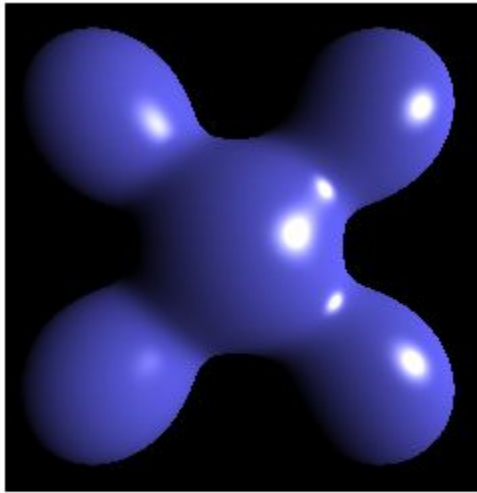
Vietnamese computer scientist (1942 - 1975)

Inventor of **Phong Shading** - method of per-pixel calculation of light reflection using interpolated normals.

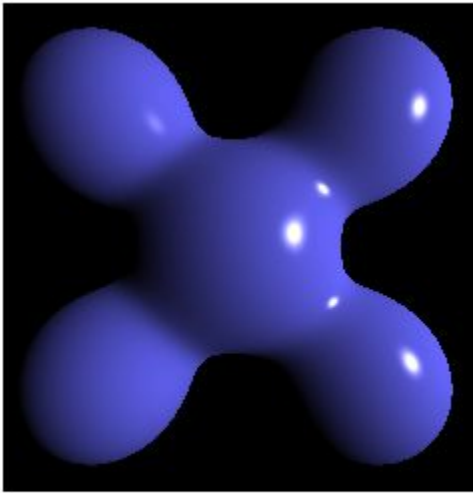
Inventor of **Phong reflection model** - 3D computer graphics lighting model consisting of 3 components: ambient, diffuse and specular highlight.



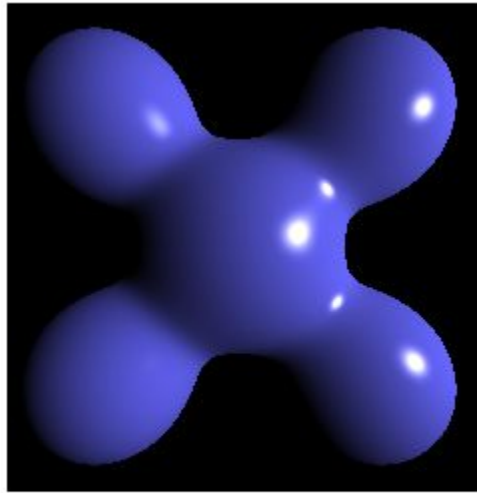
Blinn-Phong reflection model



Blinn-Phong



Phong



Blinn-Phong
(higher exponent)

Jim Blinn

American computer scientist (born 1949)

Improved Phong's reflection model which became a default fixed-function pipelines of OpenGL and DirectX, named **Blinn-Phong reflection model**



Physically Based Rendering (PBR)

Is a concept of developing modern shading models and rendering pipelines using more accurate physical properties of light and surfaces.

PBR models usually take into account

- Fresnel effect
- Subsurface scattering
- Light bounces
- Ambient occlusion
- Refraction
- Gamma correction