Maharaja Agrasen Institute of Technology
ETCS 211
Computer Graphics & Multimedia
UNIT 2

ILLUMINATION MODEL

What is illumination model?

Simplified and fast methods for calculating surfaces intensities, mostly empirical

• Calculations are based on optical properties of surfaces and the lighting conditions (no reflected sources nor shadows)

• Light sources are considered to be point sources

• Reasonably good approximation for most scenes.

What is illumination model?

Illumination model, also known as Shading model or Lightning model, is used to calculate the intensity of light that is reflected at a given point on surface.

There are three factors on which lightning effect depends on:

1.Light Source :
Light source is the light emitting source. There are three types of light sources:

Point Sources – The source that emit rays in all directions (A bulb in a room).

Parallel Sources – Can be considered as a point source which is far from the surface (The sun).

Distributed Sources – Rays originate from a finite area (A tube light). Their position, electromagnetic spectrum and shape determine the lightning effect.

What is illumination model?

There are three factors on which lightning effect depends on:

2.Surface :
When light falls on a surface part of it is reflected and part of it is absorbed. Now the surface structure decides the amount of reflection and absorption of light. The position of the surface and positions of all the nearby surfaces also determine the lightning effect.

3.Observer :
The observer's position and sensor spectrum sensitivities also affect the lightning effect.

Types of illumination model

1.Ambient Illumination :

Ambient Illumination is the one where source of light is indirect. Example: Assume you are standing on a road, facing a building with glass exterior and sun rays are falling on that building reflecting back from it and the falling on the object under observation.

The reflected intensity I_{amb} of any point on the surface is:

$$I_{amb} = K_a I_a$$

Where, I_a : ambient light intensity
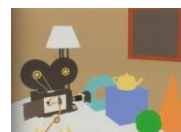K_a : surface ambient reflectivity, value of K_a varies from 0 to 1

Types of illumination model

1.Ambient Illumination :

The amount of ambient light incident on each object is constant for all surfaces and

over all directions.

Types of illumination model

2.Diffuse Reflection :
Diffuse reflection occurs on the surfaces which are rough or grainy. In this reflection the brightness of a point depends upon the angle made by the light source and the surface.

The reflected intensity I_{diff} of a point on the surface is:

$$I_{diff} = K_d\,I_p\,\cos(\theta) = K_d\,I_p(N \cdot L)$$

Where, I_p : the point light intensity
K_d : the surface diffuse reflectivity, value of K_d varies from 0 to 1
N : the surface normal
L : the light direction

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Types of illumination model

Diffuse Reflection :

Diffuse surfaces are rough or grainy, like clay, soil, fabric
• The surface appears equally bright from all viewing directions
• The brightness at each point is proportional to $\cos(\theta)$

Brightness is proportional to $\cos(\theta)$ because a surface which is perpendicular to the light direction is more illuminated than a surface which is at an oblique angle

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Types of illumination model

3.Specular Reflection :

when light falls on any shiny or glossy surface most of it is reflected back, such reflection is known as Specular Reflection.

Phong Model is an empirical model for Specular Reflection which provides us with the formula for calculation the reflected intensity I_{spec}:

$$I_{spec} = W(\theta)\,I_l\,\cos^n(\Phi)$$

where, $W(\theta) : K_s$
L : direction of light source
N : normal to the surface
R : direction of reflected ray
V : direction of observer
Θ : Angle between L and R
Φ : angle between R and V

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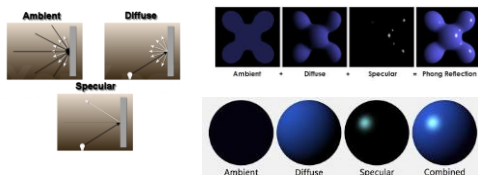## Types of illumination model

3.Specular Reflection :

Models shiny and glossy surfaces (like metal,plastic, etc..) with **highlights**

• Reflectance intensity changes with reflected angle

• An ideal specular surface (mirror) reflects light exclusively in one direction: **R**

• Glossy objects are not ideal mirrors and reflect in the immediate vicinity of *R*

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Types of illumination model

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