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EECS 101

HW 7

Note that this is the same as the problem on the practice exam. Assume that we have a Lambertian polyhedron illuminated by a collimated source at the same position as the viewer.

a) What is the reflectance map R(p, q) for this case?

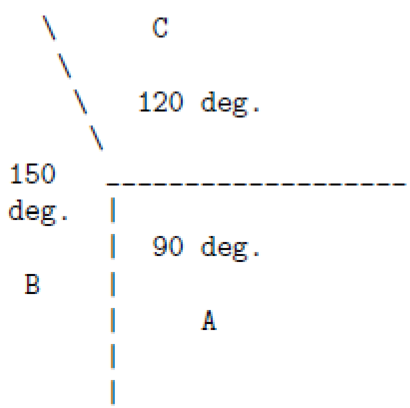
$$p = \frac{\partial z}{\partial x} \quad , \quad q = \frac{\partial z}{\partial y}$$

$$p_s = \frac{\partial z}{\partial x} \quad , \quad q_s = \frac{\partial z}{\partial y}$$

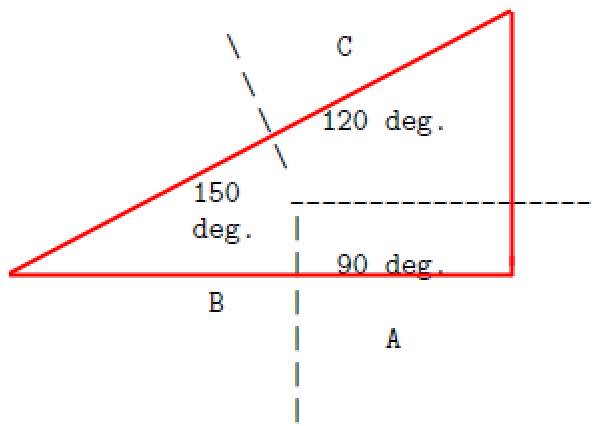
$$R(p, q) = \frac{p p_s + q q_s + 1}{\sqrt{p^2 + q^2 + 1}\sqrt{{p_s}^2 + {q_s}^2 + 1}}$$

$$R(p, q) = \frac{1}{\sqrt{p^2 + q^2 + 1}}$$

Suppose that from an image we have recovered the edges below corresponding to a place in space where 3 planes meet. The angles correspond to angles in the image.



b) Draw a diagram in gradient space with points corresponding to the gradient of each plane and their relationship. Assume orthographic projection.



c) Suppose that our imaging system is calibrated so that measured image irradiance equals the corresponding value in the reflectance map (E(x, y) = R(p, q)). If we measure image irradiance values of 1.0 for plane A and $\frac{1}{\sqrt{5}}$ for plane B, then determine the irradiance of plane C and the orientation (p, q) for each plane.

$A = 1.0 = \frac{1}{\sqrt{p^2+q^2+1}}$

$\sqrt{p^2 + q^2 + 1} = 1$

$p^2 + q^2 + 1 = 1$

$p^2 + q^2 = 0$

Theta = acos(1) = 0

(0, 0, 1)

$B = \frac{1}{\sqrt{5}} = \frac{1}{\sqrt{p^2+q^2+1}}$

$\sqrt{p^2 + q^2 + 1} = \sqrt{5}$

$p^2 + q^2 + 1 = 5$

$p^2 + q^2 = 4$

theta = acos(1/sqrt(5)) = 1.107

(-0.447, -0.894, 1)

Explain the effect of each of the four variables: S, m, a, and r

S: effects the direction of the light source

m: effects the surface roughness, lower it is the less the specular reflectance, the greater it is the greater the specular reflectance

a: determines what percent of scene radiance L is determined by Lambertian reflectance Ll and specular reflectance Ls; when a = 1 L is based solely on Ll; when a = 0 L is based solely on Ls

r: changes the radius of the sphere

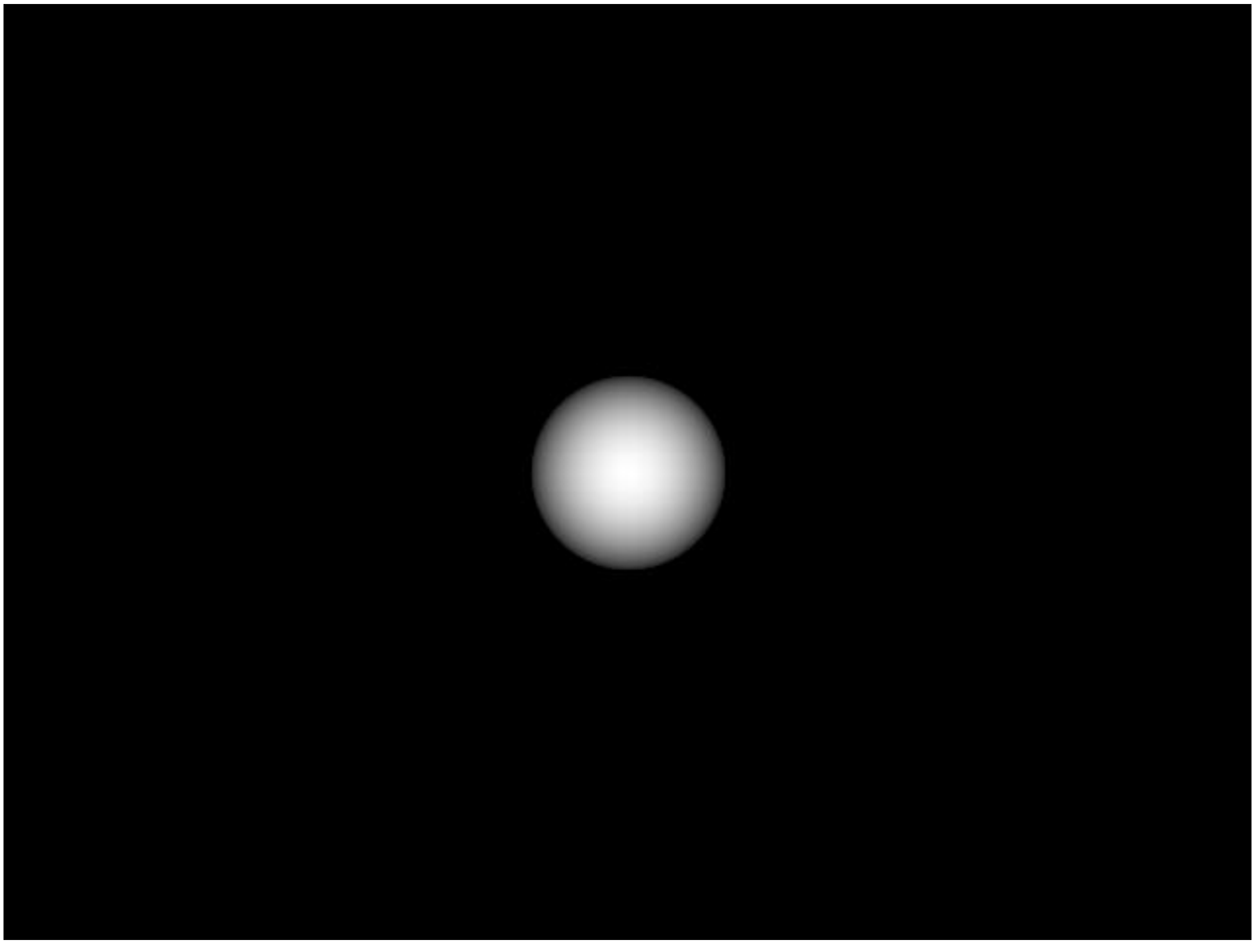


Image A: S=[0,0,1], r=50, a=0.5, m=1

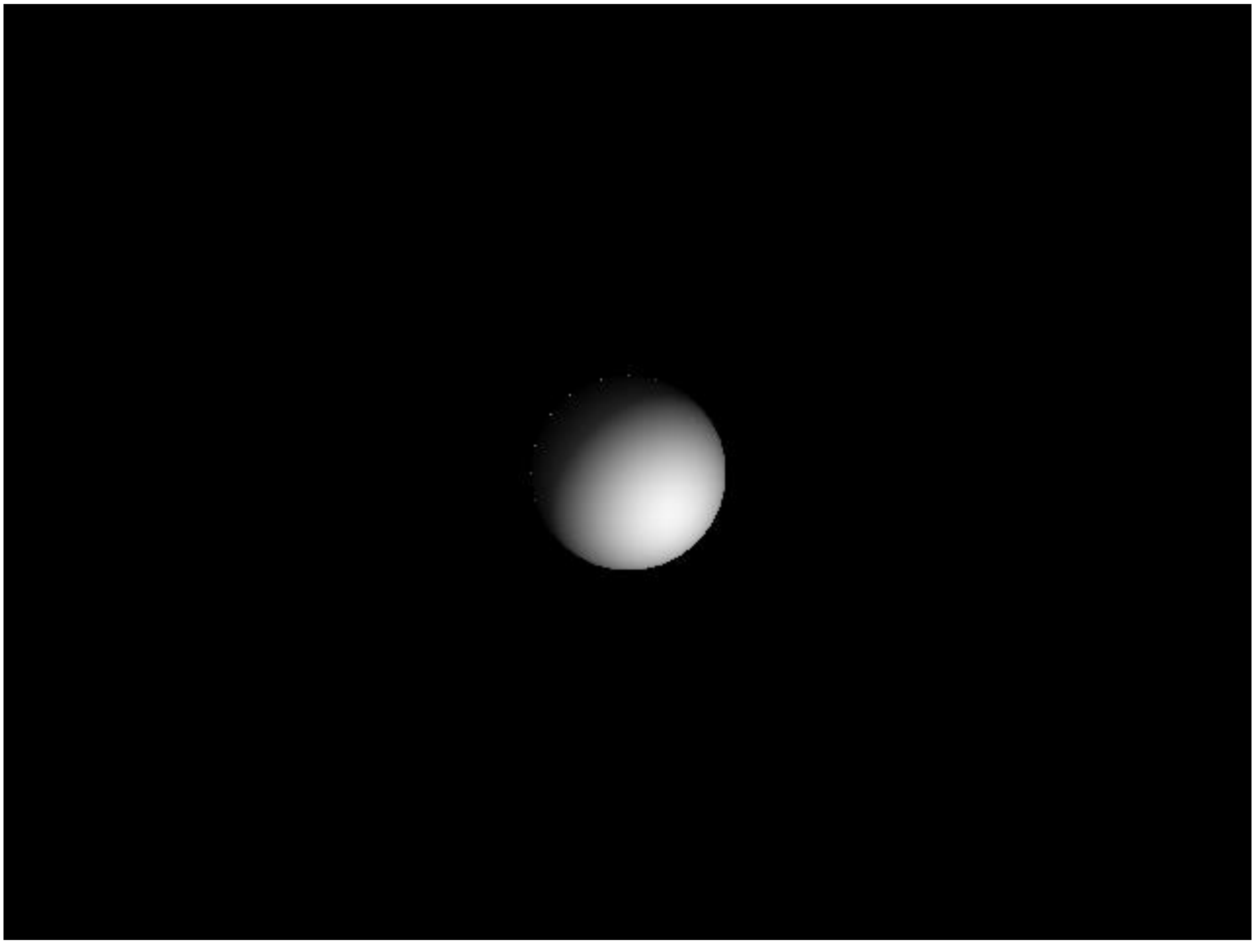


Image B: S=[1/√3,1/√3,1/√3],r=50,a=0.5,m=1

Image C: S=[1,0,0],r=50,a=0.5,m=1

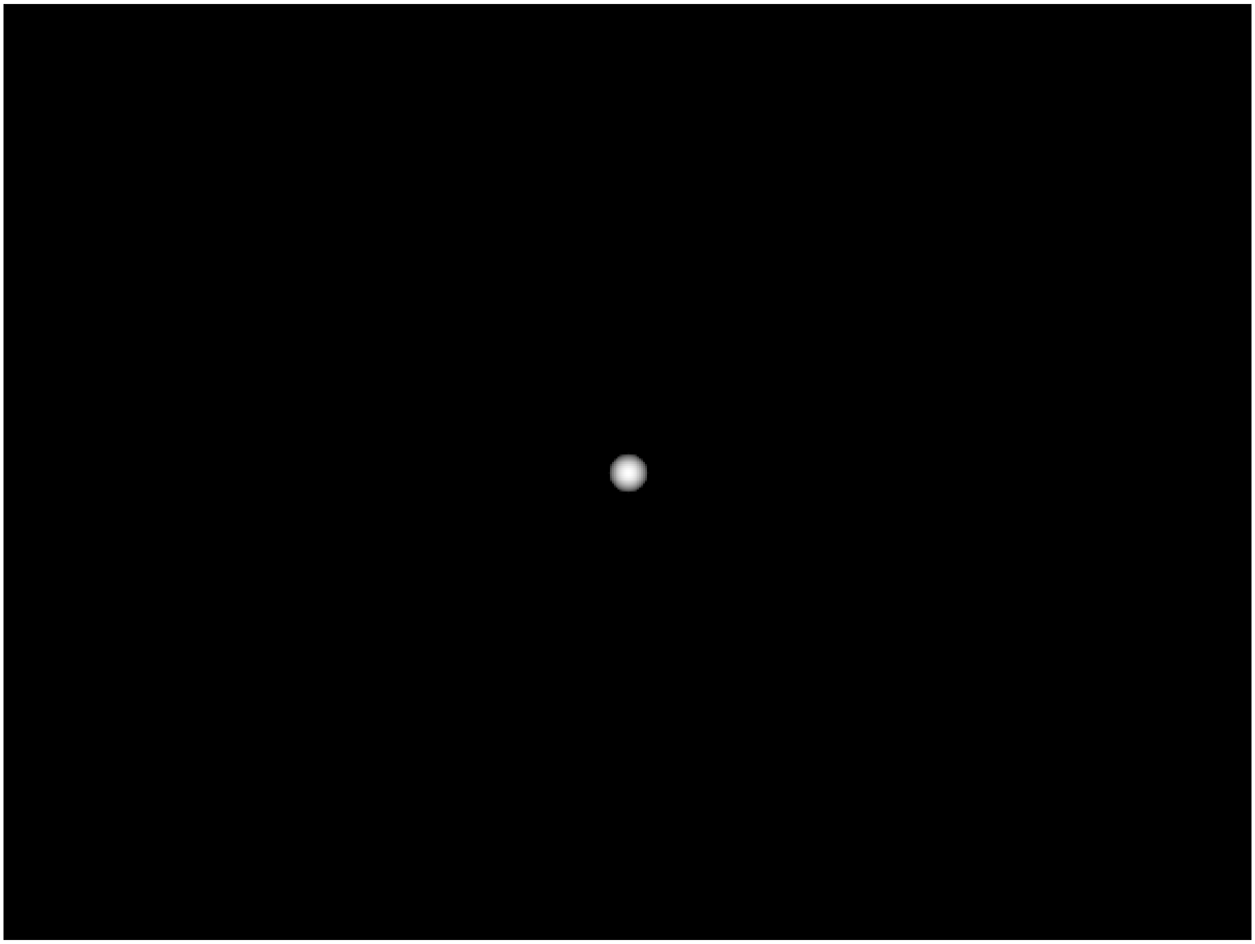


Image D: S=[0,0,1],r=10,a=0.5,m=1

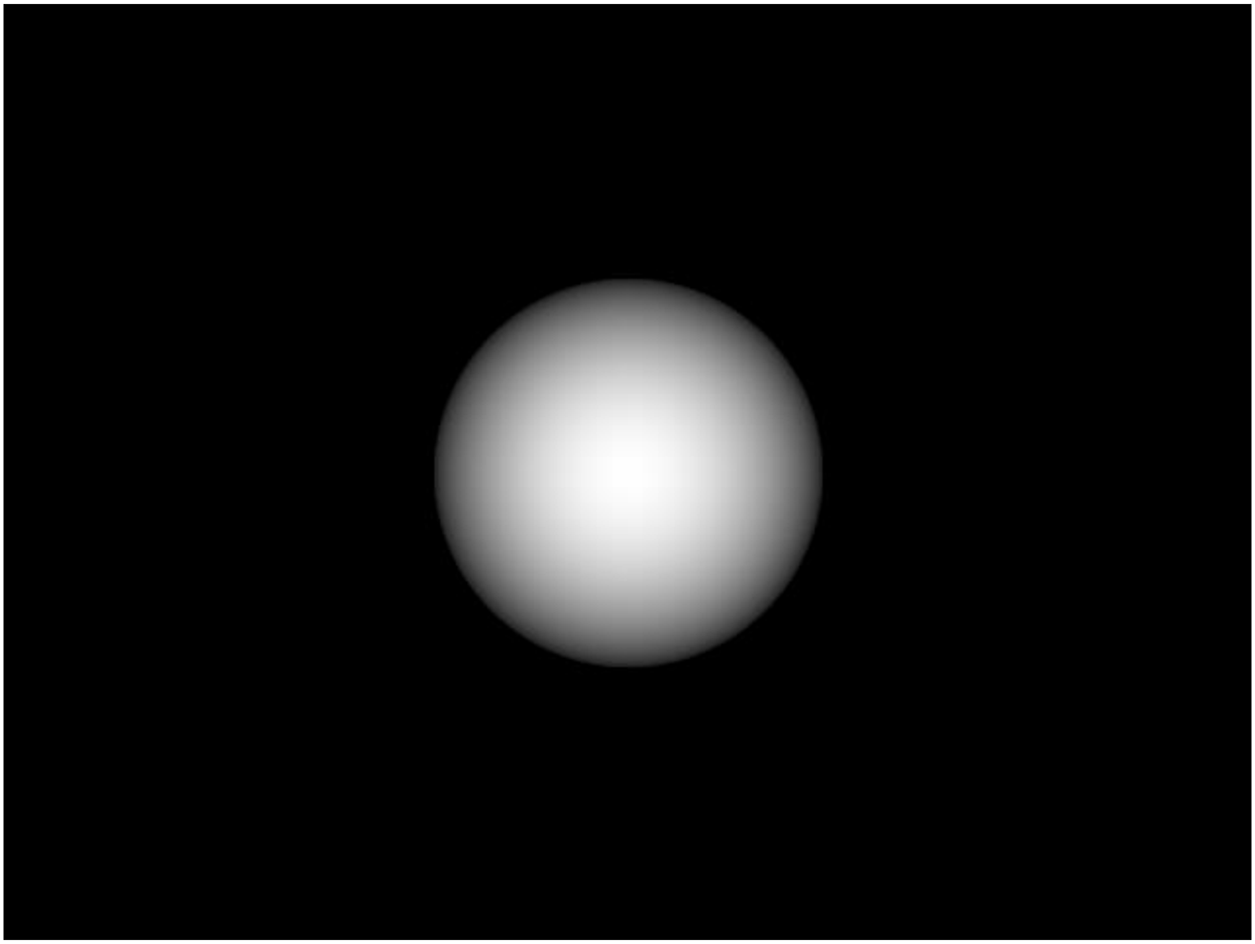


Image E: S=[0,0,1],r=100,a=0.5,m=1

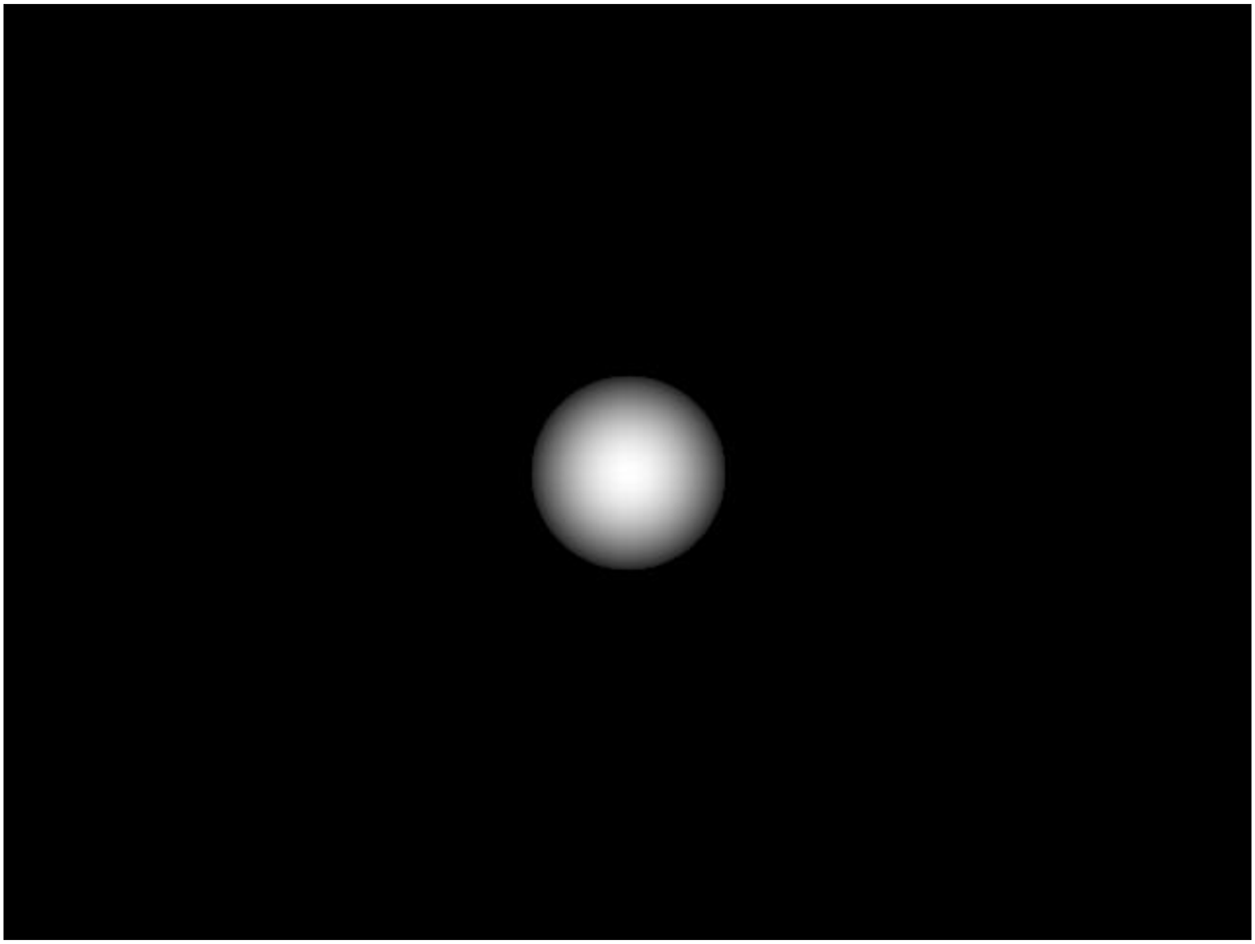


Image F: S=[0,0,1],r=50,a=0.1,m=1

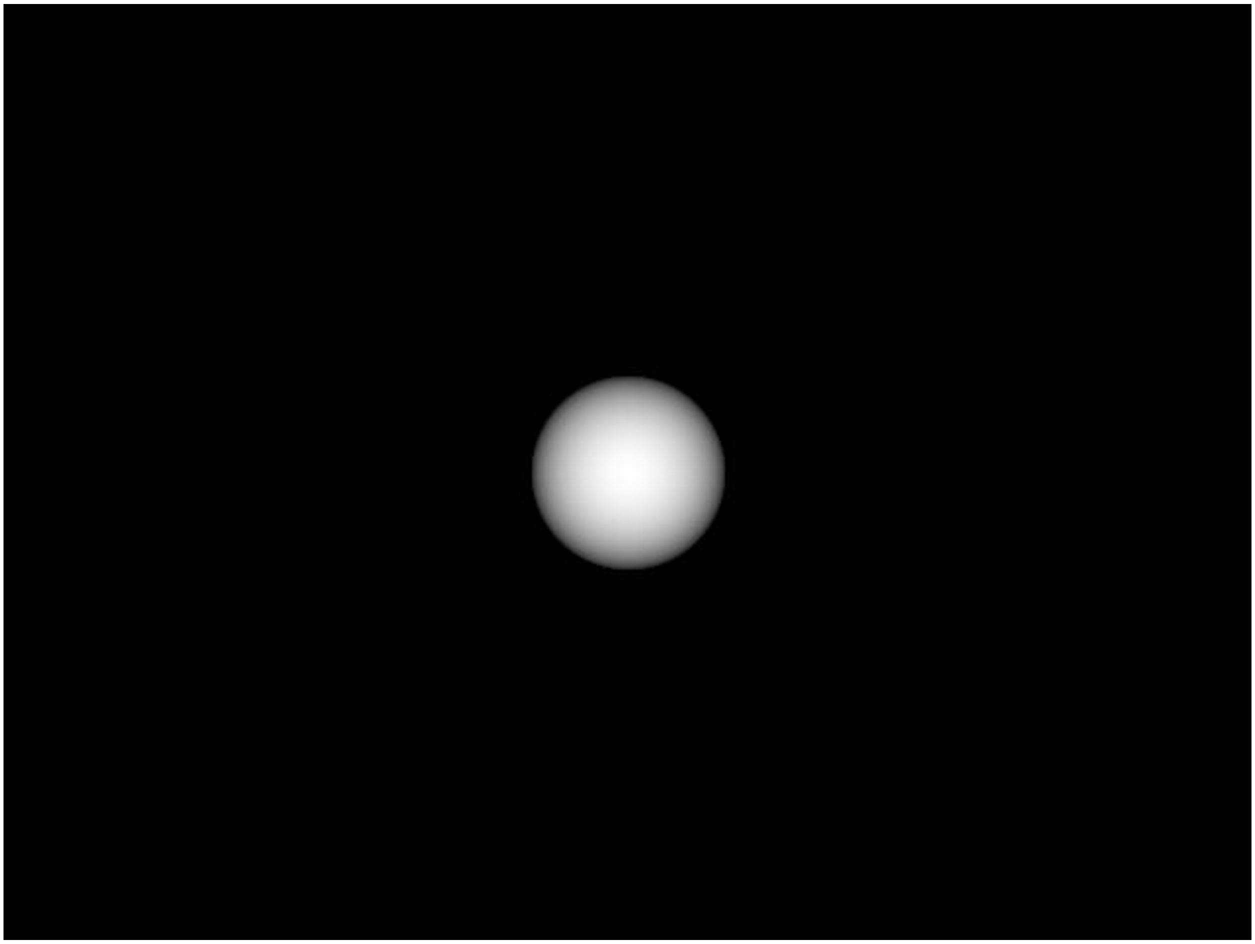


Image G: S=[0,0,1],r=50,a=1,m=1

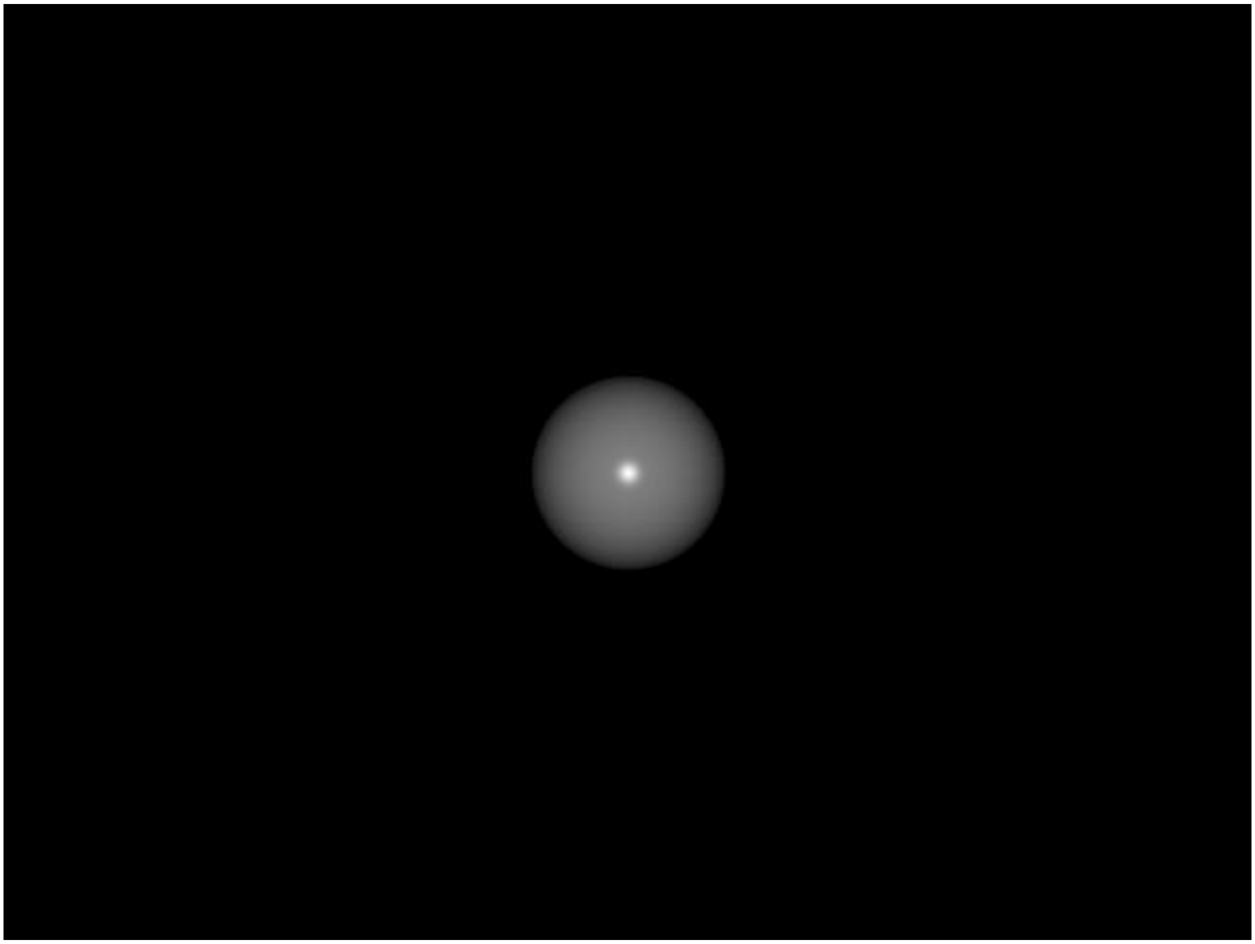


Image H: S=[0,0,1],r=50,a=0.5,m=0.1

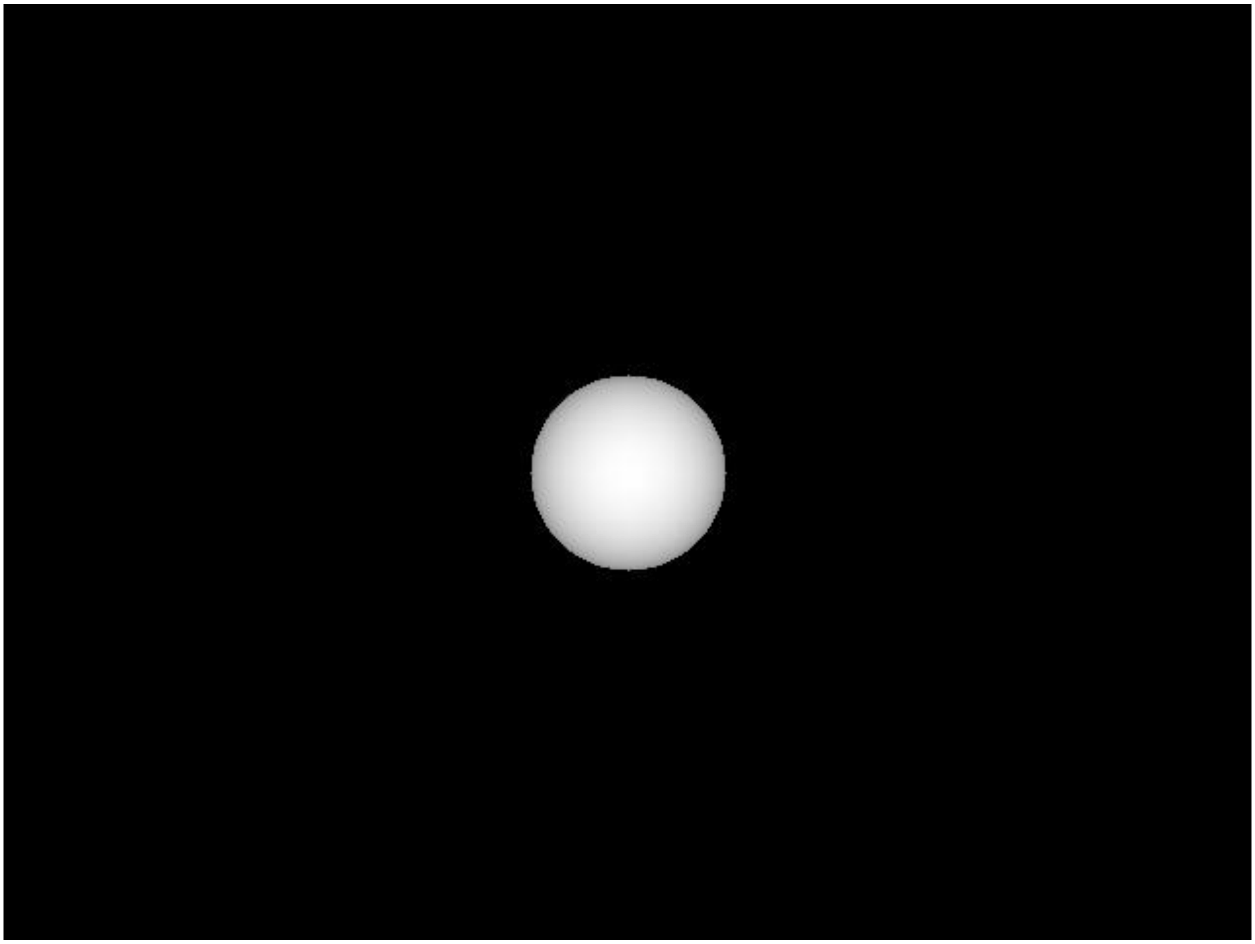


Image I: S=[0,0,1],r=50,a=0.5,m=10000