

Light and optics is one of the major topic in physics. Light can be simulated as bunch of photons. When light meets a different medium other than it is passing, it can get reflected or it can pass through the medium. In addition, certain portion of the energy get absorbed to the medium. Photon can disappear in the medium if the energy is absorbed by the medium. Absorption is proportional to the distance that the photon travels.

Use C++ in this exercise.

Exercise 1

Consider a layer of glass is 1 cm thick. Each photon that directly (90degree to the surface) falls on the surface has a 99% chance of entering the glass. There is a 0.1 % chance of reflect the photons at the exiting surface and 0.5 % chance to get absorbed to the glass.

Simulate 10000, 100000, and 1 million photons that directly falls on the glass surface and represent the count of photons that reflect on the entering surface, reflect on the exiting surface, absorbed to the medium, and exit from the glass after each 10000 simulations.

The photons that reflected in the exiting surface can either absorbed or meet the entering surface. In this exercise, do not simulate the photons that reflects in the exiting surface after it get reflected.

Hint: use a random number generator can be used to select the photons behavior.

Exercise 2

Assume a reflective paint with 99% reflectivity is applied on the exiting surface of the medium in exercise 1.

Calculate the number of photons that exit from the medium entering surface due to reflection occurred in the second surface when 1 million photons enter to the medium. Indicate the results after each 10000 photon simulations.

Exercise 3

Two mediums can be stacked and light can pass though it. Consider the chances of reflections and absorption for two medias as given below.

Parameter	Medium 1	Medium 2
Reflect in entering surface	1%	0.5%
Absorption	0.75%	0.5%
Reflect in exiting surface	0.1%	0.01%

Assume the light falls perpendicularly to the surface of the first medium.

Simulate 1 million photons that directly falls on the glass surface (medium 1) and represent the count of photons that reflect on the entering surface, reflect on the exiting surface (medium 1 & 2 meeting surface and medium 2 exit surface), absorbed to the medium 1 and 2, and exit from the medium 2 after each 10000 simulations.

The photons that are reflected from medium 1 & 2 meeting surface and medium 2 exit surface should not be further simulated under this exercise.

Exercise 4

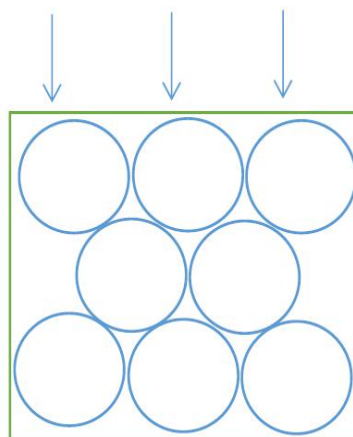
Consider the exercise 3 medium setup. Assume a reflective paint which reflects 95% of the photons falls on it, is applied on the second mediums exiting surface.

Simulate 10 million photons and calculate the following numbers for the photons that reflect due to the paint and display them for at the end of each 100000 rounds.

- Total number of photons reflects from the paint
- Total number of photons that re-enter the medium 1 from medium 2 due to reflection
- Total number of photons exit form the medium 1

Exercise 5

There are transparent plastic cylindrical rods which has a radius of 1 cm and length of 5 cm. Eight of those rods are packed to a box and a side view of the setup is shown below. The plastic has a 10% absorption and 5% reflection in outer surface and 3% reflection in inner surfaces. The refraction angle of light for the plastic rod is 20° .



Assume a light falls perpendicular to the structure. Simulate the light propagation and calculate the percentage of light that pass through the structure.