MATERIALS AND CAMERAS 8

CS184: COMPUTER GRAPHICS AND IMAGING

March, 2022

1 Cameras and Lenses

1.1 Terminology

When dealing with cameras and lenses, it is easy to get bogged down by the various terms and mix up how they all relate to one another. Some have direct relationships, while others have inverse relationships, and so on. Let's start by defining the terminology that we commonly use when talking about cameras and lenses.

1. Briefly define each of the following terms in your own words. Where applicable, also draw an accompanying diagram to help explain the concept.
   (a) Focal length
   (b) Field of view
   (c) Exposure
   (d) Shutter speed
   (e) Aperture
   (f) F-stop
   (g) Circle of confusion
   (h) Depth of field

1.2 Configurations and Effects

1. Assuming focal length is the distance between the sensor and lens, how are focal length and field of view related? For a fixed sensor size, how does increasing focal length affect field of view?

2. An image captured with a 50mm focal length is considered to have a "normal" field of view. What about an image taken with a 15mm focal length? How about 150mm focal length? Do these types of images have special names?

3. Which of the following camera configurations has the smallest field of view?
   (a) 36mm wide sensor and 50mm focal length lens
   (b) 12mm wide sensor and 18mm focal length lens
   (c) 24mm wide sensor and 8mm focal length lens

4. How are sensor size and field of view related? What happens to the field of view if I don't move my sensor, but increase its size? What about decreasing its size?

5. If my F-number is increasing, then what can I deduce about the size of my aperture and/or my focal length?

6. To help reduce motion blur when I capture photos, I can increase the shutter speed of

my camera (which reduces the amount of time the sensor is exposed to light). What are the tradeoffs of doing so? What can I do to mitigate the tradeoffs?

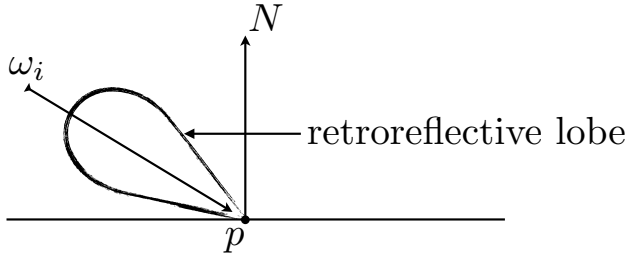
7. How are depth of field and aperture size related? What happens to the depth of field if I reduce the size of my aperture? What else happens if I reduce the size of my aperture?

8. Briefly explain why photographers must choose between depth of field and motion blur for moving objects.

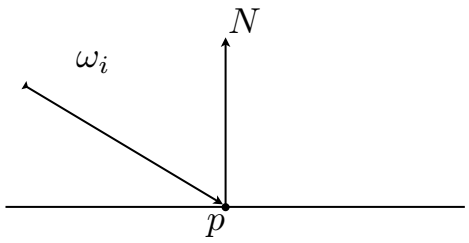
2 BRDF Material

For surfaces with the BRDFs described below, consider a single incident ray of light as shown from direction ω_i to a surface point p with indicated surface normal vector N. Please sketch on these drawings the reflected distribution of light at point p. The first is done as an example for you.

Example: BRDF: glossy retroflection.



1. BRDF: a material with both specular reflection and specular refractive transmission, such as glass.



2. BRDF: a material with both diffuse and glossy specular components, such as sand-blasted aluminum.