Lecture 19: Global Illumination – Review Questions

- The contributions of light to an image can be considered as light collected over a huge collection of paths through an environment. When thinking about the possible paths, we need to consider all types of bounces, both specular (predominant in ray tracing) and diffuse (predominant in radiosity). If we use a regular expression for the paths considered in ray tracing, we would have:

  $L(D \mid S)E$ (*direct lighting*)

  $L(D \mid S)S^{+}E$ (*with specular bounces*)

  where L indicates that the path starts at the light
  D refers to a diffuse bounce
  S refers to a specular bounce
  E indicates that the path ends at the eye

  Explain these expressions and show how they result from the ray tracing equation:

$$I = k_a L_a + k_d (l \bullet n) \frac{L_d}{(a + br + cr^2)} + k_s (r \bullet v)^{\alpha} \frac{L_s}{(a + br + cr^2)} + k_r I_r + k_t I_t$$

- What is the equivalent regular expression for paths represented in radiosity?
- What light paths are missing (not captured by either technique)? Think of an effect captured by such paths that neither ray tracing nor radiosity will handle well.
- What is particle tracing? What is path tracing?
- What is the key goal represented in the Metropolis Light Transport paper (Veach and Guibas, SIGGRAPH '97)? (The paper is available from the course syllabus web page.)
- What is the key idea behind photon mapping? In particular, describe the steps of photon shooting and photon collection. The following reference may be useful: http://graphics.ucsd.edu/~henrik/
- In photon mapping, we collect two separate maps: (1) a global map, with rays expressed as [$L(S \mid D)^{*} D - LS^{+} D$] and (2) a caustic map, with rays expressed as [$LS^{+} D$]. Explain the caustic paths and explain why this map is separated from the global map.
- How are shadows captured in photon mapping?
- Give some pros and cons of photon mapping compared to ray tracing and radiosity.