Week 8

So far you have been working with perfectly diffuse (Lambertian) and perfectly specular materials. Naturally, there are several models to describe *glossy* materials, that is, materials which are in-between perfectly diffuse and perfectly specular. These models are typically based on a microfacet distribution (see **P**: Sec. 8.4) or based on experiments (see **P**: Sec. 8.5). The following exercises are about implementing shaders for glossy materials.

Learning Objectives

- Define BRDFs for light-material interaction.
- Describe an advanced BRDF model which is, for example, based on a microfacet distribution.
- Analyse the physical plausibility of a BRDF.
- Use importance sampling for improved Monte Carlo integration.

Ray Tracing

No lighting model for glossy materials works perfectly for all materials. So you should choose the model that you find most appealing and use this model in all the following exercises.

- Pick a model for rendering glossy materials. Describe the model. Comment on the physical plausibility of the model in your description.
- Load a scene with some glossy materials into your ray tracer (for example the Cornell box with two glossy spheres or a glossy floor, but creativity is encouraged). Implement a shader for glossy materials which only takes local illumination into account. (In the `pathtrace` project of the course framework, implement the `shade` function in `Glossy.cpp`. This shader is called when a material has the wavefront OBJ illumination model set to `illum 2`.)
- Render the scene with the glossy materials and store the view. (In the framework, a view is saved in a file called `view` when you press 'S' on the keyboard.) Store the resulting image.
- Implement a shader which uses Monte Carlo sampling to capture global illumination of the glossy materials. Importance sample the BRDF. (In the framework, implement the `shade` function in `MC-Glossy.cpp`.)
- Render the loaded scene again using the same view as before. (In the framework, a view is loaded from the file `view` when you press 'L' on the keyboard.) Store the resulting image.

Week 8 Deliverables

A description of the model used for rendering glossy materials. Images showing a scene with some glossy materials: local illumination alone and the complete global result. Include relevant code and render log (number of triangles, number of samples, render time, etc.).

Reading Material

The curriculum for Week 8 is

P Sections 8.4–8.5. *Microfacet Models*.
P Sections 14.4–14.5.4. *Importance Sampling*.

Alternative literature available online or uploaded to CampusNet:

- Dutré, P. *Global Illumination Compendium*. Lecture Notes, Katholieke Universiteit Leuven, September 2003. http://www.cs.kuleuven.ac.be/~phil/GI/.
- Lewis, R. R. Making shaders more physically plausible. *Computer Graphics Forum*, Vol. 13, No. 2, pp. 109–120, 1994.

Additional resources:

- Weidlich, A., and Wilkie, A. Arbitrarily layered micro-facet surfaces. In *Proceedings of GRAPHITE 2007*, pp. 171–178, ACM, December 2007.
- Weidlich, A., and Wilkie, A. Exploring the potential of layered BRDF models. *ACM SIGGRAPH Asia 2009 Course Notes*, ACM Press, 2009.
- Neumann, L., Neumann, A., and Szirmay-Kalos, L. Reflectance models with fast importance sampling. *Computer Graphics Forum 18*(4), pp. 249–265, 1999.