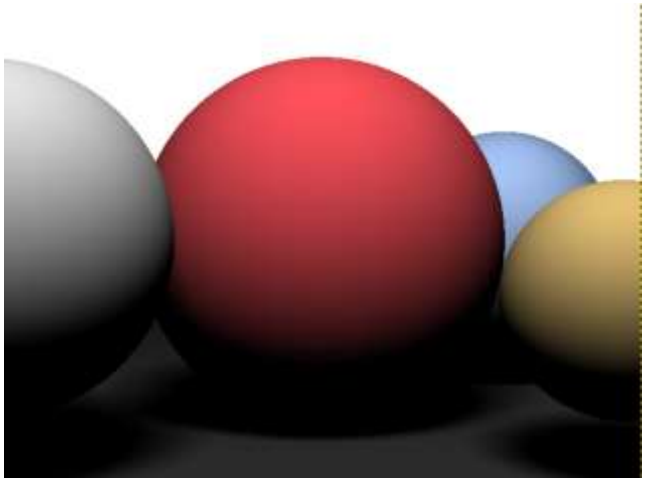
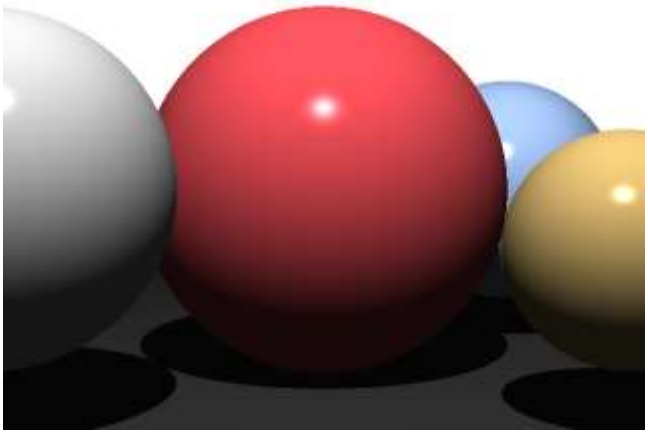
Advanced Graphics Programming

Workshop Three (Part B) – Ray Tracing (Soft Shadows)

This workshop follows on from the Ray Tracing algorithm you developed in workshop 3 part A. This workshop involves distributed ray tracing to create soft shadows as shown below:

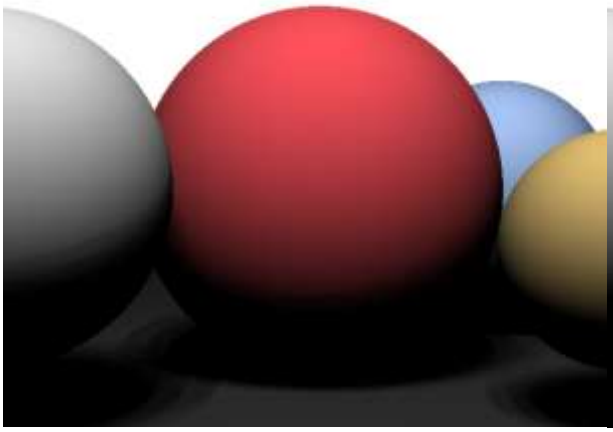


Before you start this workshop you should already have hard shadows as shown below:

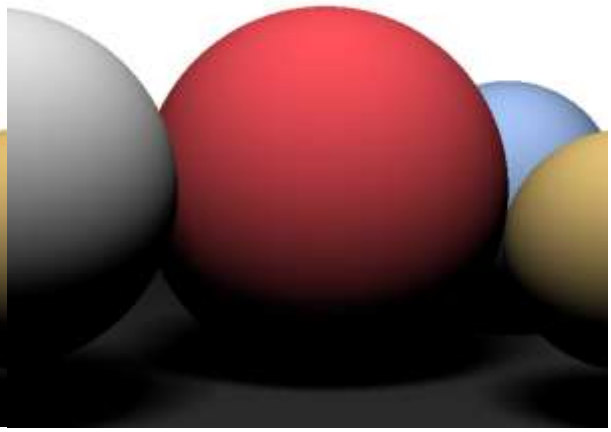


Step 1: Add soft shadows. To add soft shadows you need to use distributed ray tracing and instead of a point light you need to use an area light. First, add a box (axis aligned) for the area light, defined by its position e.g. (-4.5, 20, -4.5) and size e.g. (9, 0.1, 9). Replace your point light in your scene with your area light. Your code will not work correctly until you also complete the next step.

Step 2: Now shoot multiple rays from each intersection point using a regular sampling of the light area and average the result of the rays (see lecture 4 for more details). Try with a small number of samples first e.g. 9. If you run your code you should now see soft shadows (as shown below) but you can also see banding. Increasing the number of rays per pixel should improve the situation but you will still see banding, especially if you zoom in.

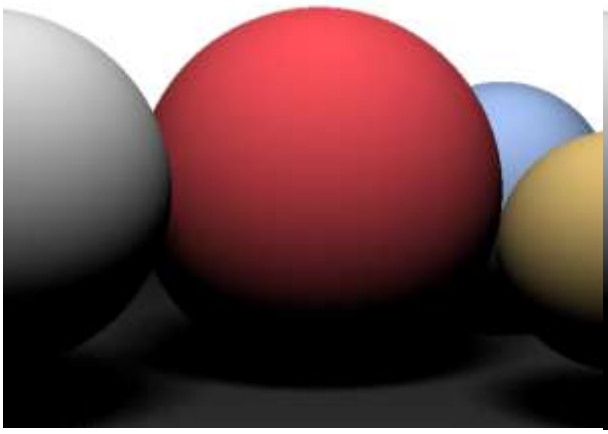


9 samples (uniform)

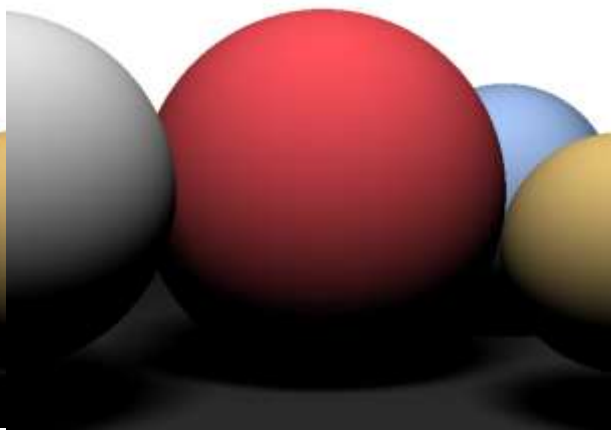


64 samples (uniform)

Step 3: Use jittered sampling to add noise and remove the banding effect. Instead of using a regular pattern of sampling within a grid you can a small amount of random noise to each sample, where the maximum amount of noise is the size of each grid cell (see lecture slides 4 for more details). If you run with a low number of samples you may see shadow aliasing but increasing the number of samplings will fix the problem.



9 samples (jittered)



64 samples (jittered)

Step 4: The same code can be used to create soft shadows for triangles and therefore models comprised of triangles. You will need to use area lights instead of point lights in the scene. Some examples of teapots with soft shadows using area lights in different positions are provided below. In all the examples the size of the area light is (9, 0.1, 9) and the light intensity is (1, 1, 1).

Figure 1 Teapot with soft shadow using area light at position (-4.5, 20, -4.5)

Figure 2 Teapot with soft shadow using area light at position (-3.5, 10, -3.5)

Figure 3 Teapot with soft shadow using area light at position (-3.5, 3, -3.5)