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Exercise Sheet 9

Assignment 9.1 Perception [2 Points]

1. Why can one percieve reddish yellow, but not reddish green? [*0.5 Points*]
2. Why can astronomers not focus on dim stars? [*0.5 Points*]
3. What are metamers? Name different reasons for metamerism. [*1 Point*]

Assignment 9.2 3D Visual Perception [2 Points]

Read up on two common methods for stereoscopic display, anaglyph 3D [1] and polarized light [2]. Briefly explain how these two methods create the impression of a three-dimensional image, with respect to color perception and the wave properties of light, respectively.

Assignment 9.3 Color Systems [4 Points]

1. What do we mean by additive and subtractive color mixing? Where does additive/subtracticve color mixing occur? [*1.5 Points*]
2. Determine the representation of the RGB color $(1, 0, 0)$ in the color models CMYK, HSV and HSL (HSV color value 0°). [*1.5 Points*]
3. Name a reason why most current printers still have a cartridge for black besides the color cartridges. [*1 Point*]

Assignment 9.4 BONUS ASSIGNMENT: Fractal Snowflakes [8 Points]

A k-spherical snowflake is a three-dimensional fractal which can be described procedurally. For this, k smaller spheres are placed evenly distributed around a root sphere, with the smaller spheres touching the surface of the root sphere. This step is recursively repeated until the recursion depth n is reached.

1. How many spheres make up a k-spherical snowflake with recursion depth n, assuming the root node represents iteraton $n = 0$? [*1 Point*]
2. Put together an algorithmic procedure to generate a spherical snowflake for $k = 9$, similar to the one in the image below. Let K_0 be any parent sphere, which is the root node to K_1 to K_9. K_1 through K_6 should be placed around the equator (x-z-plane), with K_7 to K_9 placed on the upper hemisphere, with the same distance to both the closest points in $K_{\{1-6\}}$ and the remaining points of $K_{\{7-9\}}$. [*3 Points*]

   Hint: Respect the fact that the equatorial plane is with respect to the local coordinate system of K_0, and not the globally-defined coordinate system.

[1] `https://en.wikipedia.org/wiki/Anaglyph_3D`
[2] `http://www.physics.org/article-questions.asp?id=56`

For the second part of this exercise, implement the spherical snowflake in the raytracer. For this, use the provided class `Raytracer::Scenes::SceneObject`. Recall the different methods, as introduced in exercise sheet 06.

Extend the function `BuildScene` in the file `main.cpp` with the algorithm from the previous part. Use the parameter `depth` for the recursion depth. Choose a reasonable ratio for the radius reduction, but do make sure that the parent and child spheres do not overlap at any point. [*4 Points*]

Hint: If you were not able to solve part 4.2, you may create any structure which resembles the provided screenshot as closely as possible.

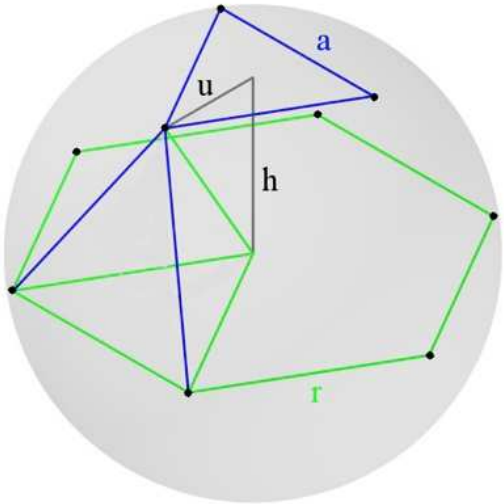

Figure 1: Exemplary spherical snowflake (left, image credit: Per H. Christensen), and placement of the subspheres (right).

Submission: January 09, 2017, 8:00 pm via Moodle