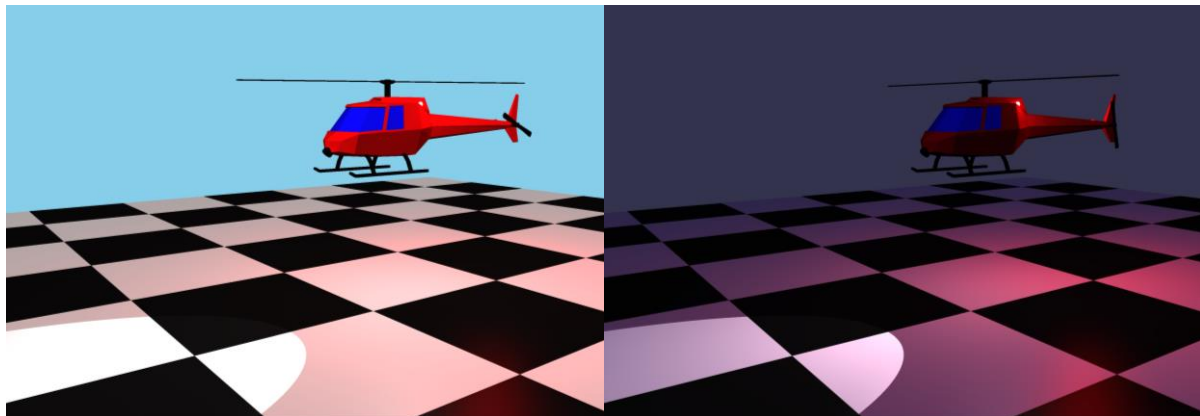**Proseminar Visual Computing**
Winter Semester 2022

CG Assignment 2
Hand-out: December 06, 2022
Hand-in: December 19, 2022

Topics

- Lighting and Materials
- Shader programming

Outline

The goal of the Computer Graphics assignments of the Visual Computing PS is to build an animated helicopter. This work is divided in 3 steps. Each step corresponds to a programming assignment. The objective of this assignment is to implement *Blinn-Phong Illumination* in the *Fragment Shader* in GLSL using material properties defined in the .obj data format. Furthermore, multiple light sources should be implemented (one directional light and four spotlights).

Template code

A template code is provided with this assignment. It loads the helicopter mesh and its material properties from an .obj file. The helicopter controls from the previous assignment are already implemented. Currently, the fragment shader sets the fragment color according to the diffuse material color.

Tasks

1. Implement *Blinn-Phong* illumination in the *Fragment Shader* for a directional light source with the material properties (color values and shininess) given in the helicopter model (loaded from an .obj (.mat) file).
   Find color values and the direction of the light source to emulate the lighting condition during the day and night. You should be able to switch between them by pressing a key.

2. Next, add point light sources with decaying intensity. There should be *three white lights*. Two behind the main rotor on each side of the helicopter's main body (*lights* in the .obj) and one headlight in the front at the bottom (*spotlight* in the .obj). In addition, there should be a *red blinking strobe light* on top of the tail boom, right in front of the tail rotor (*strobe* in the .obj). You will need to update the position of these point lights when the helicopter moves. Finally, add a toggle (on key press) to *switch the three white point lights on and off*.

3. Finally, change the *point lights to spotlights*. You can implement this without a smooth edge and simply cut the lights power if a fragment is not in the light cone (defined with a direction and a cut-off angle).
   If you direct the headlight in the front to face 45° down, you will have a visible light cone on the ground plane. Further, use a small light cone angle for the headlight and large angles for the other lights. The red strobe light can even have a light cone angle of 360° or it can be staying a point light.
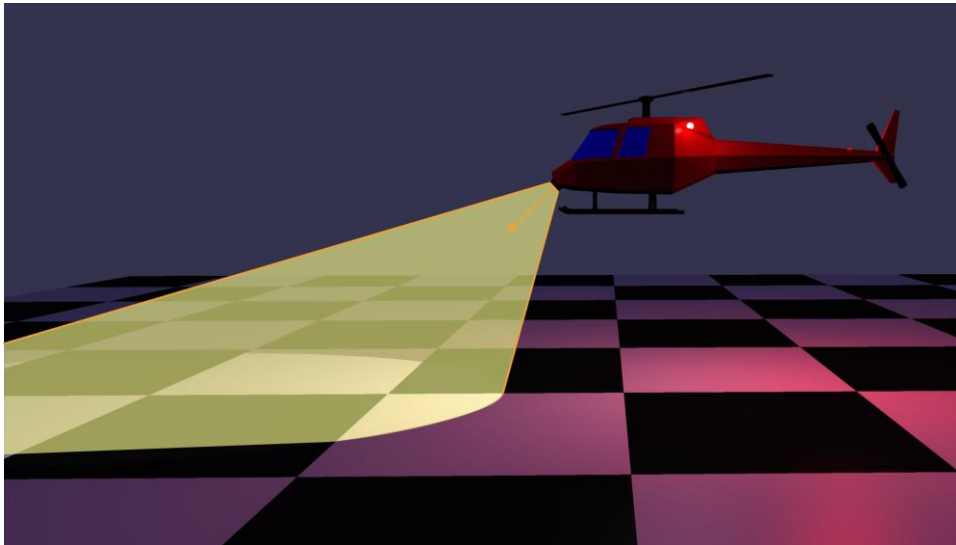
Implementation Remarks

Make sure that your code is clear and readable. Write commentaries when necessary. Your solution should contain a readme file with names of the team members, list of keyboard controls, and any explanation that you think is necessary for the comprehension of the code.

Submission and Grading

Submission of your solution is due on December 19th, 2022 (23:59). **Submit the sources** (i.e., only the content of the *src* folder) in a ZIP archive via OLAT. Do not submit the executable and the content of the *build* folder. Do not submit the external dependencies either. Both folder and archive should be named according to the following convention:

Folder: **CGA2_<lastname1>_<lastname2>_<lastname3>**

Archive: **CGA2_<lastname1>_<lastname2>_<lastname3>.zip**,

where <lastname1>, etc. are the family names of the team members. Development in teams of two or three students is requested. Please respect the academic honor code. In total there are 15 marks achievable in this assignment distributed as follows:

- A directional light source (sun/moon) (**5 marks**)
- Point light sources attached to the helicopter (**5 marks**)
- Spotlight sources **(3 marks)**
- Code readability, comments, and proper submission: (**2 marks**)

Resources

- Lecture and Proseminar slides as well as code and information are available via OLAT.

- OpenGL homepage
  http://www.opengl.org

- OpenGL 3.3 reference pages
  https://www.khronos.org/registry/OpenGL/specs/gl/glspec33.core.pdf

- OpenGL Tutorial for Blinn-Phong Illumination (Phong Shading)
  https://learnopengl.com/Lighting/Basic-Lighting
  http://www.opengl-tutorial.org/beginners-tutorials/tutorial-8-basic-shading/

- GL Framework GLFW
  https://www.glfw.org/documentation.html

Note: Be mindful of employed OpenGL and GLSL versions!