

Summer Semester 2025

## Assignment on Advanced Computer Graphics - Sheet 4

Due Date 19.06.25

### Exercise 1 (Physically Based Rendering (PBR))

In this assignment, you will implement physically based rendering in GLSL.



(a) non-metallic, high roughness    (b) non-metallic, low roughness    (c) metallic, low roughness

Figure 1: results of the physically-based rendering when implemented correctly.

On the CGVR-homepage you will find the *PBRFramework*. In default mode, the scene is rendered with standard Phong lighting. Using the radio buttons (a) *Phong lighting* and (b) *Physically-based-Rendering*, you can switch between the default Phong lighting and your PBR-implementation on the fly. Additionally, you can dynamically control the object-wide roughness and metallicness via the two corresponding sliders.

The PBR-model is implemented in the `getPBRLighting()`-method of the fragment shader (s. `shader/lighting.frag`). It has a specular and diffuse component, as described on the slide "Constructing Actual BRDF's" from the lecture on *Physically-Based Lighting / Rendering*.

The diffuse component is already implemented. Therefore, your task is to implement the Micro-FacetBRDF for the specular component of the PBR-model (s. slide "The Normal Distribution Function in Detail"). For that, you also have to implement its sub-components, such as the `fresnel()`-method. This includes the:

- Normal Distribution Function (NDF), abbreviated to D (s. slide "A Commonly Used NDF", Trowbridge-Reitz/GGX)
- Geometry-Function, abbreviated to G (s. slide "The Geometry Function", Smith equation)
- Fresnel Function, abbreviated to F (s. slide "Approximation of the Fresnel Equation", Schlick approximation)