PBR IN GLTF
CURRENT STATE

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Physically-Based Rendering (PBR) gets increasingly popular

- glTF 1.0: two ways to define materials
  - Full custom technique / shaders (complex, too general)
  - KHR_materials_common (non-PBR-ready blinn / phong)

- **Aim**: PBR-ready materials in glTF, using most common parameters
# COMMON PARAMETER SET
## CASE STUDY

<table>
<thead>
<tr>
<th>Diffuse</th>
<th>NDF (D)</th>
<th>Masking (G)</th>
<th>Fresnel (F)</th>
<th>Roughness (α)</th>
<th>Textures</th>
<th>Specular AA</th>
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</thead>
</table>
| **Frostbite 3**   | Disney's Model [Burley12] | GGX                  | Height-Correlated Smith [Hertz14] | Schlick | α = (1 - Smoothness)^2 | • Normal  
• BaseColor  
• Smoothness  
• Reflectance  
• Metallic | None |
| **Unity 5**       | • Torrance-Sparrow (PC/Consoles)  
• Minimalist Cook-Torrance (Mobile ES 3.0+)  
• Blinn-Phong in CDF form (DX9, ES 2.0) | • Blinn-Phong (PC/Consoles)  
• Approx. Kehlman (Mobile ES 3.0+)  
• Lookup Texture (DX9, ES 2.0) | Schlick | α = 1 - Smoothness | • Albedo (RGB)  
• Specular (RGB)  
• Metallic (R)  
• Smoothness (A) | None |
| **CryEngine 3**   | Oren-Nayar [OREN84] | GGX                  | Schlick-Smith | Schlick | α = (1 - Smoothness)^0.7|^5 | • Normal (RGB)  
• Translucency Luminance/Prebaked AO Term (A)  
• Diffuse Albedo (RGB)  
• Subsurface Scattering Profile (A)  
• Roughness (R)  
• Specular YCbCr/Transmittance/CbCr (GBA) | Tolkovig |
| **BlackOps 2**    | Cook-Torrance based | Blinn-Phong           | Schlick-Smith | Approx. Schlick 2^(-10x) = (1-x)^5 | a = 8192^g  
a: specular power  
g: gloss | ??? | None |
| **The Order 1886** | Lambert (balanced with specular intensity)  
• GGX  
• Beckman  
• Anisotropic GGX | Smith                | Schlick | α = Roughness | • Spherical Gaussians Normals (RG)  
• Diffuse with Alpha (RGSA)  
• Specular with Intensity (RGBA)  
• Roughness (R)  
• AO (G)  
• BRDF Blend (B)  
• Anisotropy (A) | • Frequency Domain  
• Normal Map  
• Filtering [Han et al.] |
| **Unreal 4.7**    | Lambert           | GGX                  | Schlick-Smith | Schlick | α = Roughness | • BaseColor  
• Metallic  
• Roughness | Tolkovig |
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→ tl;dr: No single common parameter set
COMMON PARAMETER SET
CASE STUDY

Bad News
- No single common parameter set across engines

Good News
- Frequently used common terms / material properties (Metallic, Specular, Roughness, Smoothness, …)
- Used shading models are very similar
SHADING MODEL
HOW TO IMPLEMENT PBR?

- Common Model: Microfacet model (Cook-Torrance)
  - Specular (reflected) part via terms D/F/G
  - Diffuse part models scattering effects

- Various approximations in use
  - Lambert, Oren-Nayar, … for Diffuse,
    GGX, Beckmann, … for Specular D, …

- Don‘t enforce a particular approximation,
  but provide a useable material parameter set.
PROPOSAL: TWO PARAMETER SETS
SPECULAR-GLOSSINESS & METAL-ROUGHNESS

Diffuse + Specular + Glossiness =

BaseColor + Metallic + Roughness =
"materials": {
  "gold": {
    "extensions": {
      "FRAUNHOFER_materials_pbr": {
        "technique": "PBR_metal_roughness",
        "values": {
          "baseColorFactor": [1.00, 0.71, 0.29],
          "metallicFactor": 1.0,
          "roughnessFactor": 0.2
        }
      }
    }
  }
}
GLTF EXTENSION
PROPOSAL ON GITHUB

Document / Fork
https://github.com/tsturm/glTF/tree/master/extensions/Vendor/FRAUNHOFER_materials_pbr

Pull Request
https://github.com/KhronosGroup/glTF/pull/643

Our framework
http://instant3dhub.org
THANKS FOR YOUR ATTENTION!