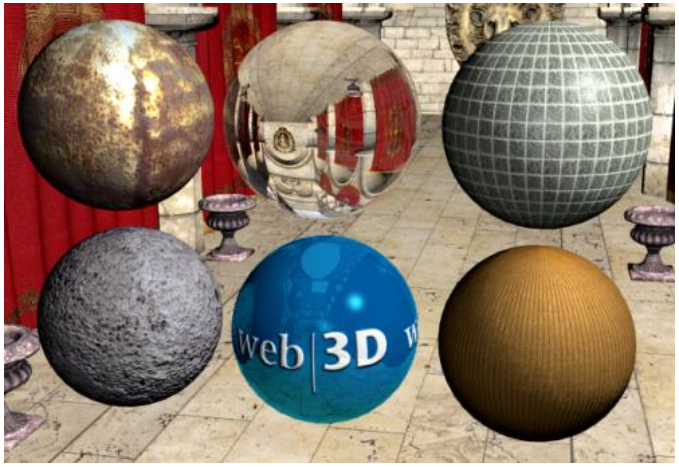
CommonSurfaceShader Revisited: Improvements and Experiences

Karsten Schwenk, Yvonne Jung, Gerrit Voß, Timo Sturm, Johannes Behr



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Outline

- Introduction
  - Why CommonSurfaceShader?
  - The original CommonSurfaceShader
- Improvements
  - Energy conservation
  - Anisotropy
  - Layered materials
- Open Problems
- Conclusion

Introduction – Why CommonSurfaceShader

- Material, Texture, etc.
  - Portable, easy to specify
  - Not powerful enough to model modern features
  - … at least not intuitively
- Shaders
  - Very powerful
  - Not very portable
- CommonSurfaceShader
  - Solid default material
  - Portable and expressive

Introduction – Original CommonSurfaceShader

- “Declarative Surface Shader“
  - Shader in X3D‘s node hierarchy
  - But no explicit code, just data fields with fixed semantics

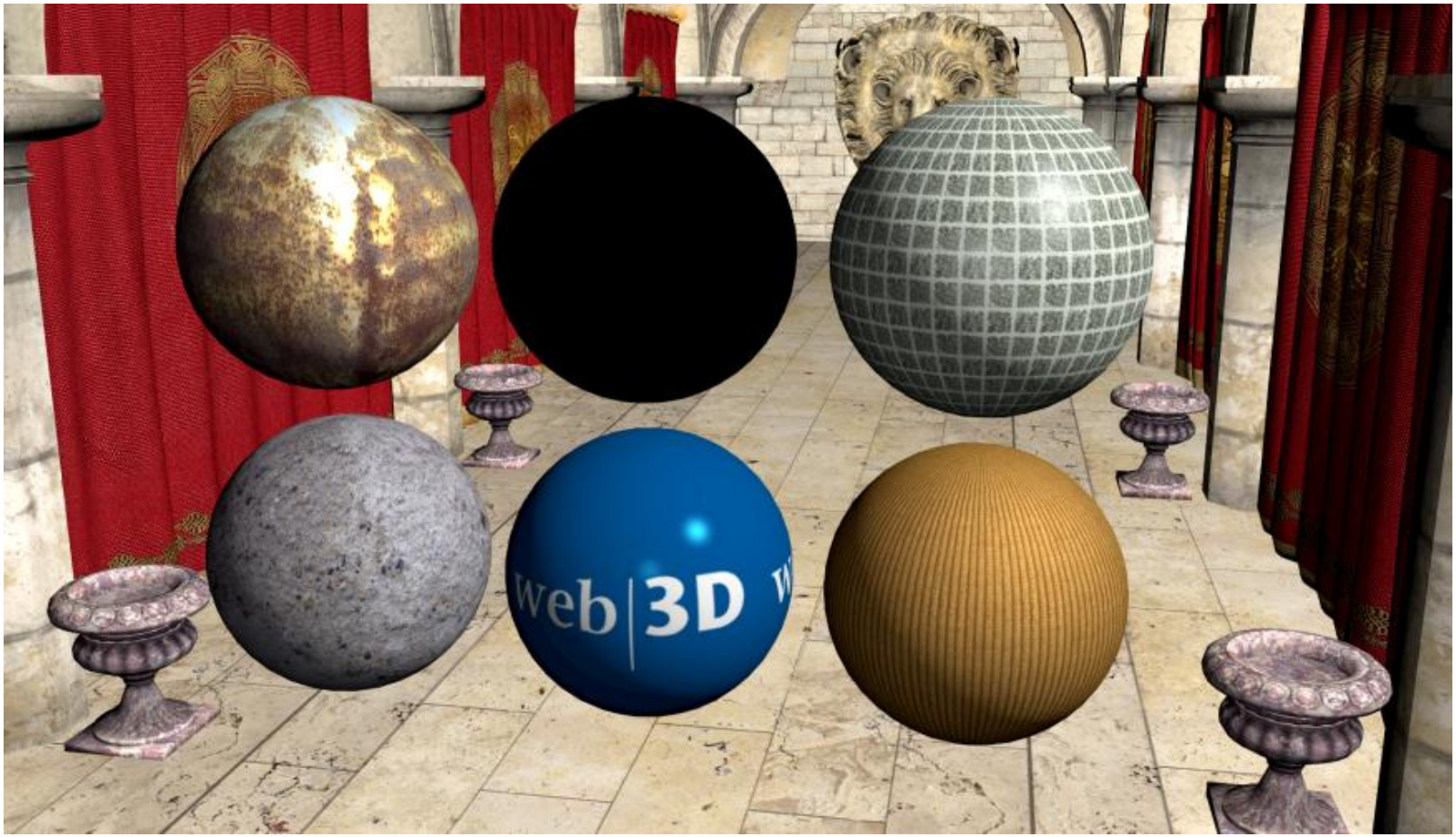
```
<Appearance>
  <CommonSurfaceShader
      diffuseFactor='.2 .2 .2' specularFactor='1 0 1' shininessFactor='.8'>
    <SurfaceShaderTexture containerField='diffuseTexture'>
      <TextureTransform2D scale='10 10'/>
      <ImageTexture url='bongo_karl.jpg'/>
    </SurfaceShaderTexture>
  </CommonSurfaceShader>
</Appearance>
```

Introduction – Original CommonSurfaceShader

- Three components
  - Core (diffuse, glossy, emission, ambient, …)
  - Bump (bump/normal mapping)
  - Specular (perfect specular reflection/refraction)

Introduction – Original CommonSurfaceShader

- Only Core



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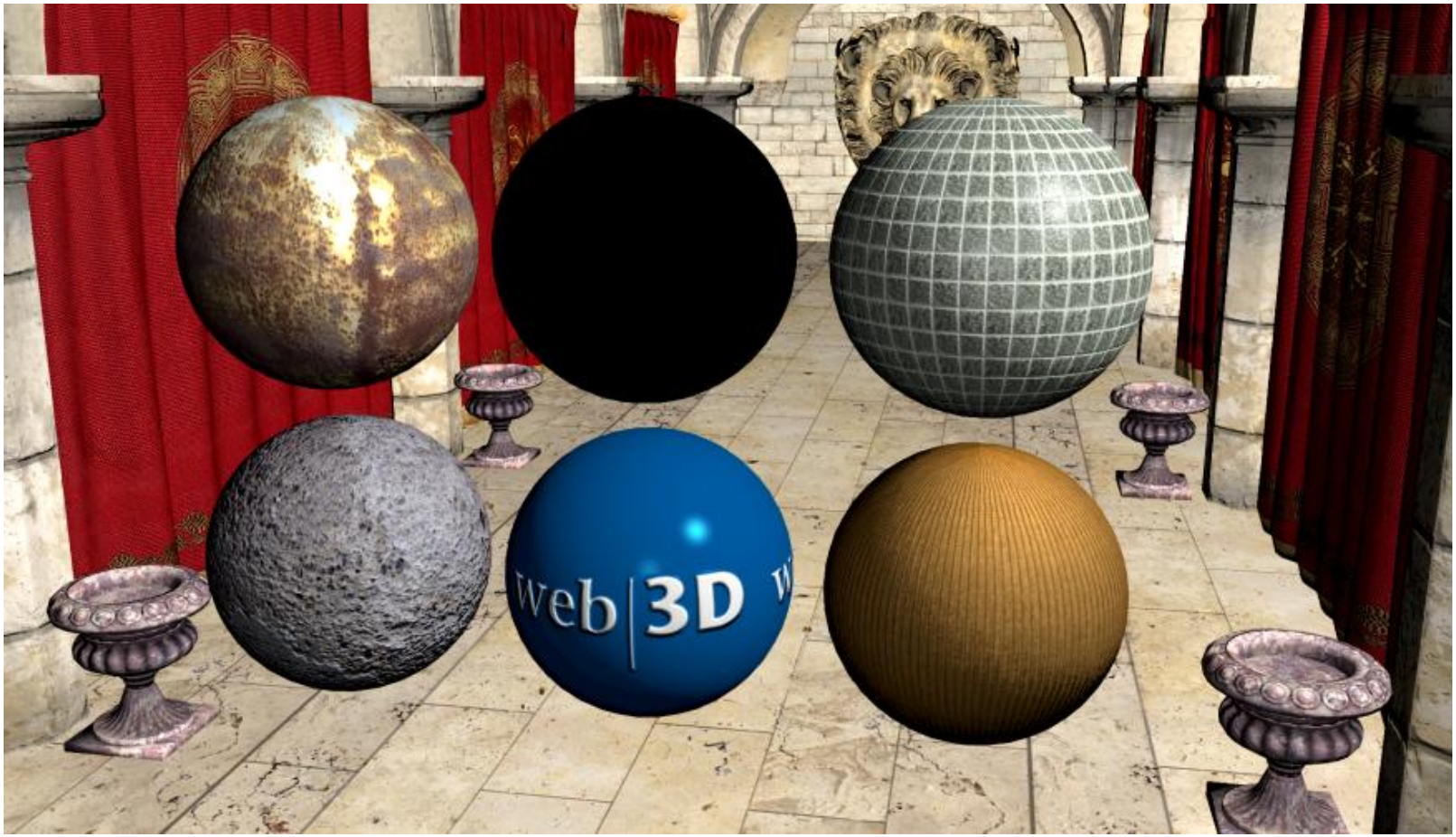
Introduction – Original CommonSurfaceShader

- Core + Bump



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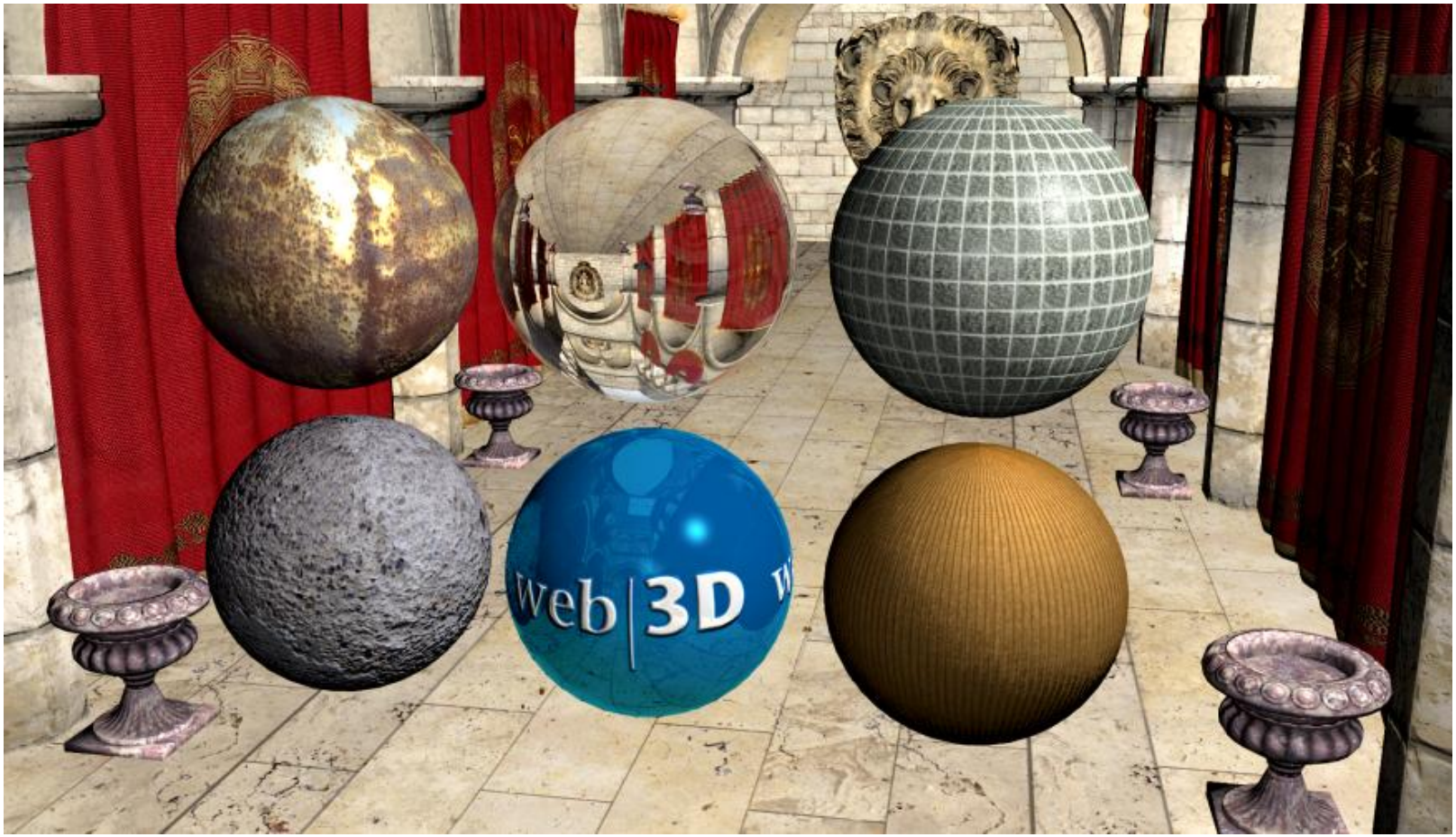
Introduction – Original CommonSurfaceShader

- Core + Bump + Specular



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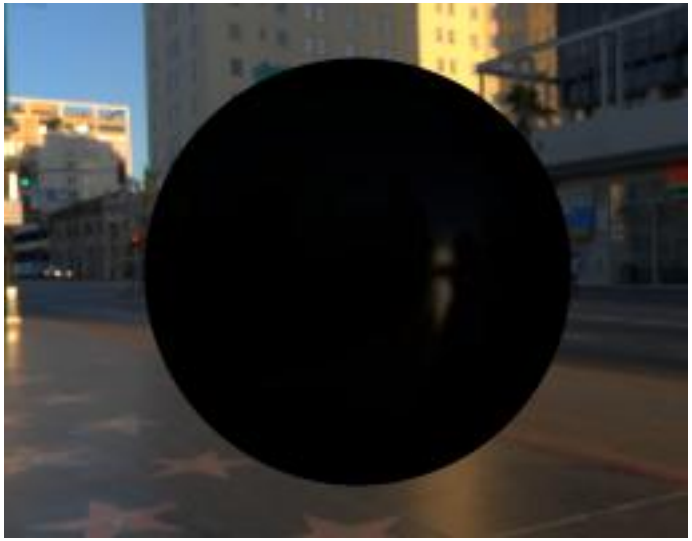
Improvements – Energy Conservation

- Problem:
  - BRDF of original core component not energy conserving
  - Closer to Material node and OpenGL‘s FFP material
  - But a HUGE problem for physically-based rendering
    - Implausible results in HDR environments
    - Multiple light bounces not correct



Improvements – Energy Conservation

- Improvement:
  - Require normalized, energy-conserving BRDF

- But which BRDF?
  - Torrance-Sparrow microfacet model with a Blinn microfacet distribution
  - Or close approximation
  - What is “close approximation“?
    - Not really defined yet

- Why so fuzzy?
  - More freedom for implementations
  - Problematic if exact port of appearance is required

Improvements – Anisotropy

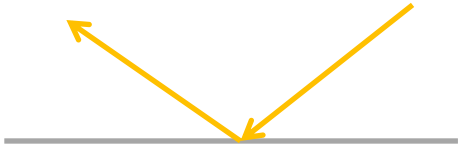
- Problem:
  - BRDF of original core component not anisotropic
  - Can be limiting for some materials (e.g. brushed metal)

Improvements – Anisotropy

- Solution:
  - Allow anisotropic BRDF
  - Shininess now SFVec2f
  - But support optional (for now…)
    - Fallback: use average exponent

Improvements – Layered Materials

- Problem:
  - Core and specular components independent in original design
  - Fast, easy to implement
  - Diffuse (or glossy) layer underneath specular layer not correct



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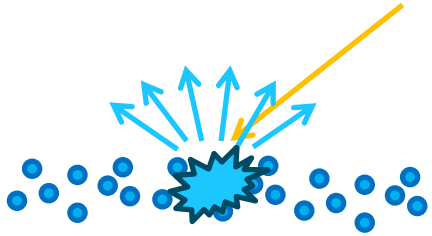

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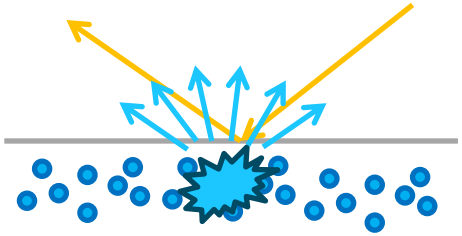

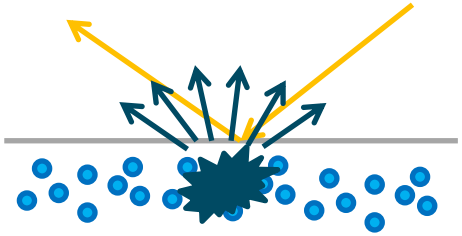

Improvements – Layered Materials

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Improvements – Layered Materials

- Solution:
  - Extent meaning of fresnelBlend parameter
  - Now blends between
    - Physically correct
      - Fresnel reflection/refraction
      - Core beneath specular
    - Physically implausible
      - Constant reflection/refraction
      - Core and specular added

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Open Problems – Layered Materials

- A lot of conflicting goals
  - Generality vs. compactness
  - Portability vs. expressiveness
  - Real-time vs. off-line
  - Backwards compatibility vs. new shiny stuff

- Concrete questions
  - Core-BRDF specification?
  - Alpha vs. transparency in diffuse under specular?
  - Which features are mandatory?
  - What will go into spec?
  - More declarative SurfaceShaders?

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Conclusion

- Presented improved version of CommonSurfaceShader
  - More physically plausible
  - Did not bloat interface
  - More freedom for implementations

- Limitations
  - Some materials require compromises
  - Some cannot be modeled at all

- All in all:
  - Pretty decent and up-to-date default Material
  - Supplement (maybe even replacement) for X3D-Material

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Thank you.

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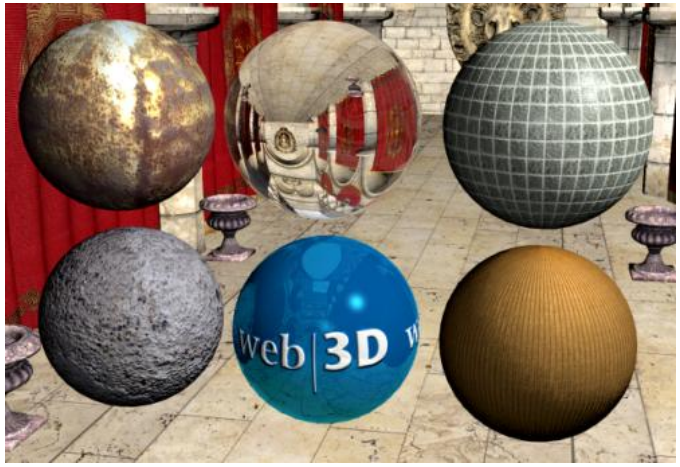

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