Image-Based Remapping of Material Appearance

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There's no clear way to translate between different BRDF models.
Model implementations and parameters differ between renderers.
Model incompatibility

1. Different BRDF models used by different softwares
2. No clear way to translate between models
3. We usually don’t have access to the implementations
4. and they change between renderers
BRDF remapping

Reference BRDF model

External BRDF model (initial condition)

External BRDF model (after remapping)
BRDF remapping

**BRDF fitting**

- BRDF model (initial guess)
- Nonlinear optimization of BRDF parameters
- Fitted BRDF
- Reflectance data

**BRDF remapping**

- External model (initial guess)
- Nonlinear optimization of BRDF parameters
- External model remapped
- Reference model rendering
Appearance comparison

- Spherical geometry
- Point light illumination
- $L_2$ metric for comparison
- Nonlinear optimization with TRF
Results

- GGX
- Ashikhmin-Shirley
- Beckmann
- Ward
- Phong

Conductors

Dielectrics
Results: conductors

Ashikhmin-Shirley
- RGB Reflectivity
- Roughness

Ward
- RGB Specular reflectance
- Roughness

Reference Ashikhmin-Shirley BRDF
External Remapped GGX BRDF
Error
Results: remapping of conductors

Ashikhmin-Shirley
- RGB Reflectivity
- Roughness

Ward
- RGB Specular reflectance
- Roughness

60 conductors from Mitsuba’s DB
Results: remapping of conductors

Ashikhmin-Shirley
- RGB Reflectivity
- Roughness

Ward
- RGB Specular reflectance
- Roughness
Results: remapping of conductors (roundtrip)

Figure: remapping back conductor materials from Ward to Ashikhmin-Shirley.

Input original reflectivity $f_0$ (A-Shirley, RGB channels) vs Output reflectivity $f_0$ (A-Shirley, RGB channels).
Results: dielectrics

Ashikhmin-Shirley
- RGB Diffuse reflectance
- IOR
- Roughness

Ward
- RGB Diffuse reflectance
- RGB Specular reflectance
- Roughness

Reference Ashikhmin-Shirley BRDF.
External Remapped GGX BRDF
Error
Results: remapping of dielectrics

Ashikhmin-Shirley
- RGB Diffuse reflectance
- IOR
- Roughness

Ward
- RGB Diffuse reflectance
- RGB Specular reflectance
- Roughness

Index of refraction (Ashikhmin-Shirley)
Remapping in two stages

Remapping of diffuse term

Remapping of specular term

External model (initial guess)

Reference (diffuse)

Reference (specular)

External model remapped

External model (initial guess)
Results: 2-stage remapping of dielectrics

Ashikhmin-Shirley
- RGB Diffuse reflectance
- IOR
- Roughness

Ward
- RGB Diffuse reflectance
- RGB Specular reflectance
- Roughness

![Graph showing remapping results](image)
Remapping in three stages

External model (initial guess) → 2-stage remapping → Remapping with both terms → External model remapped
Results: 3-stage remapping of dielectrics

Ashikhmin-Shirley
- RGB Diffuse reflectance
- IOR
- Roughness

Ward
- RGB Diffuse reflectance
- RGB Specular reflectance
- Roughness

![Graph showing the remapping of dielectric materials from Ashikhmin-Shirley to Ward.](image-url)
Current work: SVBRDF remapping
Conclusions

- We presented a scheme for automatic remapping of uniform BRDFs without access to the BRDF implementations.

- The remapping procedure has been tested with both dielectric and conductor materials and with multiple BRDF models. Overall the transformation between models is robust, and in the cases where we find instabilities, these are generally located in a well-defined area of parameter space.

- When dealing with materials with both diffuse and specular terms, both need to be remapped independently to avoid instabilities.
Thank you!

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