Efficient BRDF Sampling Using Projected Deviation Vector Parameterization

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Agenda

- Introduction
- Projected Deviation Vector Parameterization
- Basis vector BRDF measurements
- Results

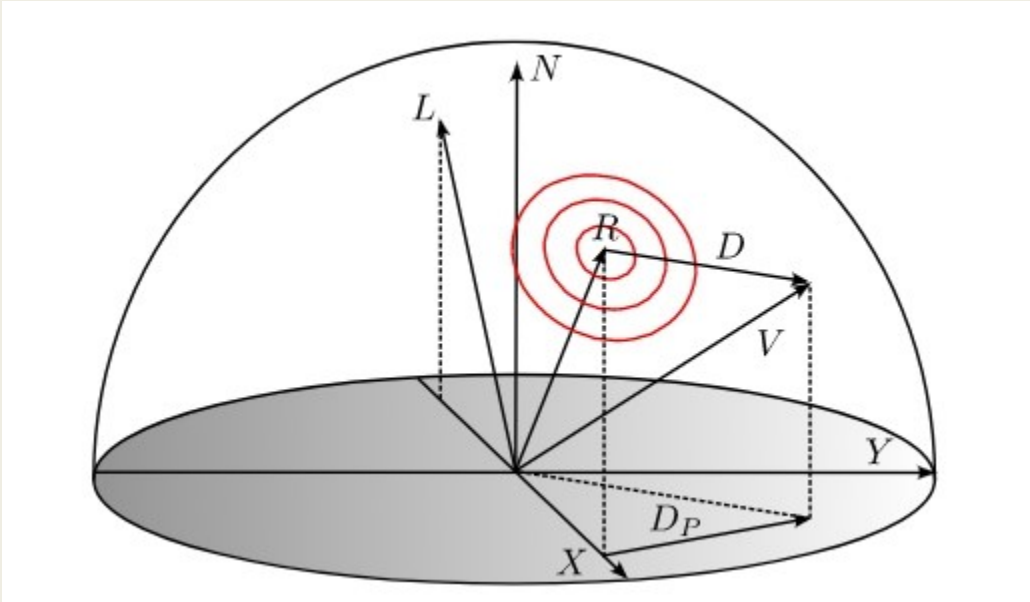


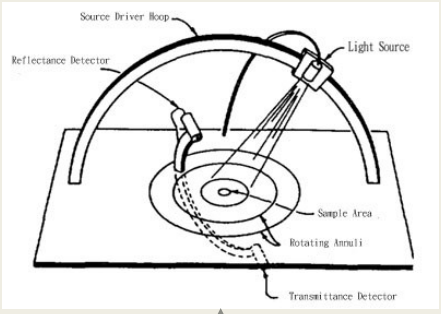
Figure from : BRDF models for accurate and efficient rendering of glossy surfaces by Löw et al.

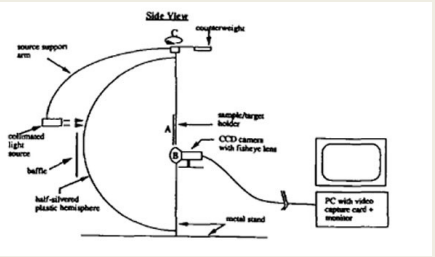
Introduction

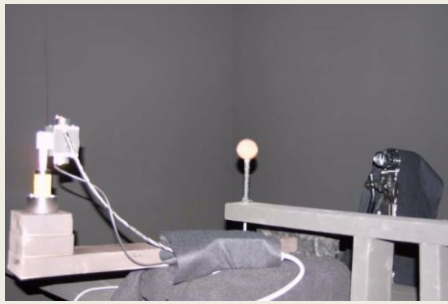
- Bidirectional Reflectance Distribution Function (BRDF)
  - *Isotropic BRDF*
  - *Anisotropic BRDF*
  - *Spatially Varying BRDF*
  - *Etc.*
- BRDF Parameterization
  - *Spherical coordinates (Standard Parameterization)*
  - *Rusinkiewicz (Half-Diff Parameterization)*
  - *Löw et al. (PDV Parameterization)*
  - *Etc.*

Introduction

- BRDF measurements and inferring
  - *Gonio-reflectometer*
  - *Ward (Hemispherical mirror and fisheye lens)*
  - *MERL*
  - *Romeiro et al. (Passive reflectometry)*
  - *Xu et al. and Nielsen et al. (PCA for minimal sampling)*

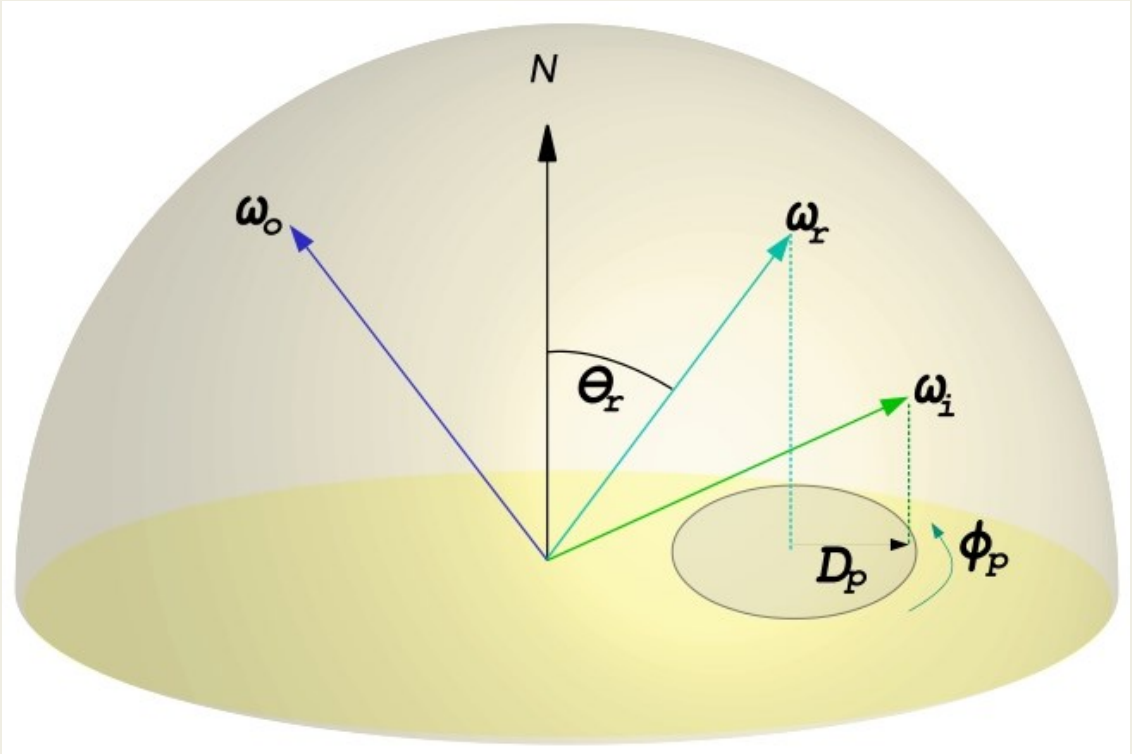






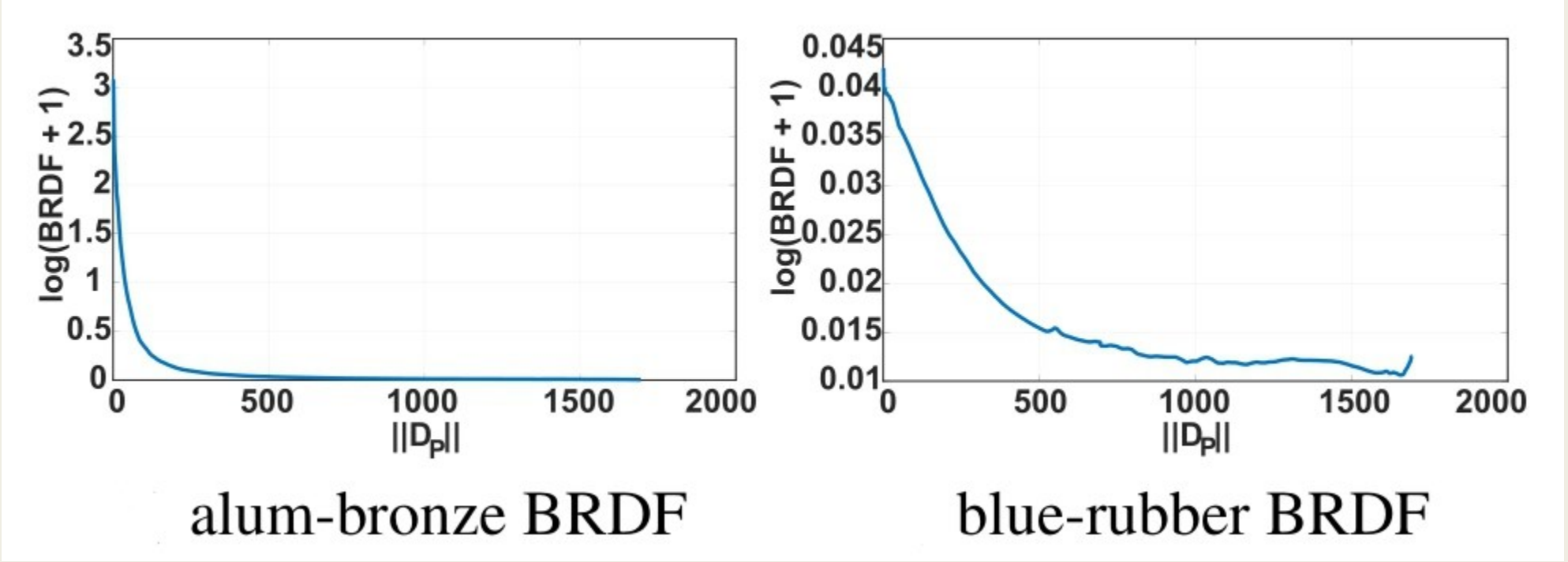
Projected Deviation Vector (PDV) Parameterization

- For isotropic BRDFs, PDV has 3 parameters. (θ_r, d_p, ϕ_p)



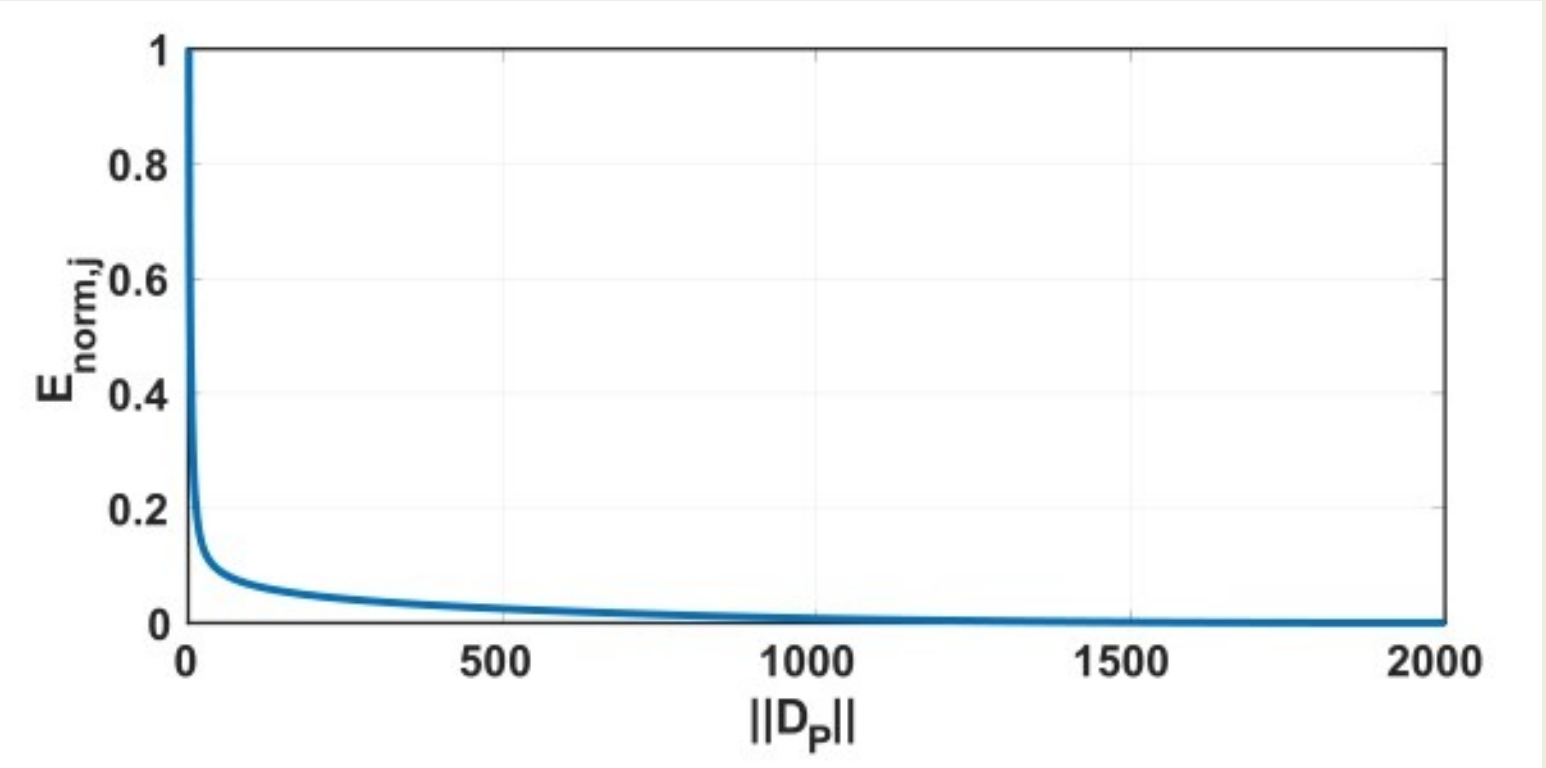
Parameter Sampling

- Linear spacing of d_p is not suitable.
- It would capture much data of unnecessary part.
- The highly distributed reflectance is close to the BRDF lobe reflection.



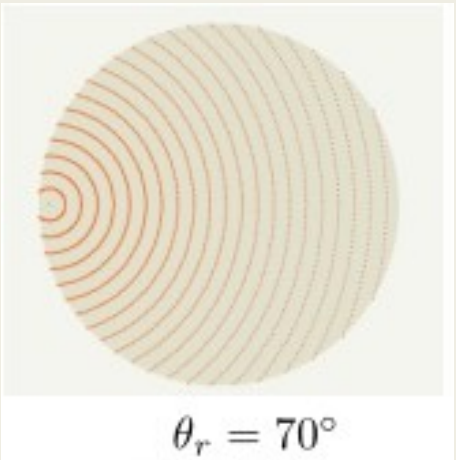
Parameter Sampling

- Inversion method of normalized mean energy.

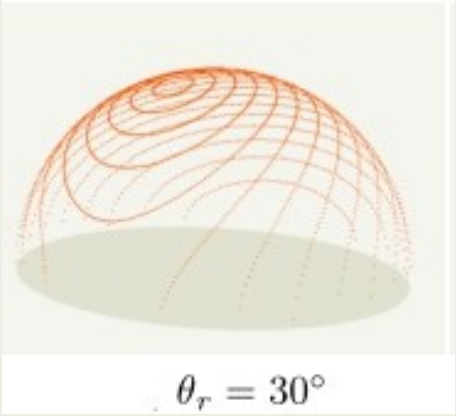


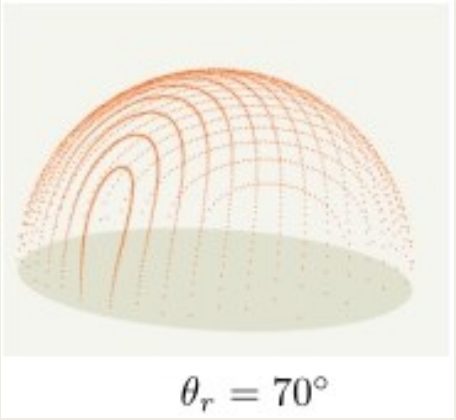
3D and 2D coordinates of PDV

2D



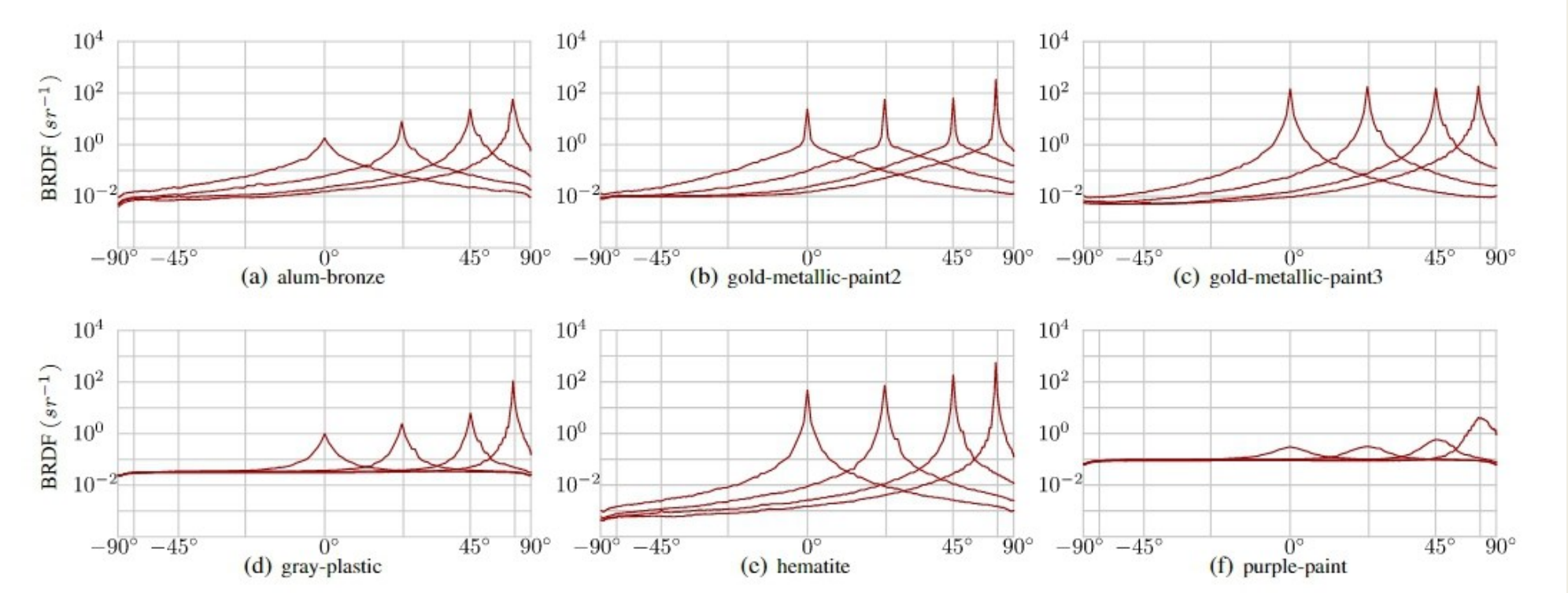
3D





Examples of BRDFs in PDV

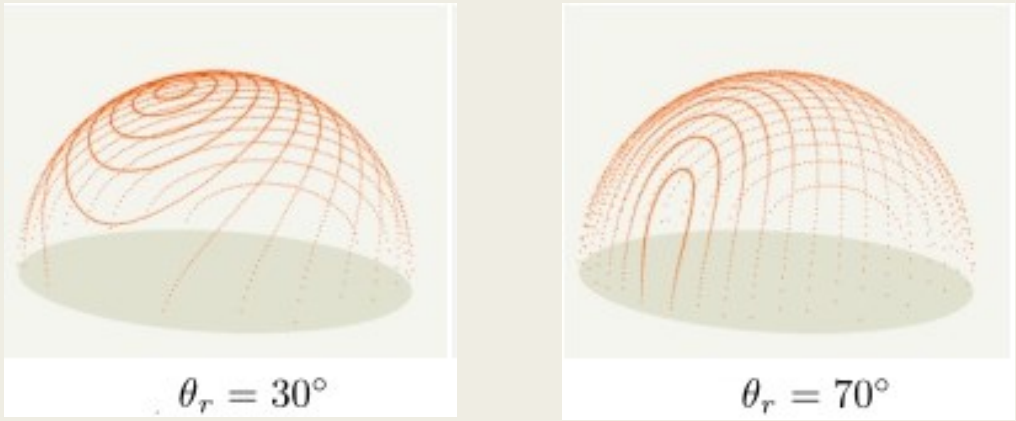
$$\theta_r = 0^\circ, 30^\circ, 45^\circ, 60^\circ$$



Figures from : BRDF models for accurate and efficient rendering of glossy surfaces by Löw et al.

PDV Coordinates Vs. BRDF Iso-contour

- The PDV coordinates behave similarly to BRDF iso-contour plots.



Coordinates

Iso-contour plots of BRDFs

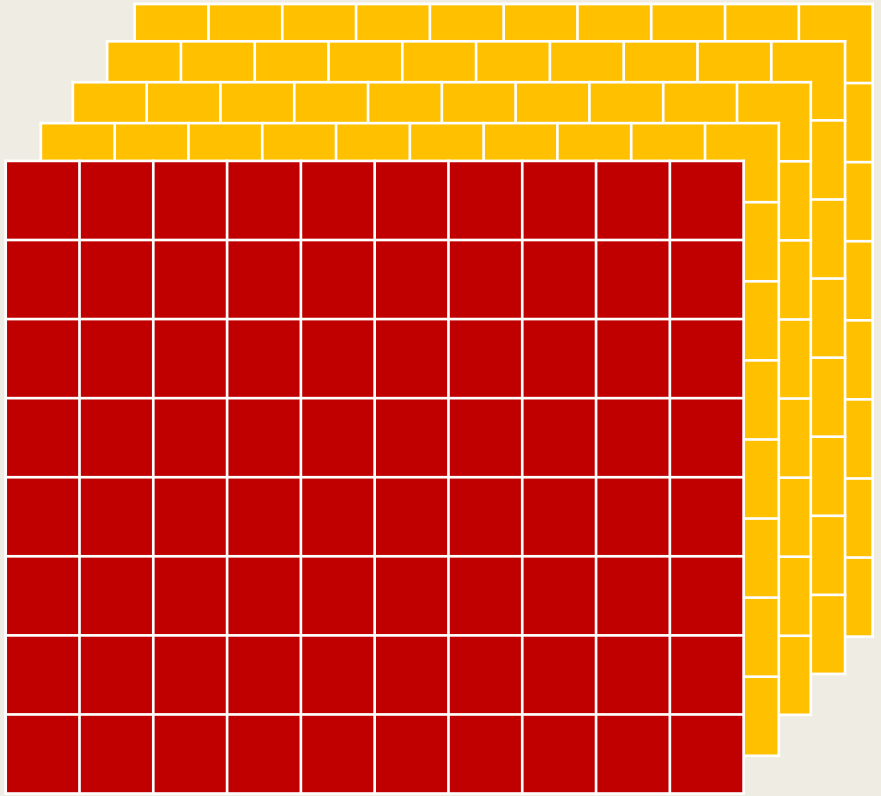
Right figures from : BRDF models for accurate and efficient rendering of glossy surfaces by Löw et al.

BRDF Basis Measurements

- Assumptions
  - *The PDV parameterization can be described by a function of (θ_r, d_p) because of the radial symmetry of BRDF values.*
  - *The logarithmic transformed BRDF values on PDV space are separable.*

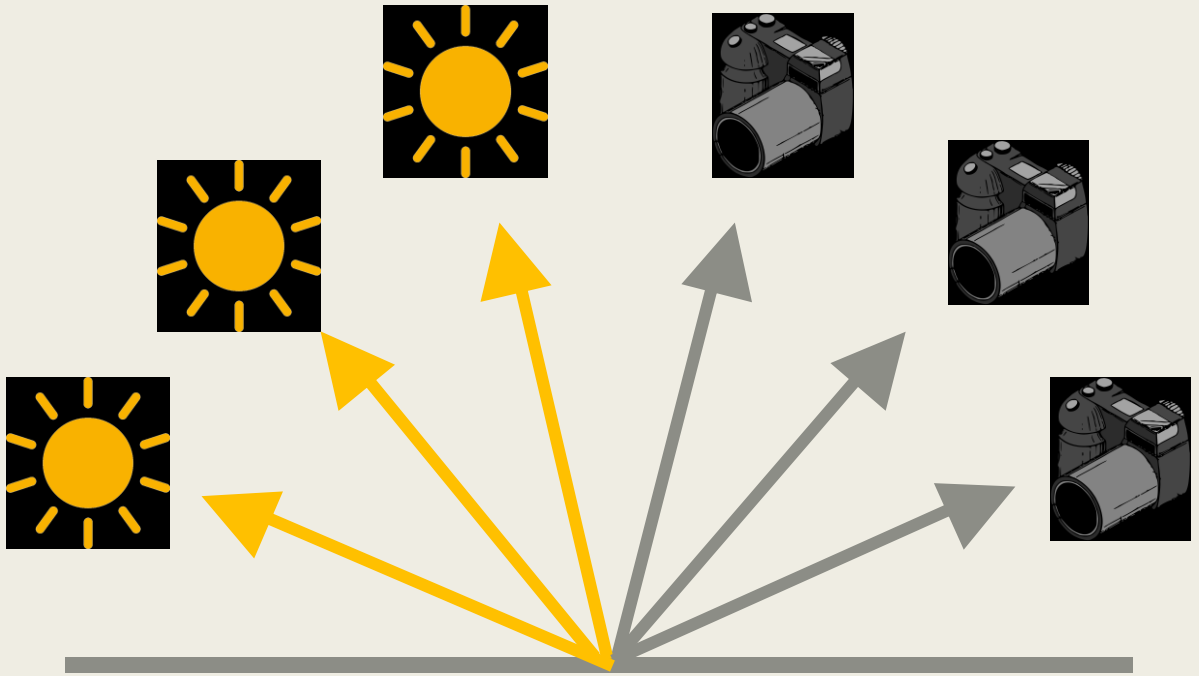
$$\rho_t(\theta_r, d_p, \phi_p) = F_1(\theta_r)F_2(d_p) \quad \phi_p)$$

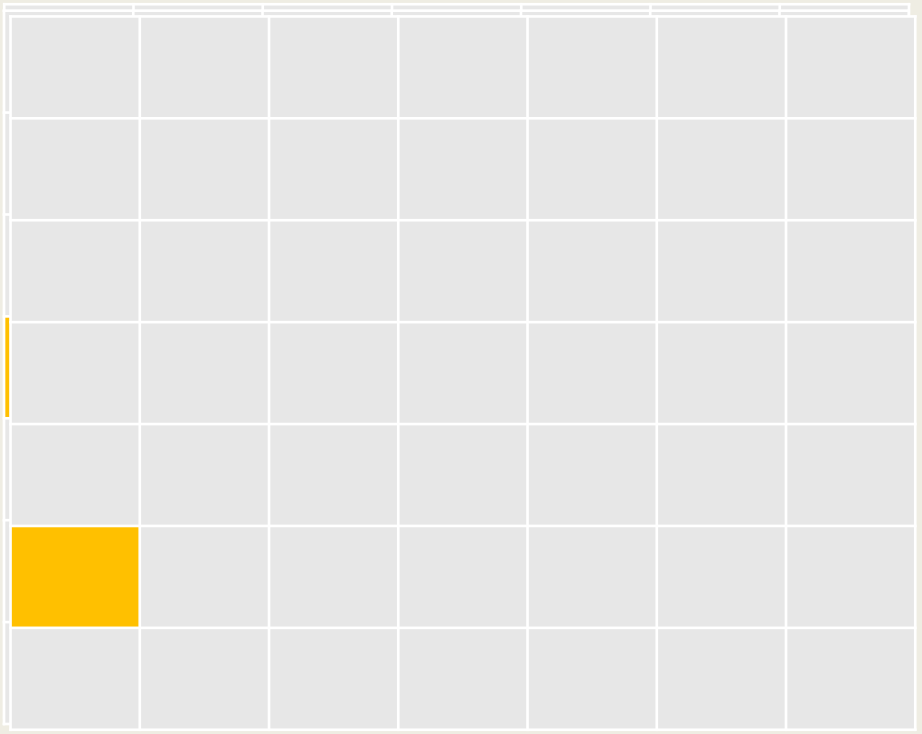
BRDF Basis Measurements



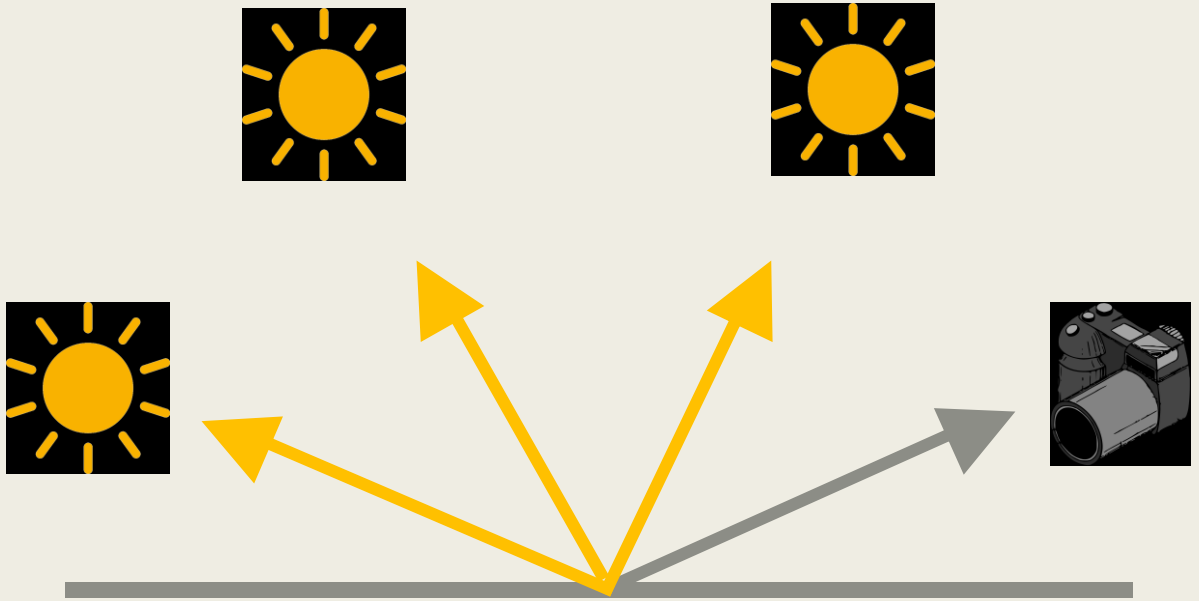
Estimating 3D BRDF with 2D BRDF

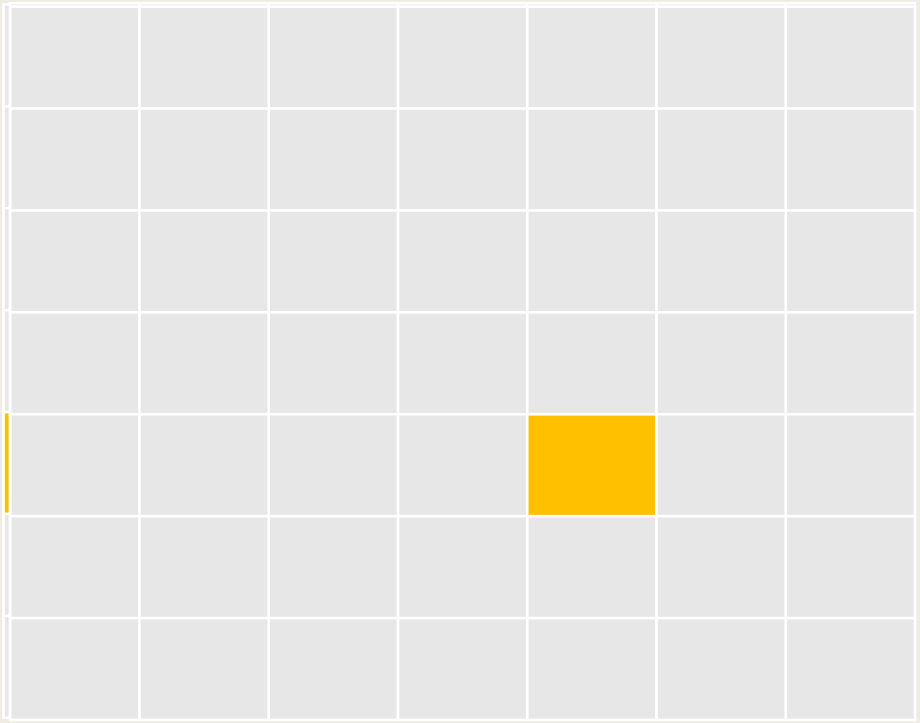
BRDF Basis Measurements (θ_r factor)



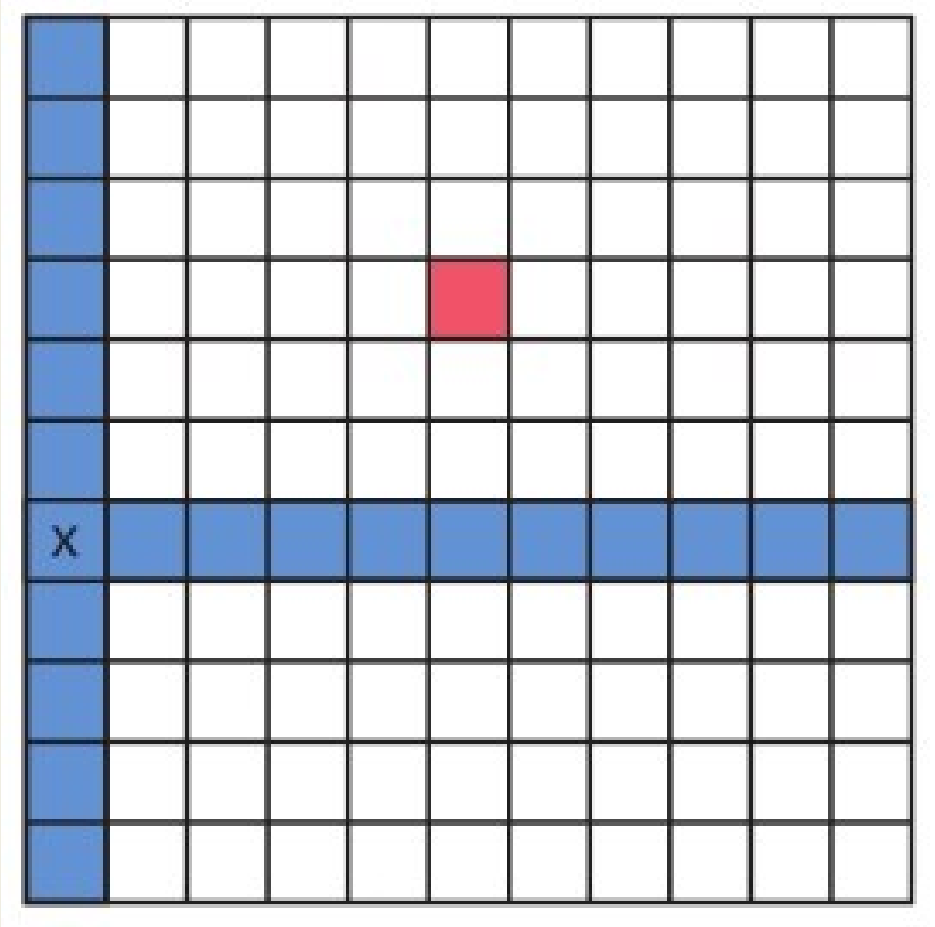


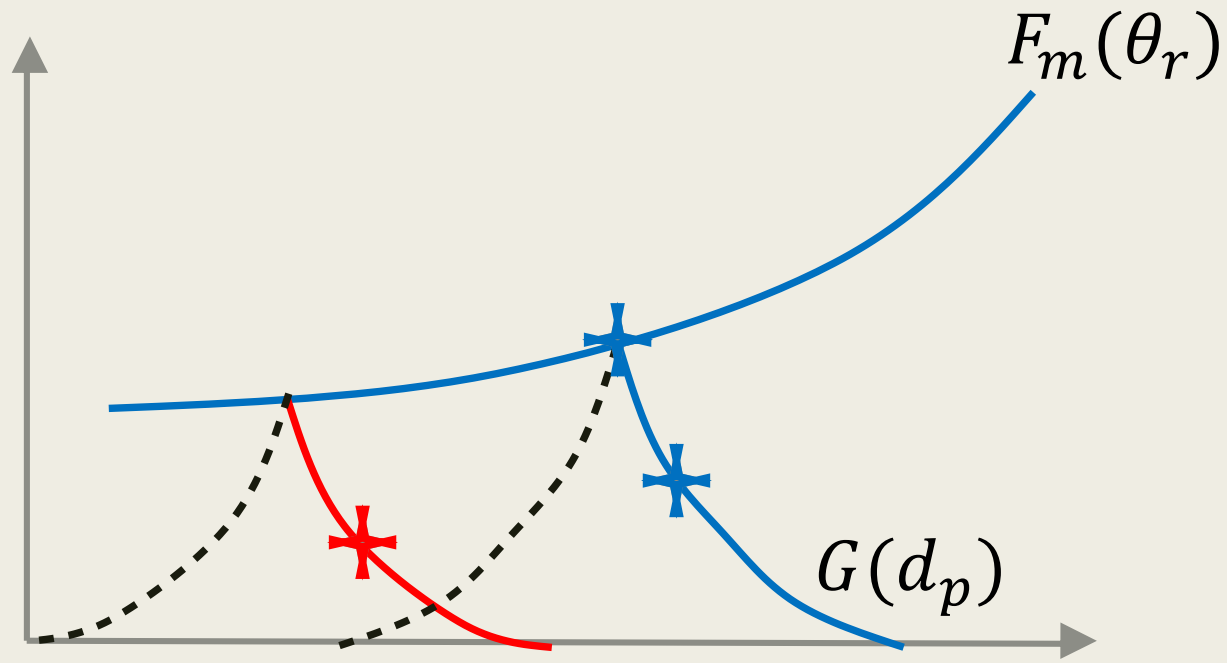
BRDF Basis Measurements (d_p factor)



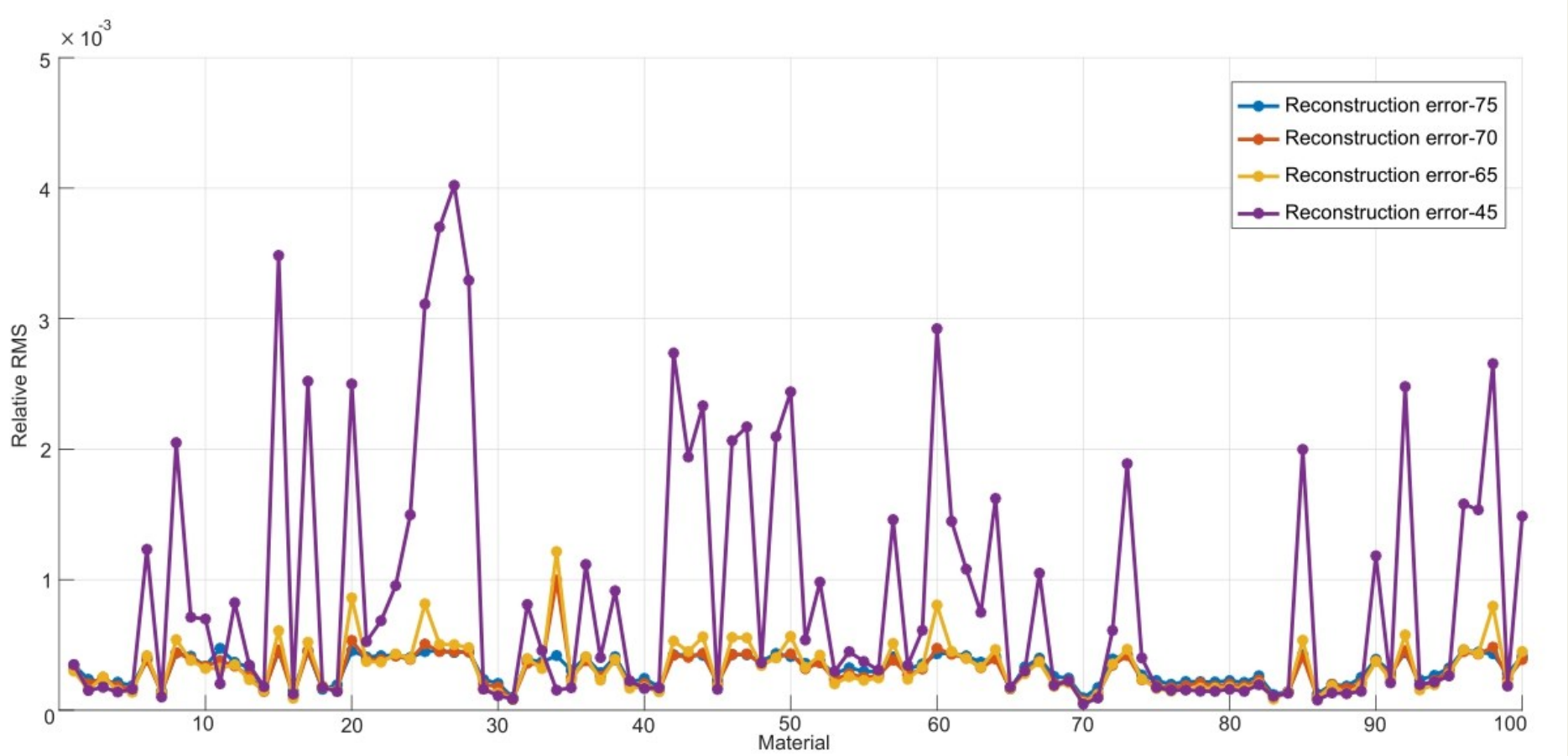


BRDF Reconstruction

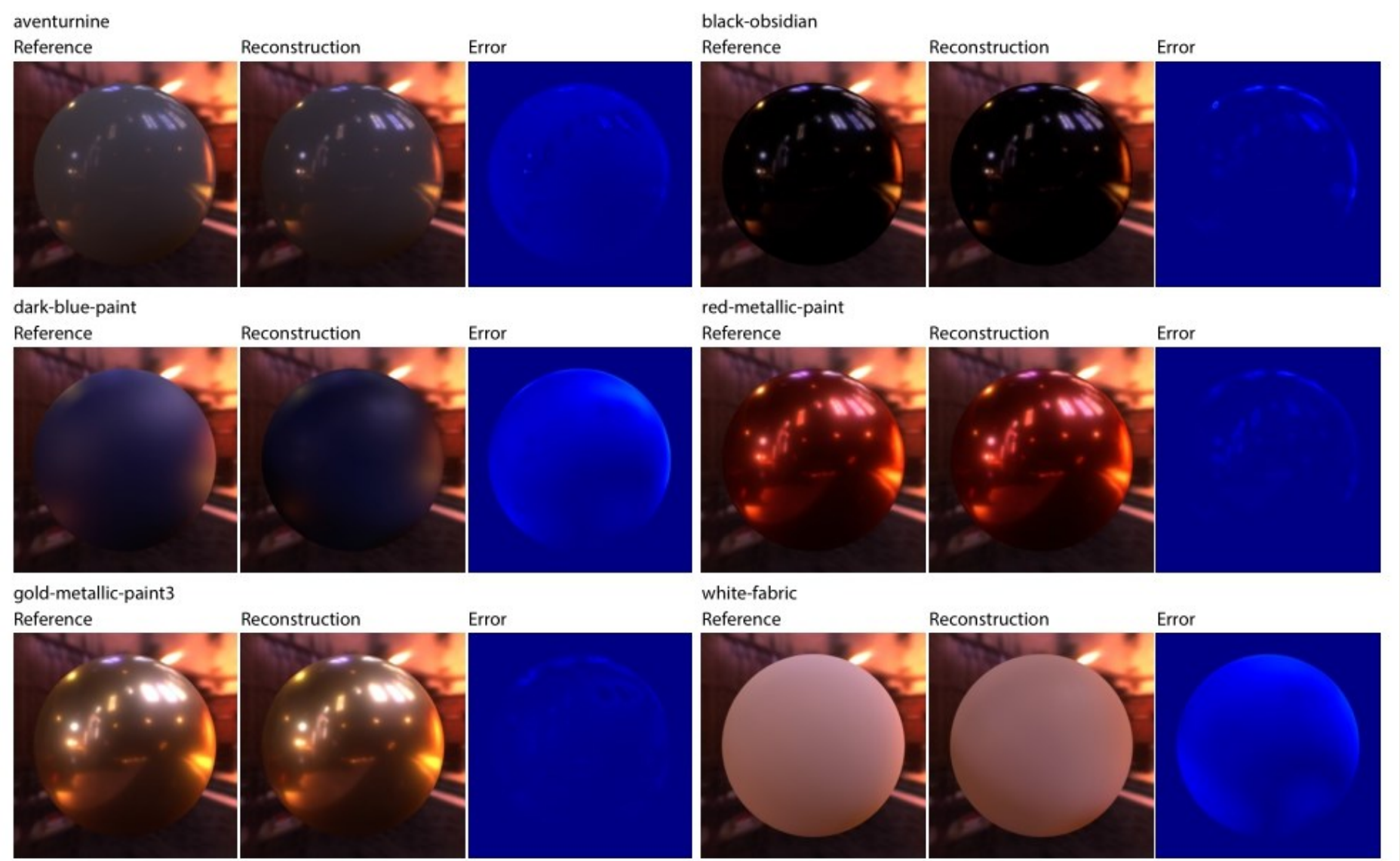




Results – Reconsturction Errors



Results - Rendering



Questions ?