LinSSS: Linear decomposition of heterogeneous subsurface scattering for real-time screen-space rendering
— Supplementary Document —

Tatsuya Yatagawa[1] Yasushi Yamaguchi[2] Shigeo Morishima[3]

[1] School of Engineering, The University of Tokyo, Tokyo, Japan
[2] Graduate School of Arts and Sciences, The University of Tokyo, Tokyo, Japan
[3] Graduate School of Advanced Science and Engineering, Waseda University, Tokyo, Japan

Appendix A Derivation of Eq. (11)

Suppose that the scaled incident irradiance $\hat{\Phi}$ is locally smooth enough to take the same value:

$$\hat{\Phi}(x') \equiv \hat{\Phi}_x \quad \text{for} \quad x' \in \mathcal{N}(x),$$

where $\mathcal{N}(x)$ is a set of neighboring pixels of x. Since we used normalized Gaussian functions to approximate the diffuse reflectance profile, the sum of the values of the Gaussian functions over the neighboring pixels will be one:

$$\sum_{x' \in \mathcal{N}(x)} G_\sigma(r) = 1, \quad \text{where} \quad r = \|x - x'\|.$$

Then, we can derive Eq. (11) as in the following:

$$\begin{aligned}
G_\sigma * (W \odot \hat{\Phi})(x) &= \sum_{x'} G_\sigma(r) W(x') \hat{\Phi}(x') \\
&\approx \left(\sum_{x'} G_\sigma(r) W(x') \right) \hat{\Phi}_x \\
&= \left(\sum_{x'} G_\sigma(r) W(x') \right) \left(\hat{\Phi}_x \sum_{x'} G_\sigma(r) \right) \\
&= \left(\sum_{x'} G_\sigma(r) W(x') \right) \left(\sum_{x'} G_\sigma(r) \hat{\Phi}_x \right) \\
&\approx \left(\sum_{x'} G_\sigma(r) W(x') \right) \left(\sum_{x'} G_\sigma(r) \hat{\Phi}(x') \right) \\
&= \Big((G_\sigma * W) \odot (G_\sigma * \hat{\Phi}) \Big) (x).
\end{aligned}$$

Appendix B Additional Results

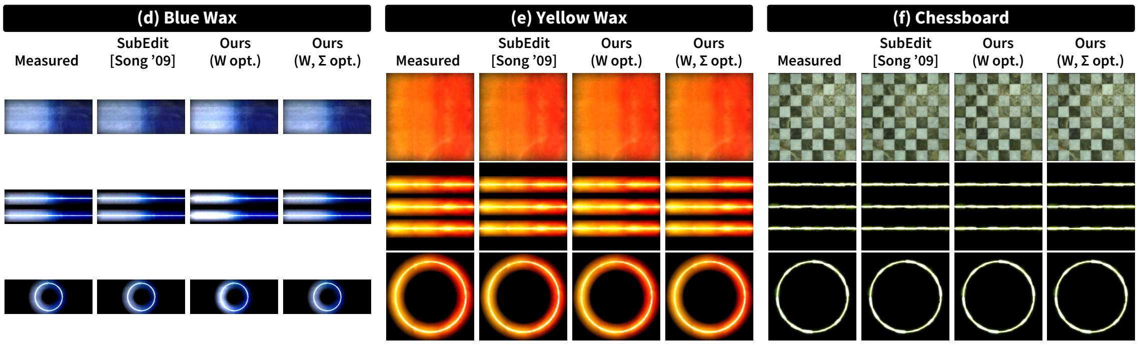

Fig. A1 Visual comparison of subsurface scattering representations for additional measured materials. The appearances are rendered for a flat geometry using uniform, line-shaped, and circle-shaped illuminations.

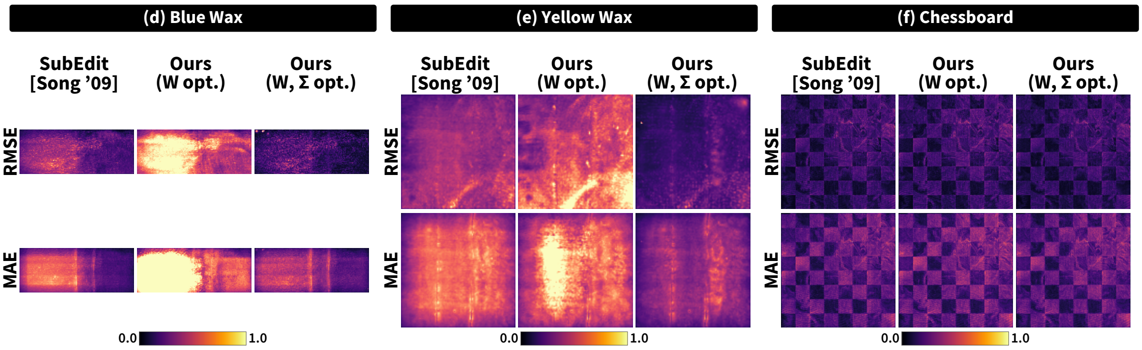

Fig. A2 Visualizations of RMSEs and MAEs for each subsurface scattering representations for additional measured materials. The errors are computed for each pair of 2D slices of measured and approximated diffuse reflectance profiles. The error values are normalized by the maximum values obtained for the SubEdit representation.

Table A1 The minimum, maximum, average values of RMSEs and MAEs are calculated for the error maps in Fig. A2. For each error metric and material, the lowest error values are indicated in bold.

		SubEdit [2]	Ours ($\mathbf{W}$ opt.)	Ours ($\mathbf{W}$, $\boldsymbol{\Sigma}$ opt.)
Error metric	Material	Min / Max /Avg.	Min / Max /Avg.	Min / Max / Avg.
RMSE	Blue Wax	0.0080 / **0.1689** / 0.0566	0.0258 / 0.2809 / 0.1213	**0.0064** / 0.4141 / **0.0341**
	Yell. Wax	0.0117 / **0.0840** / 0.0363	0.0186 / 0.1299 / 0.0504	**0.0060** / 0.1612 / **0.0190**
	Chess	**0.0243** / 1.7674 / 0.3159	0.0434 / 1.7736 / 0.3331	0.0290 / **1.4997** / **0.3021**
MAE	Blue Wax	**0.0015** / 0.0287 / 0.0125	0.0032 / 0.0873 / 0.0340	0.0023 / **0.0252** / **0.0110**
	Yell. Wax	0.0028 / 0.0221 / 0.0129	0.0036 / 0.0342 / 0.0145	**0.0021** / **0.0174** / **0.0086**
	Chess	**0.0019** / 0.0952 / **0.0253**	0.0039 / 0.0972 / 0.0280	0.0033 / **0.0926** / 0.0259

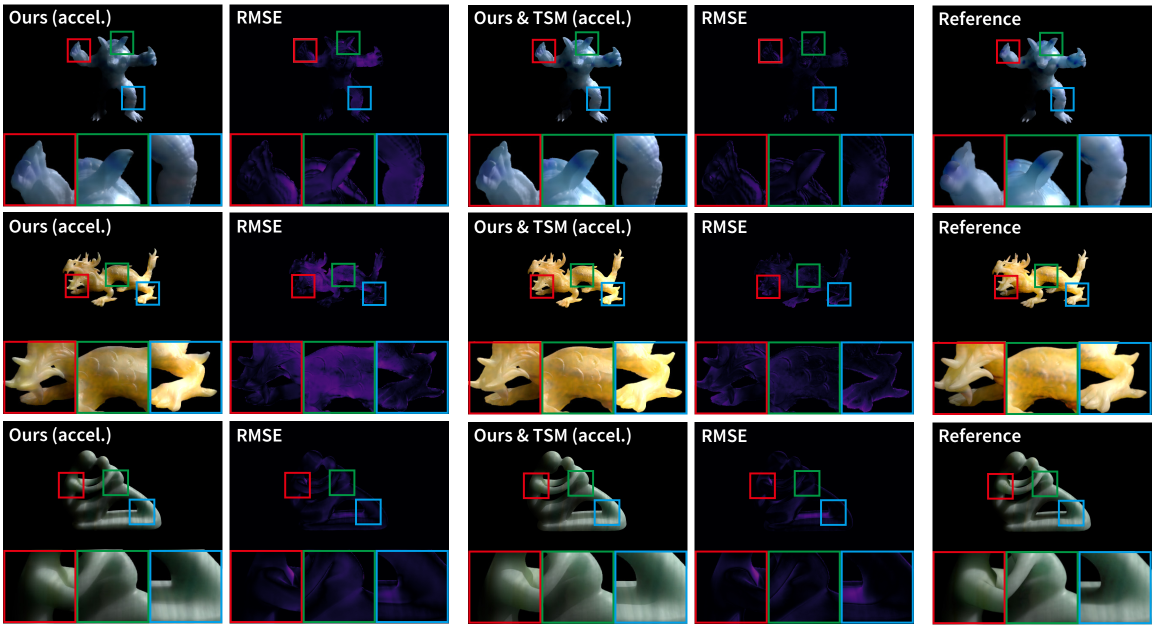

Fig. A3 Comparison of rendering results of our method with and without transmitted light computed using translucent shadow maps (TSM) [1]. As shown in this figure, the TSM significantly improves the realism of our screen-space method, since the transmitted light is not considered by our method alone. The RMSE against the path-traced results are also reduced significantly.

References

[1] Dachsbacher, C., Stamminger, M.: Translucent shadow maps. In: Proc. of the Eurographics Workshop on Rendering, pp. 197–201 (2003). https://doi.org/10.2312/EGWR/EGWR03/197-201

[2] Song, Y., Tong, X., Pellacini, F., Peers, P.: Subedit: A representation for editing measured heterogeneous subsurface scattering. ACM Trans. Graph. **28**(3), 31:1–31:10 (2009). https://doi.org/10.1145/1576246.1531337