Supplementary Material for
"Fast Voxelization and Level of Detail for Microgeometry Rendering"

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In this Supplementary Material, we show additional results and information:

1 Additional results

First we present results for our method, on two scenes: an anisotropic metallic table (Figure 2), and a scarf showing complex microgeometry (Figure 3).

We also show a limit case for our voxelization pipeline (Figure 5), a complex fiber-level fabric exhibiting macroscale anisotropic and specular effects.

We provide an additional comparison for the interpolation methods discussed in the manuscript when using triangles as input primitive for our pipeline (Figure 6).

2 Additional metrics

We provide quantitative metrics and resolution data for the remaining scenes in Table 1.

To better understand the measured performance data presented in the manuscript, we also provide photographs of the original scenes replicated for measurements in the main manuscript in Figure 4.

3 Aggregation synthetic test

To provide additional insight into how our hierarchical method works, we have designed a synthetic test where the original distribution is a mixture of SGGXs combined with equal probability.

We start with 6 SGGX functions with random parameters to generate a multi-modal distribution. Our SGGX functions are defined as:

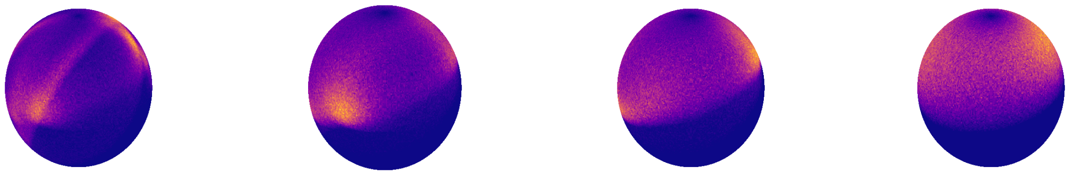
$$
\begin{aligned}
SGGX_0 &= [0.05, 0.45, 0.05, 0.0, 0.0, 0.03] \\
SGGX_1 &= [0.01, 0.05, 0.05, 0.0, 0.02, 0.0] \\
SGGX_2 &= [0.05, 0.01, 0.05, 0.02, 0.0, 0.0] \\
SGGX_3 &= [0.04, 0.04, 0.01, 0.02, 0.015, 0.01] \\
SGGX_4 &= [0.03, 0.01, 0.03, 0.01, 0.02, 0.015] \\
SGGX_5 &= [0.01, 0.03, 0.04, 0.015, 0.01, 0.02]
\end{aligned} \tag{1}
$$

where our parameters define $S_{xx}S_{yy}S_{zz}S_{xy}S_{xx}S_{yz}$ in order.

We plotted the samples obtained in 3D space, as well as compute Jensen–Shannon divergence metric between the original mix of distributions and

- Our hierarchical fit with 4 SGGX functions.
- Our hierarchical fit with 3 SGGX functions.
- A single SGGX function, as the original manuscript already suggested.

We show each plot and metric in Figure 1



(a) Ground truth (b) 4 SGGXs (0.0427) (c) 3 SGGXs (0.0820) (d) 1 SGGX (0.0965)

Figure 1: Synthetic test showing how our hierarchical process merges the closest SGGX functions to reduce the resulting error. We show the Jensen–Shannon divergence from the ground truth for each LoD in each subcaption.

References

[1] E. Heitz, “A Low-Distortion Map Between Triangle and Square.” working paper or preprint, 2019.

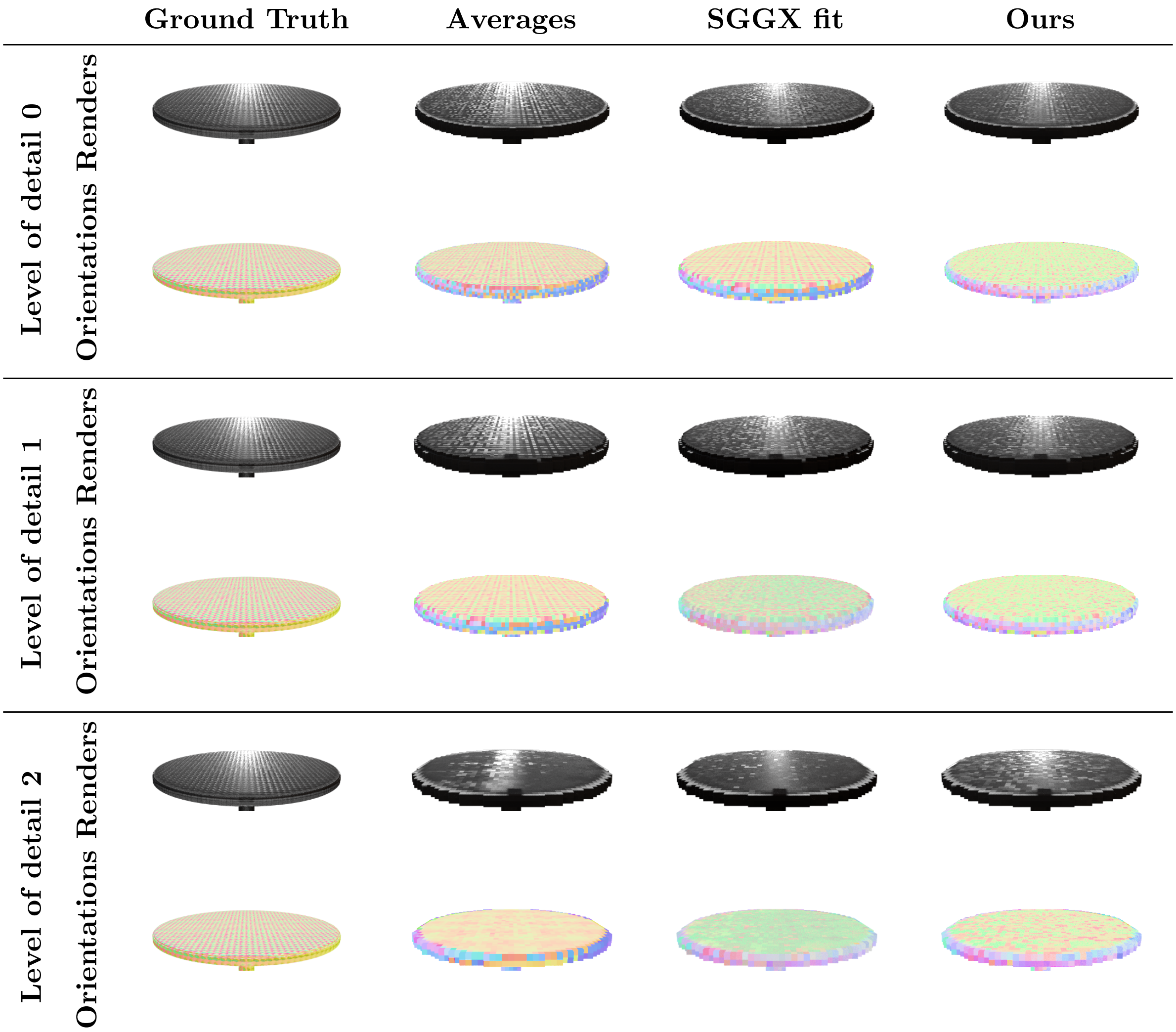


Figure 2: Comparisons of renders at different voxelization LoDs of an anisotropic table using Ground Truth data (left), naive fit to SGGX model (center) and our hierarchical model (right) for orientation storage. Tangent orientation averages to the direction between 2 perpendicular directions, however, our method evaluates separated samples of the distribution without averaging them, leading to proper shading results.

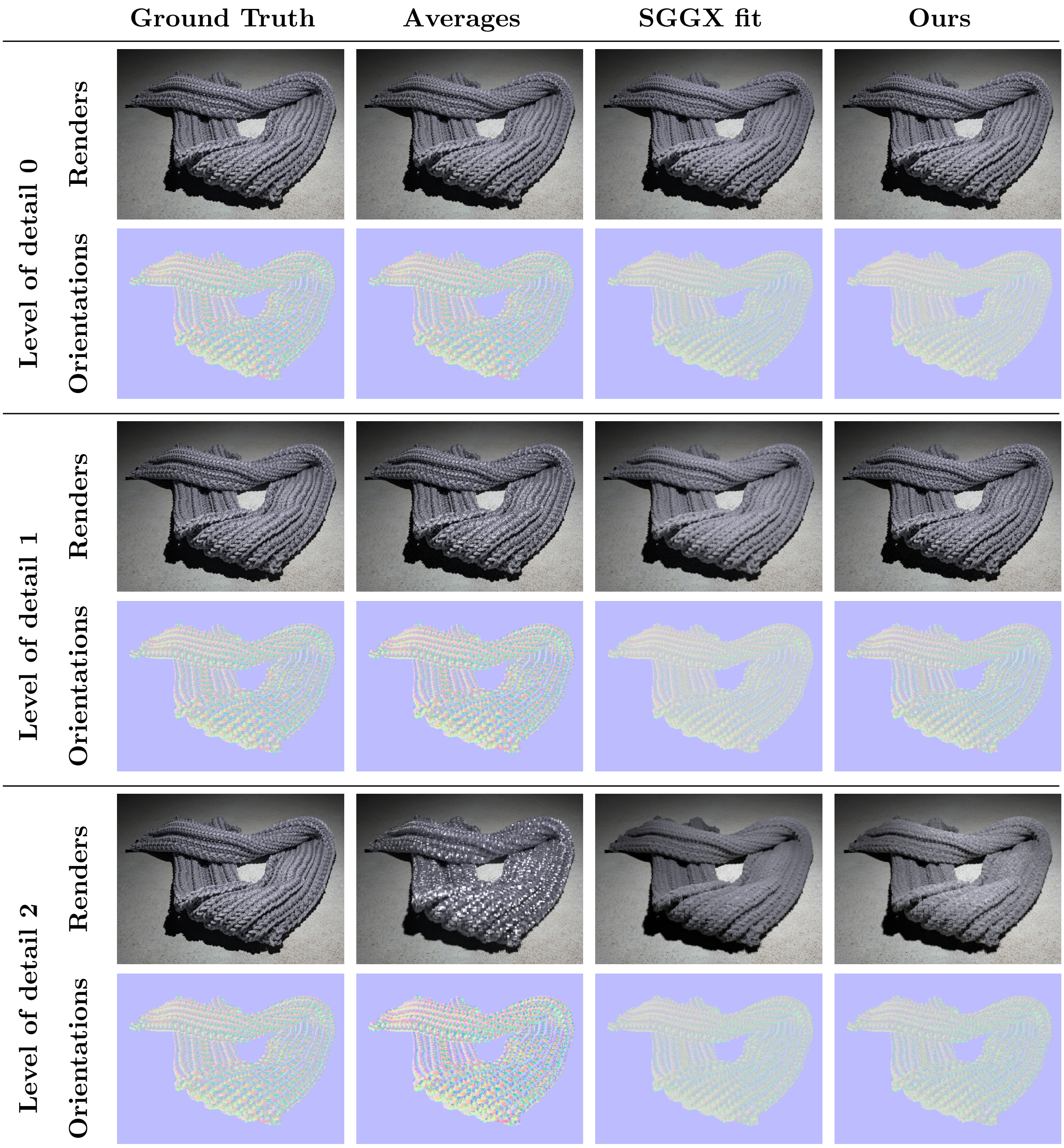


Figure 3: Comparisons of renders at different voxelization LoDs of the Scarf volume using Ground Truth data (left), naive fit to SGGX model (center) and our hierarchical model (right) for orientation storage.

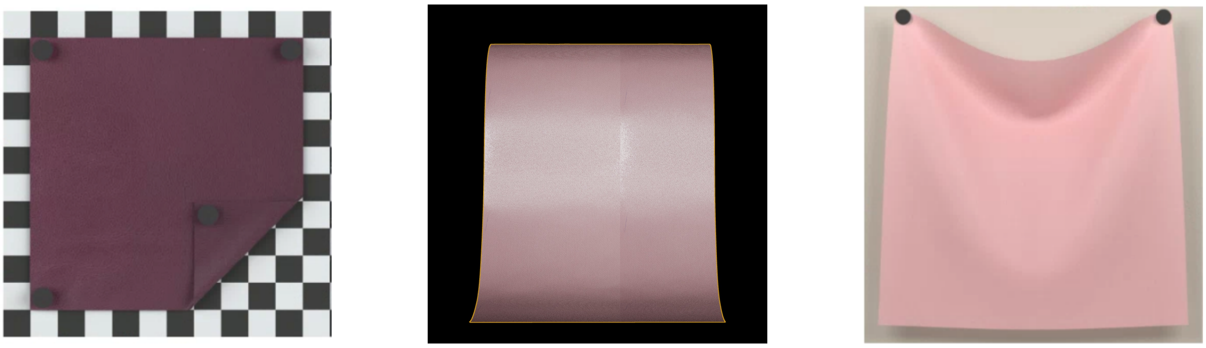


Figure 4: From left to right, configuration of the 3 scenes used for voxelization measurements: **Flat**, **Folded** and **Hanging**

Scene (Resolution)	Resolution	Method	
		Naive	Ours
Grass (2048)	200	0.259	0.256
Hibiscus (2048)	200	0.211	0.204
Gardenia (2048)	200	0.162	0.154
Plain-weave (8192)	512	0.444	0.387
Wavy Hair (1024)	64	0.064	0.059
Natural Hair (1024)	64	0.120	0.114

Table 1: Quantitative metrics and resolution data for voxelization of Levels of Detail for scene where we compare SGGX-H against a Naive approach.

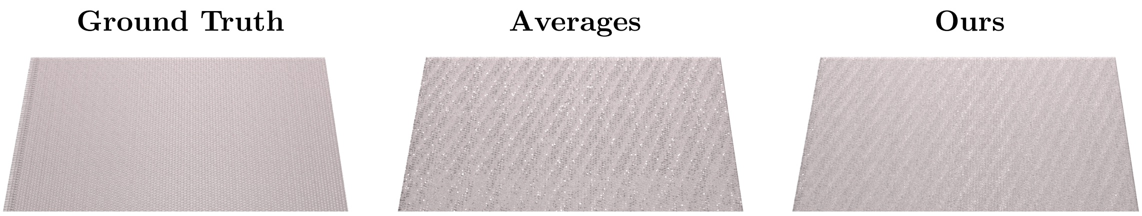
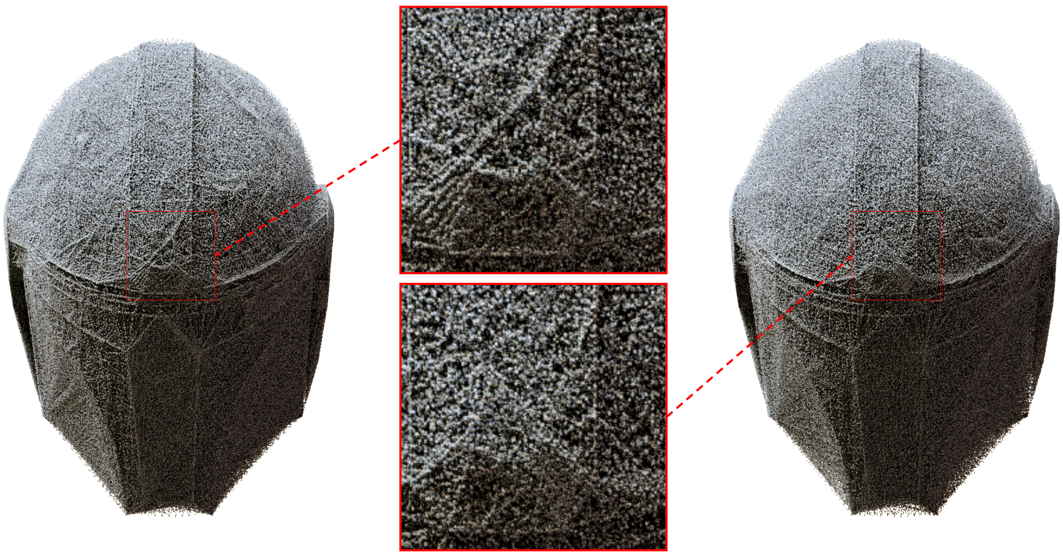


Figure 5: A limit case for Level of Detail generation. We voxelize a plain-weave fabric using two perpendicular yarns and large voxel sizes (similar scale to the yarns). We see that both methods struggle to generate LoDs for thin surfaces when resolution is too low due to wrong density order (creating a visible artifact). However, due to its multi-distribution structure, SGGX-H helps in reproducing more accurate reflections.



Naïve (a) Area (b)

Figure 6: Improved interpolation method based in Heitz's mapping (1) (right) reduces visible triangles edges after voxelization compared to naïve interpolation (left). Uniform random sampling is not used, all the samples are generated in GPU threads based on thread identifier.