Transparent Object Reconstruction via Implicit Differentiable Refraction Rendering –Supplementary Material–

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Figure 1: The results of [Bemana et al. 2022] on synthetic data "Pig". We show their view synthesis results on two novel views, compared with the ground truth as reference. The shape is extracted from their eikonal field with the marching cubes algorithm and manually set optimal threshold.

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1 COMPARISON WITH THE EIKONAL FIELD

Recently, Bemana et al. [2022] proposed a novel method for refractive novel-view synthesis, which also takes multi-view RGB images as input and considers the refractive ray. We render the transparent objects within a richly textured box since their method does not handle the scene outside the unit sphere. The ground truth object bounding boxes are provided.

Bemana et al. utilized an eikonal field that represents the indices of refraction(IoR) of points in the scene to achieve the simulation of ray refraction. However, their approach does not take into account the effect of highlights caused by total reflection on optimization. As a result, it fails to provide reasonable results when dealing with complex objects. As shown in Fig. 1, the head of the pig is full of highlights when viewed from the front, and their method produces an unrealistic result. In contrast, our method reconstructs a reliable result, as in the main body of the paper.

In addition, the high degree of freedom in the eikonal field often prevents it from converging to an accurate representation. As shown in Fig. 3, although the method of Bemana et al. produces plausible images, the eikonal field coverage to a gradually varied field of IoR instead of a uniform solid with clear boundaries. It poses a challenge in setting an appropriate threshold for extracting accurate geometry using the marching cubes algorithm.

2 COMPARISON WITH DRT

We also compare our method with [Lyu et al. 2020], which reconstructs transparent objects in a highly controlled scene, on synthetic data for reference. Their method requires around 1,500 images captured with a screen displaying Gray code to reconstruct a detailed shape.

We run their method on our synthetic transparent objects, with input images rendered in their setting. The comparison is shown in Fig. 2. Both methods reconstruct shapes globally close to the

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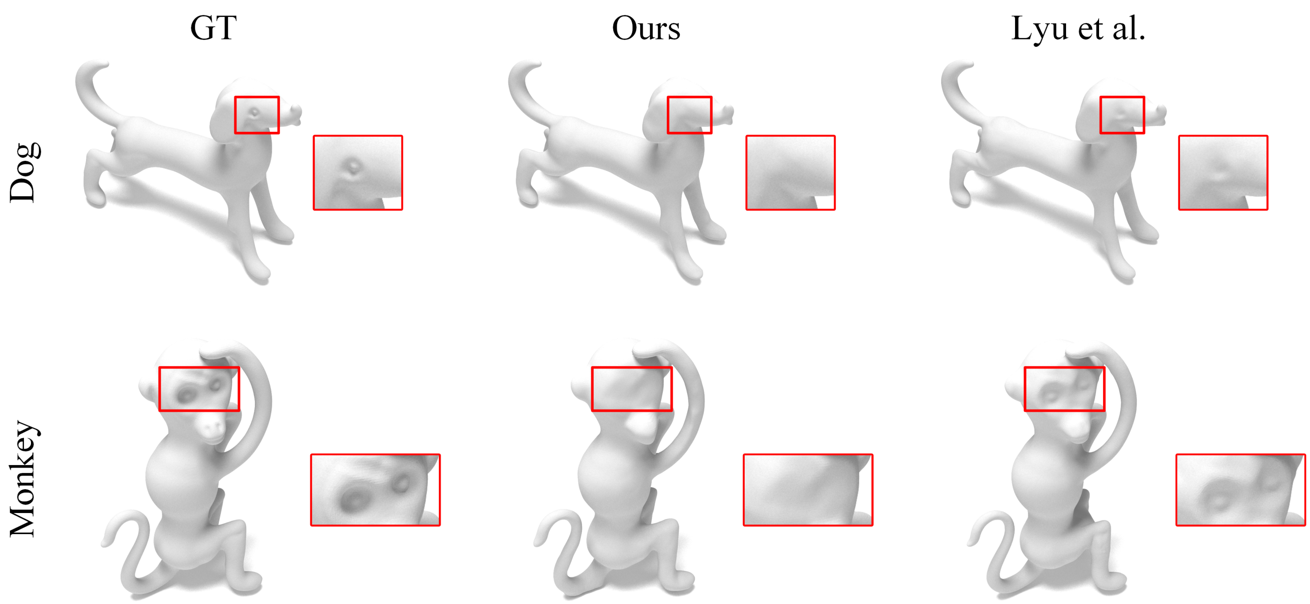

Figure 2: The comparison of our method and [Lyu et al. 2020]. Both methods reconstruct globally precise shapes, while Lyu et al. reconstructs more detailed eyes (marked in the red box) with constrained setups.

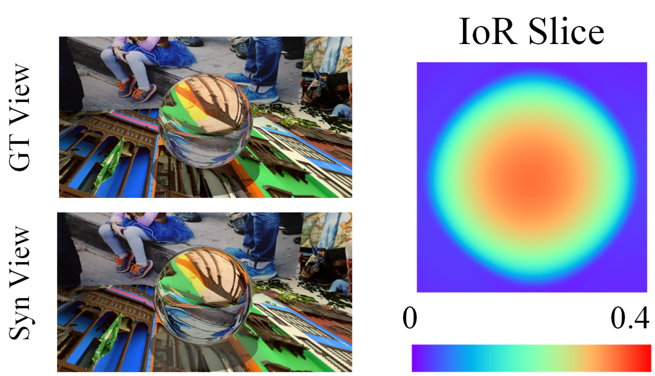

Figure 3: The results of [Bemana et al. 2022] on synthetic data "Ball". On the left, their view synthesis result. On the right, we present the IoR distribution on a cross-section of the ball, with a color bar provided below for reference.

ground truth, while their method can recover more local details, benefiting from more constrained settings.

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