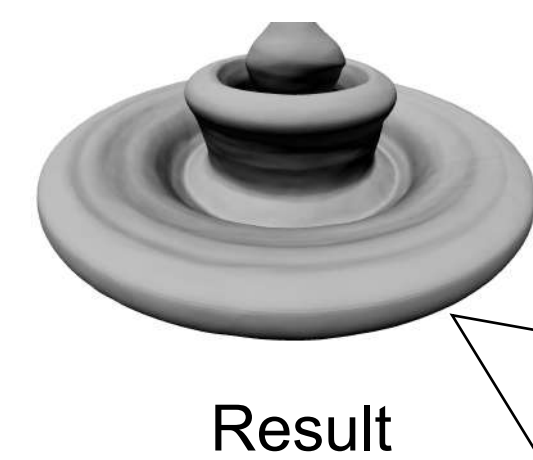


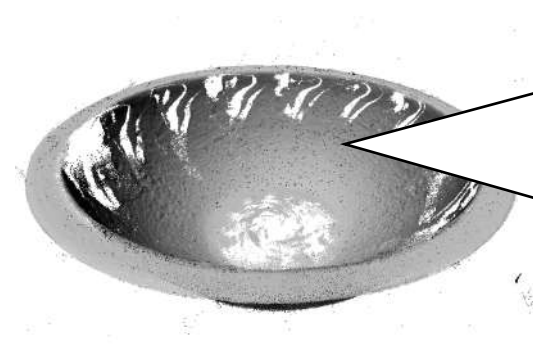
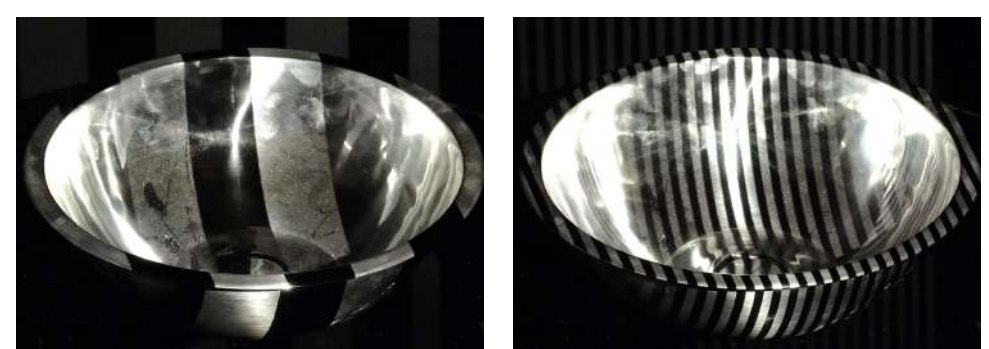
Introduction

Differentiable rendering-based method [1]



Failed to reconstruct the textureless and concave parts, because of the geometrical ambiguity of the observations.

Conventional structured light (SL) [2]



Incomplete for shiny object owing to the highlights in captured pattern images.

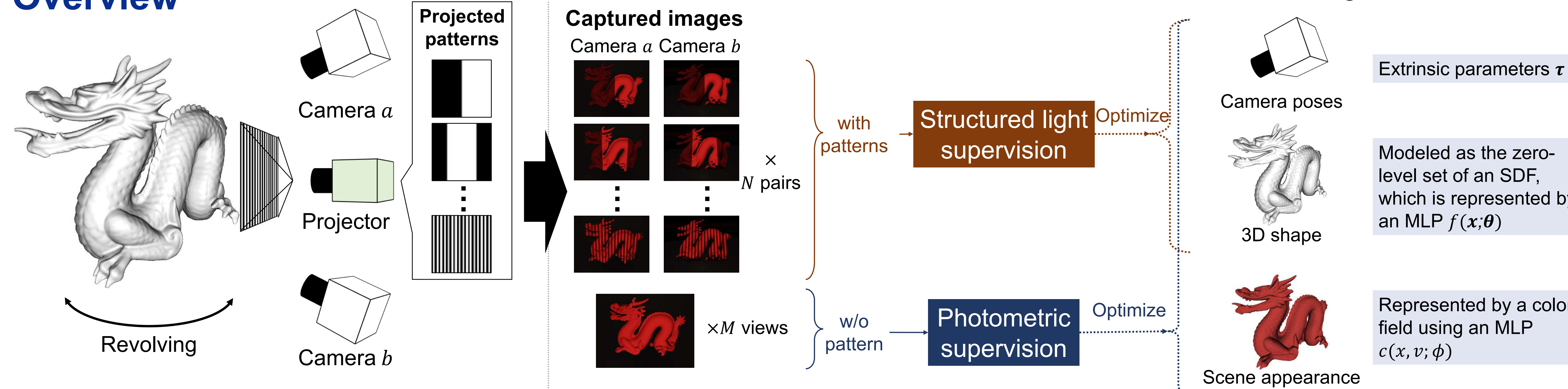


Our method

Combining SL and DR-based method

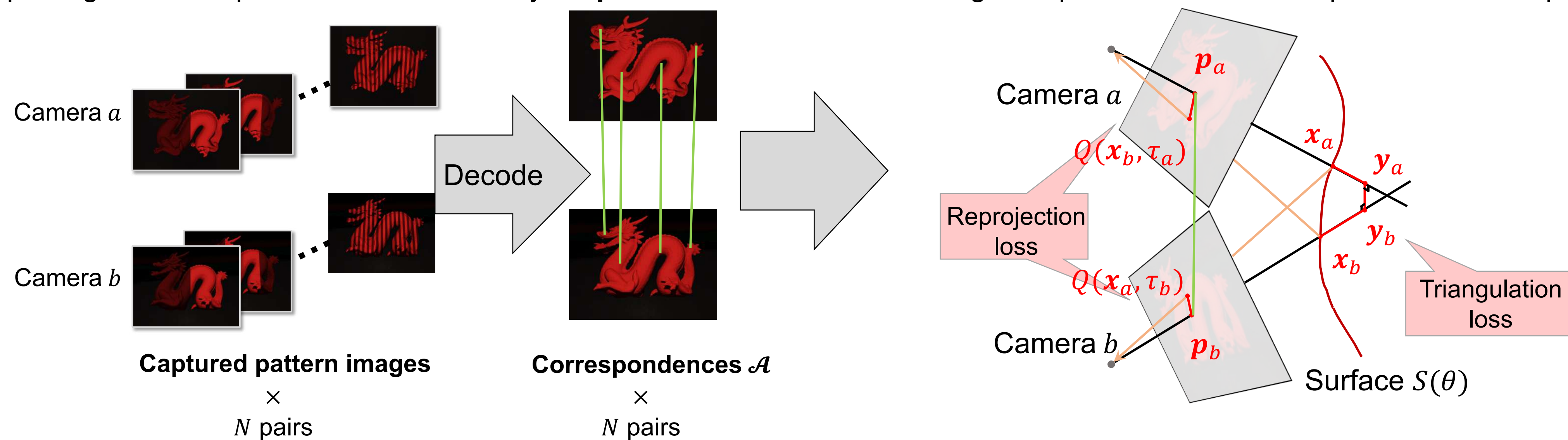
- SL supervision can provide important cues to reduce the geometrical ambiguity.
- Incomplete part for SL pattern can be optimized through photometric supervision.

Overview



Structured light supervision

Exploiting the correspondences extracted by **SL patterns** as constraints during the optimization of 3D shapes and camera poses.



Reprojection loss:

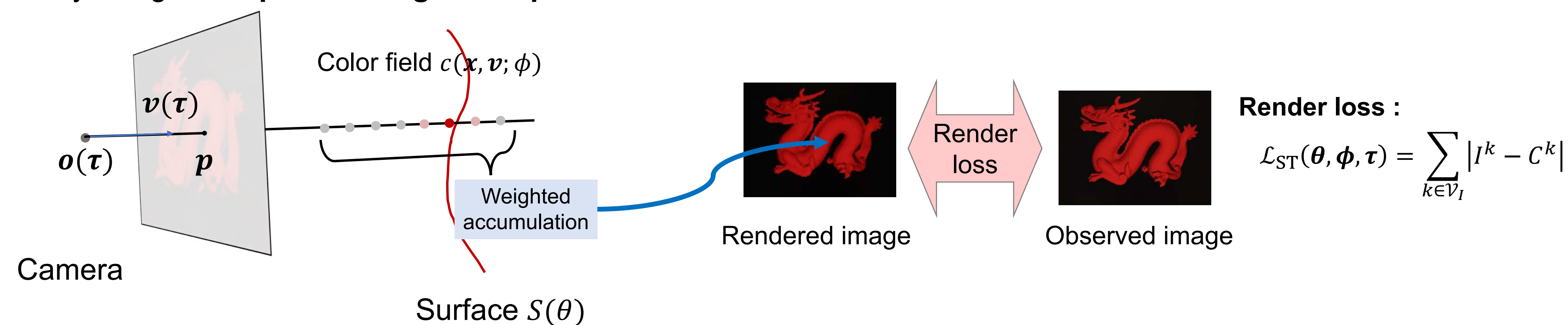
$$\mathcal{L}_{SR}(\theta, \tau) = \sum_n \sum_{i \in \mathcal{A}} (\|Q(x_a^{n,i}, \tau_b^n) - p_b^{n,i}\| + \|Q(x_b^{n,i}, \tau_a^n) - p_a^{n,i}\|)$$

Triangulation loss:

$$\mathcal{L}_{ST}(\theta, \tau) = \sum_n \sum_{i \in \mathcal{A}} (\|x_a^{n,i} - y_a^{n,i}\| + \|y_a^{n,i} - y_b^{n,i}\| + \|y_b^{n,i} - x_b^{n,i}\|)$$

Photometric supervision

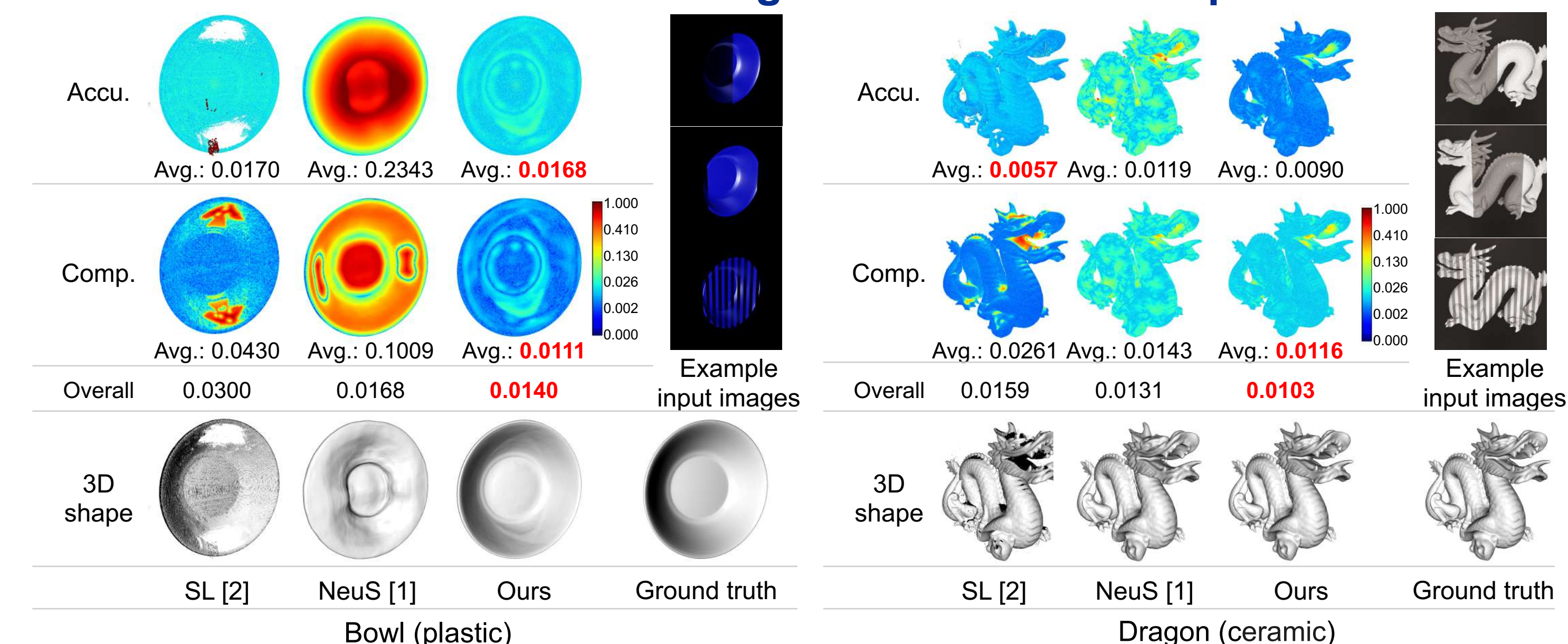
As the correspondences extracted using SL patterns are usually noisy and incomplete, we propose to consider rendered image consistency using the **captured images w/o pattern**.



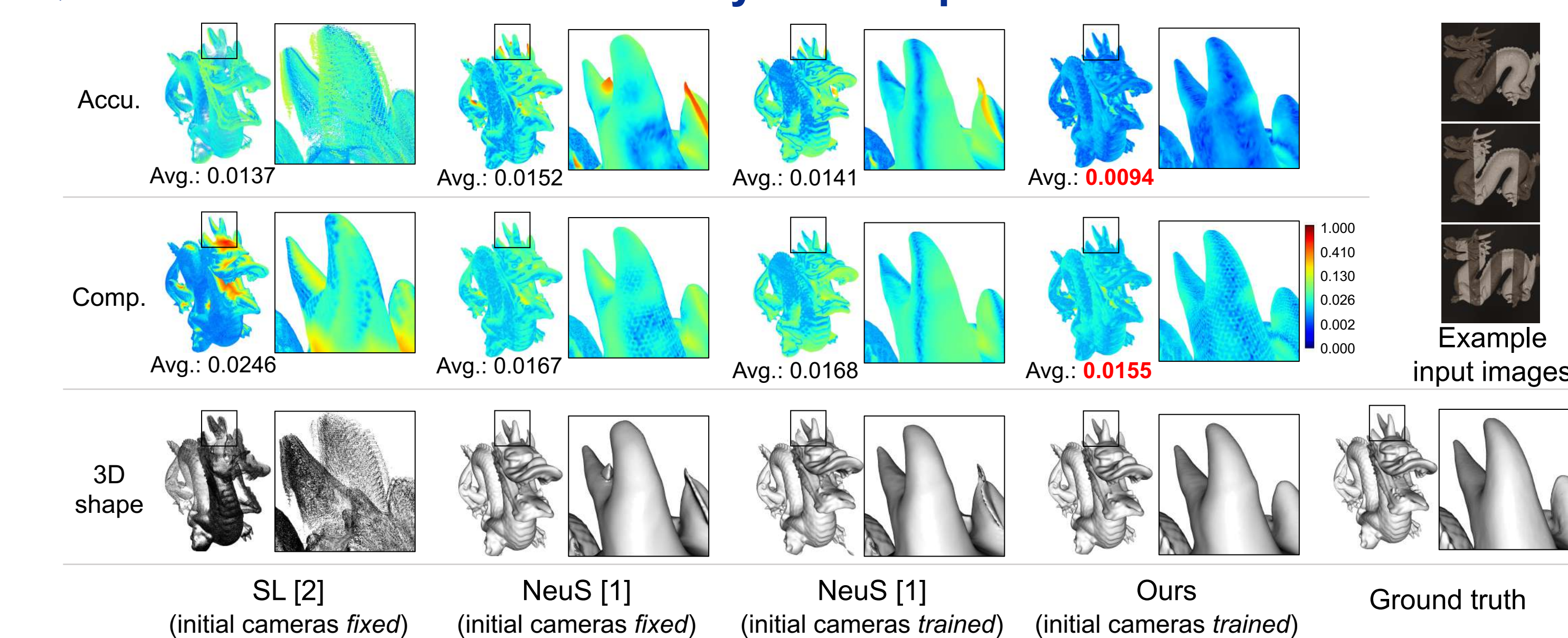
$$\mathcal{L}_{ST}(\theta, \phi, \tau) = \sum_{k \in \mathcal{V}_I} |I^k - C^k|$$

Experimental Results

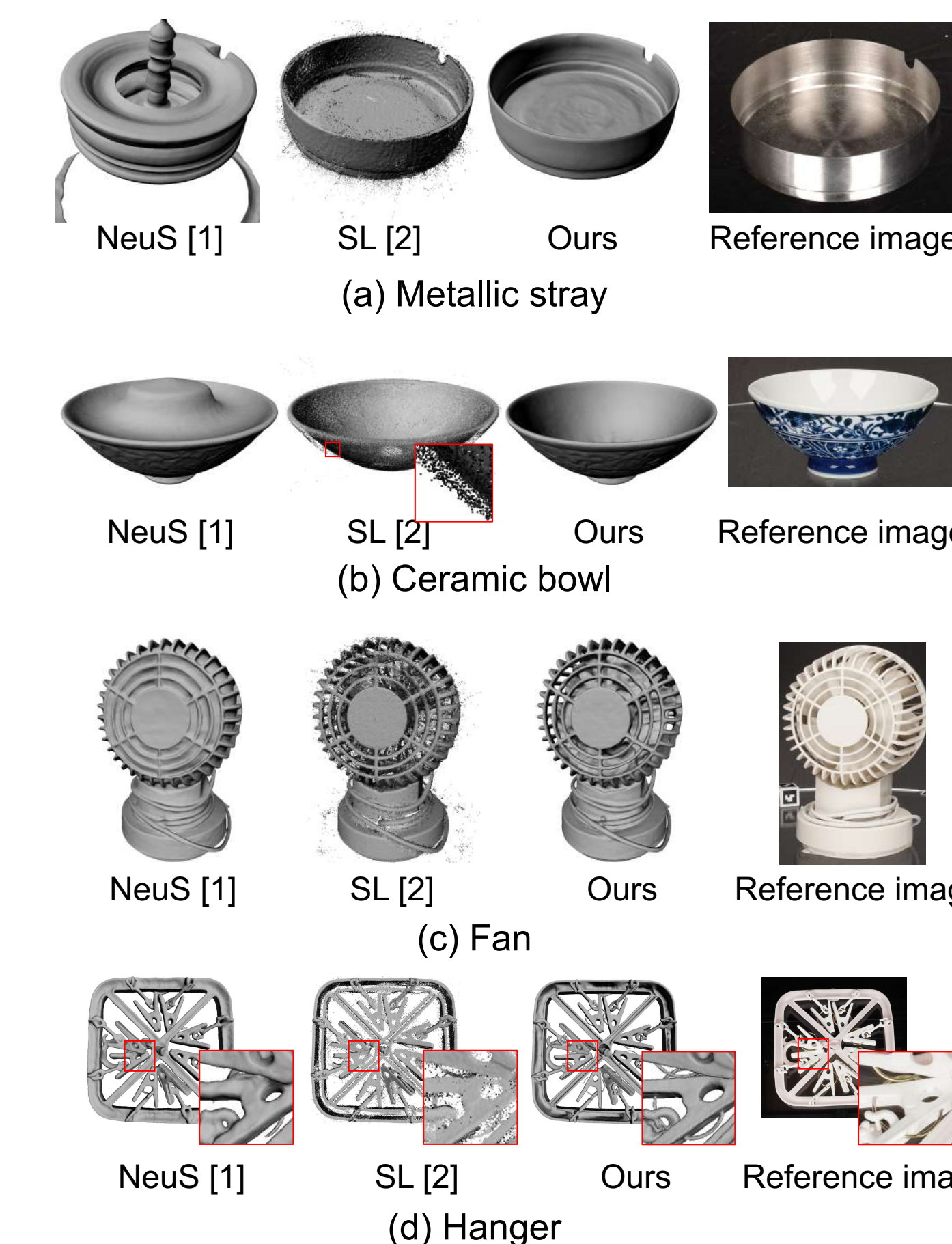
Quantitative evaluation with fixed ground truth camera poses



Quantitative evaluation with noisy camera poses



Evaluation on real-world dataset



Comparison of camera poses between initial and optimized values

	Initial	Optimized
Direction (deg)	0.070	0.049
Position (m)	0.075	0.011

Reference

- [1] Peng Wang, et al. Neus: Learning neural implicit surfaces by volume rendering for multi-view reconstruction. In NeurIPS, 2021.
[2] Kyriakos Herakleous, et al. 3DUNDERWORLD-SLS: An open-source structured-light scanning system for rapid geometry acquisition. arXiv, 2014.