NEMTO: Neural Environment Matting for Novel View and Relighting Synthesis of Transparent Objects

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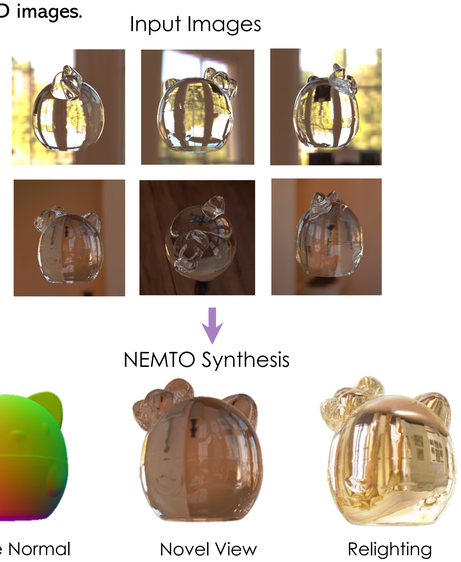
Problem

The entangled geometry and illumination-dependent appearance of transparent objects make it hard to create their 3D representations through 2D images.

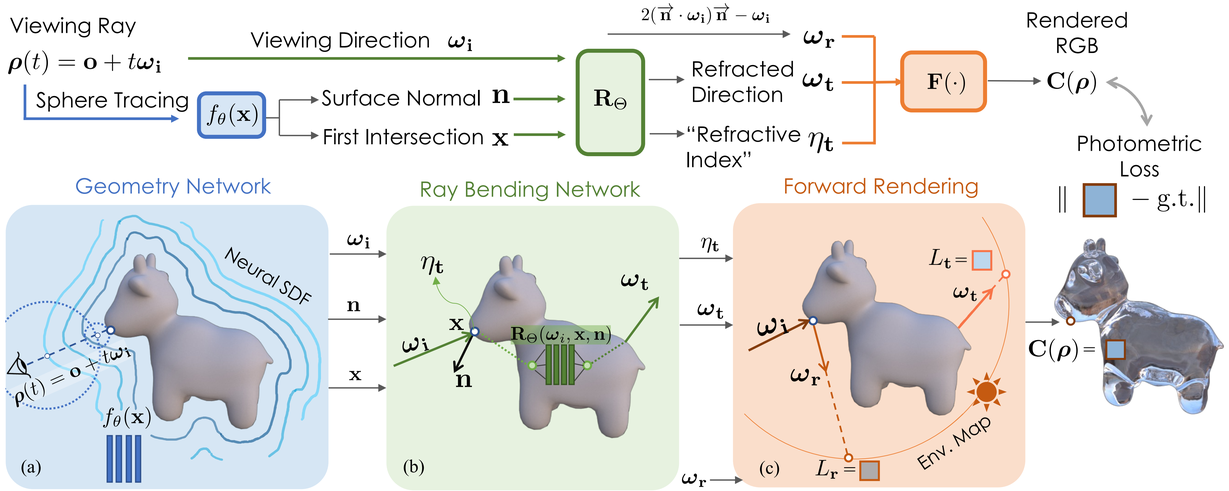


NEMTO synthesizes high-quality novel view and relighting by disentangling the geometry and illumination-dependent appearance of a transparent object.

Contributions

- NEMTO is the first end-to-end method for novel view synthesis and scene relighting for transparent objects.
- A physically-guided Ray Bending Network (RBN) for predicting ray paths through the transparent object with better error tolerance for the estimated geometry than analytically calculated refraction.
- Can model real-world transparent objects by hand-captured image.

Overview of NEMTO Framework



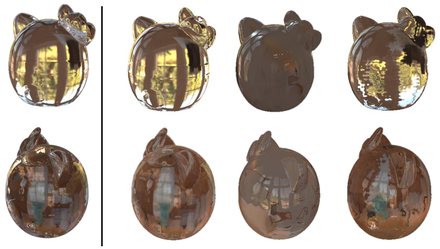
Loss Functions

For ray refraction estimation, we use two losses:

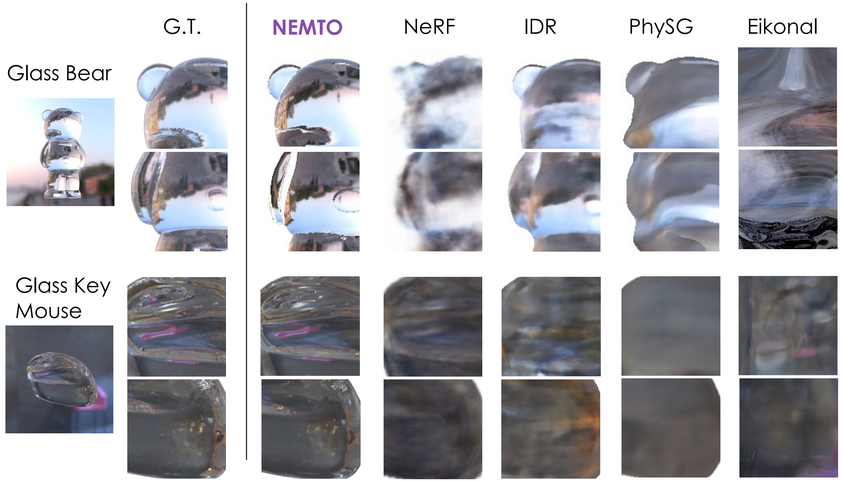
$\mathcal{L}_{\text{rg}}$ guides the refraction direction exiting the object toward the analytical solution.

$\mathcal{L}_{\text{rs}}$ encourages locally smooth refraction directions.

Ablation on Refraction Losses



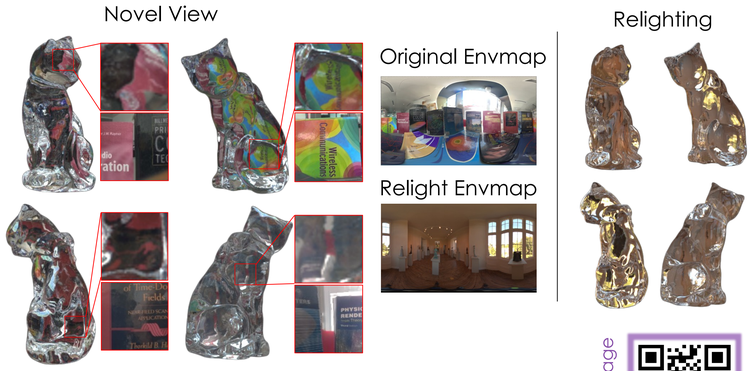
Novel View Comparison to Baseline Methods



Relighting Results

Synthesis on Real-World Captured Dataset

Despite the inaccuracy in real-world camera poses and captured environment maps, NEMTO synthesizes visually-plausible novel views and relighting results,



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