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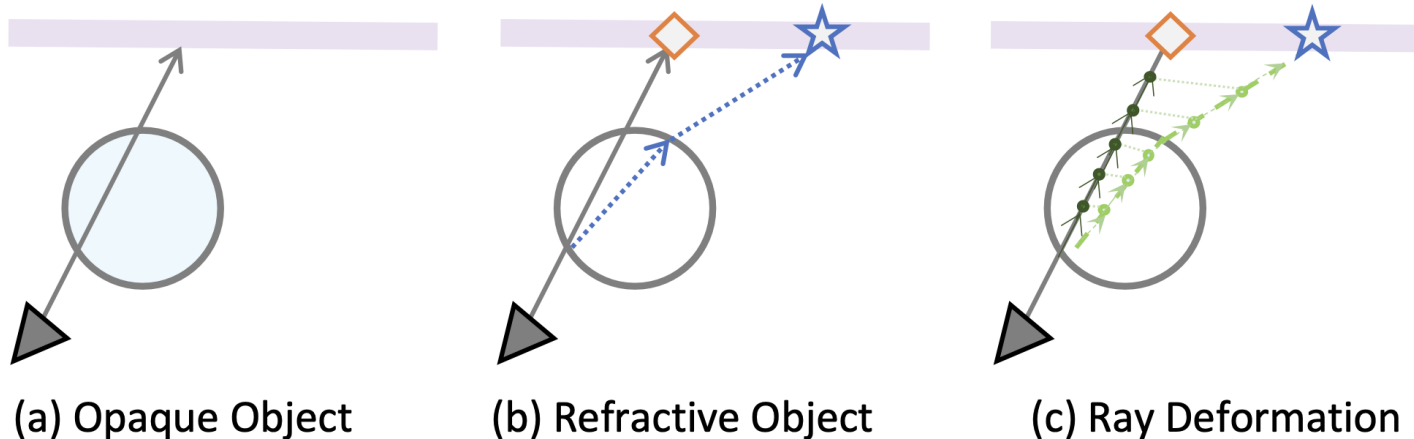
Ray Deformation Networks for Novel View Synthesis of Refractive Objects

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WAIKOLOA · HAWAII



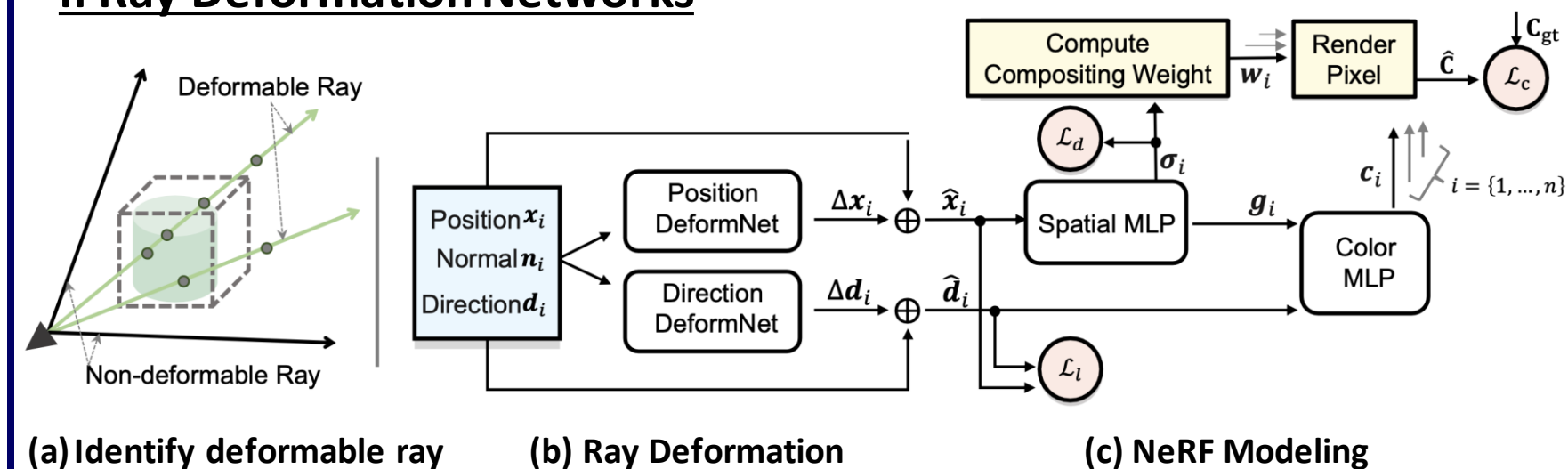
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I Motivation



- NeRF methods learn the density field based on **light transports along straight path**
- When light paths intersect refractive objects, **they may curve** (dashed line), depending on the angle of incidence
- We propose to **bend the light rays** by predicting position and direction offsets for sample points along the rays

II Ray Deformation Networks



Roughly draw bounding boxes on few training views and project into 3D space

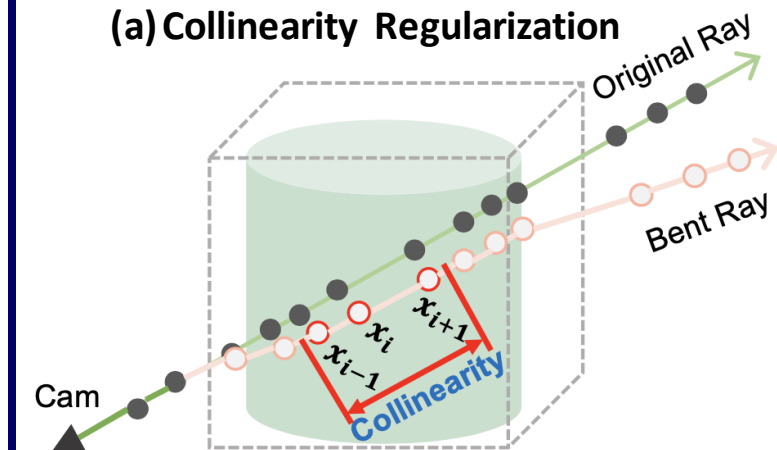
Predict offsets for the sample points along deformable ray

Compute density and color on deformed rays for rendering

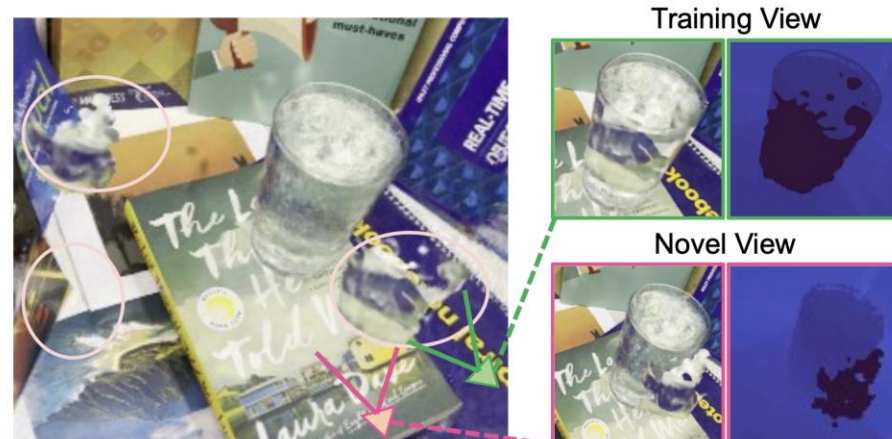
- Known geometry
- Controlled setup
- Refractive index
- Infinitely distant background

III Regularization

(a) Collinearity Regularization



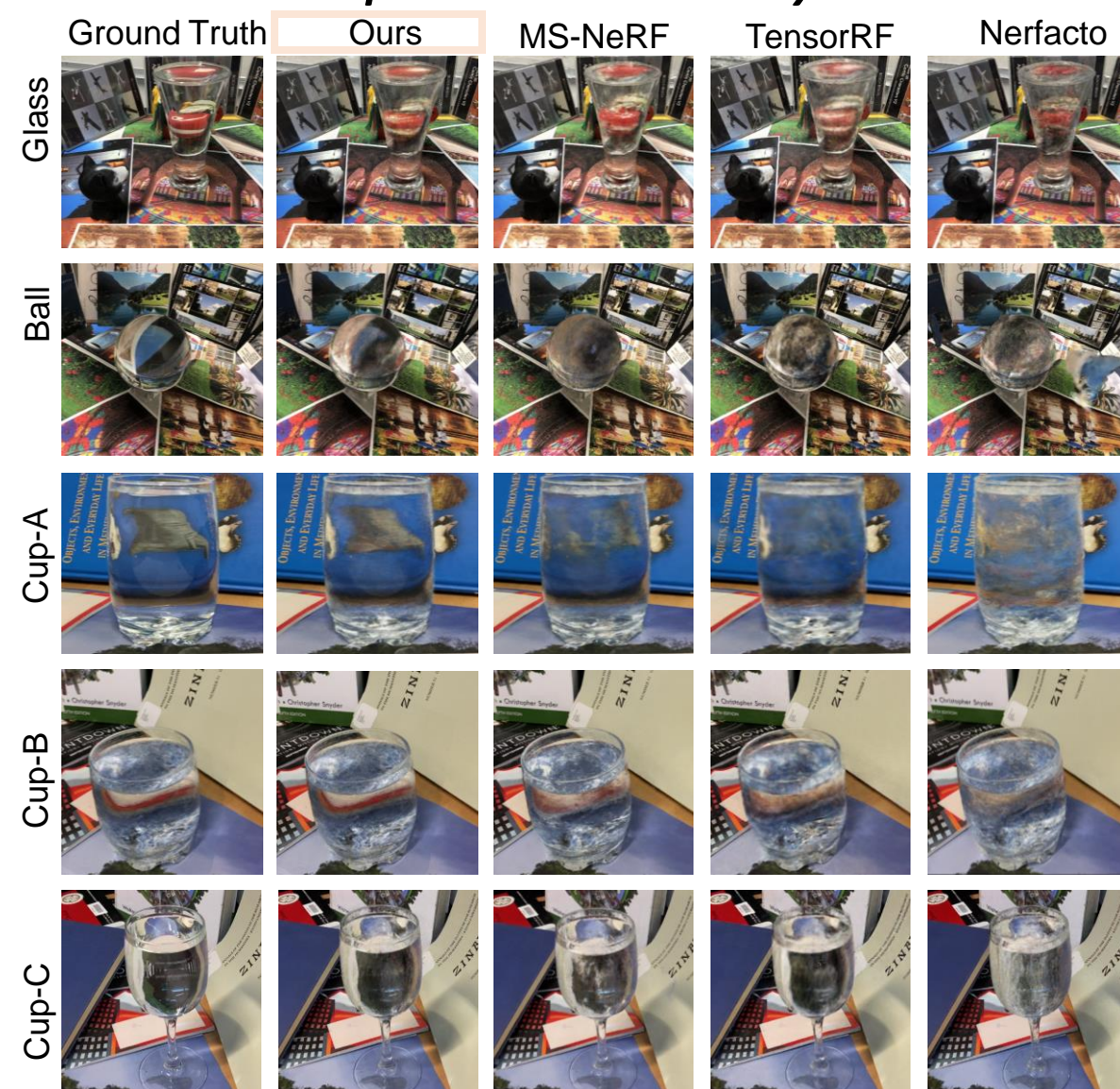
(b) Near-Camera Density Penalty



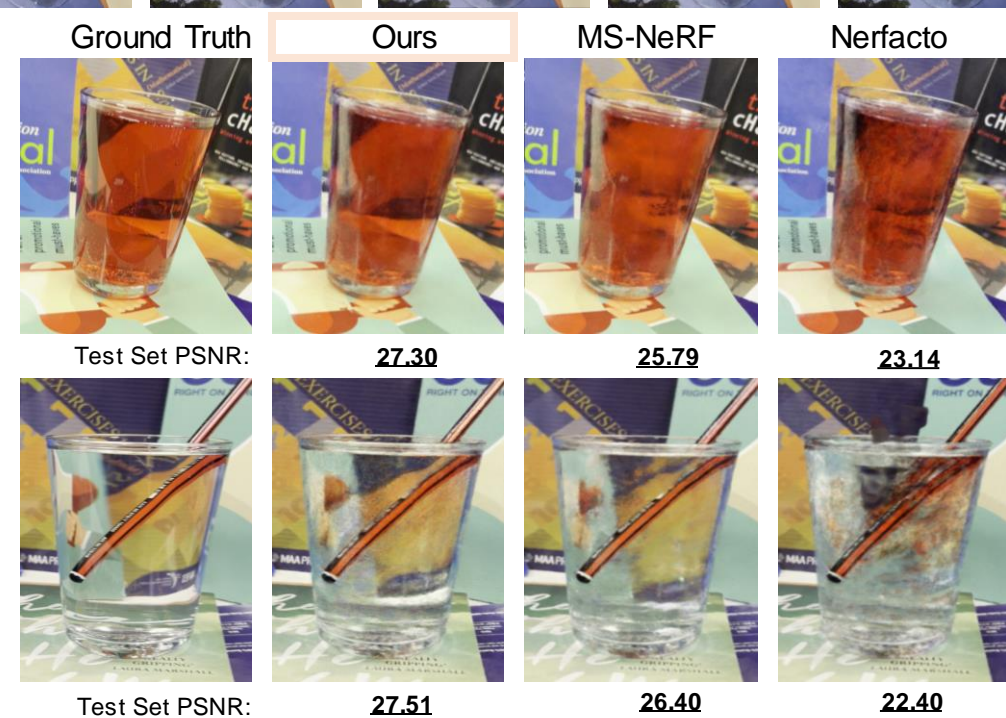
- Snell's law: refracted rays are piece-wise linear
- Encourage neighborhood points to be linear
- NeRF tends to produce artifacts near the camera
- Penalize the density field near camera to be empty

IV Experiment

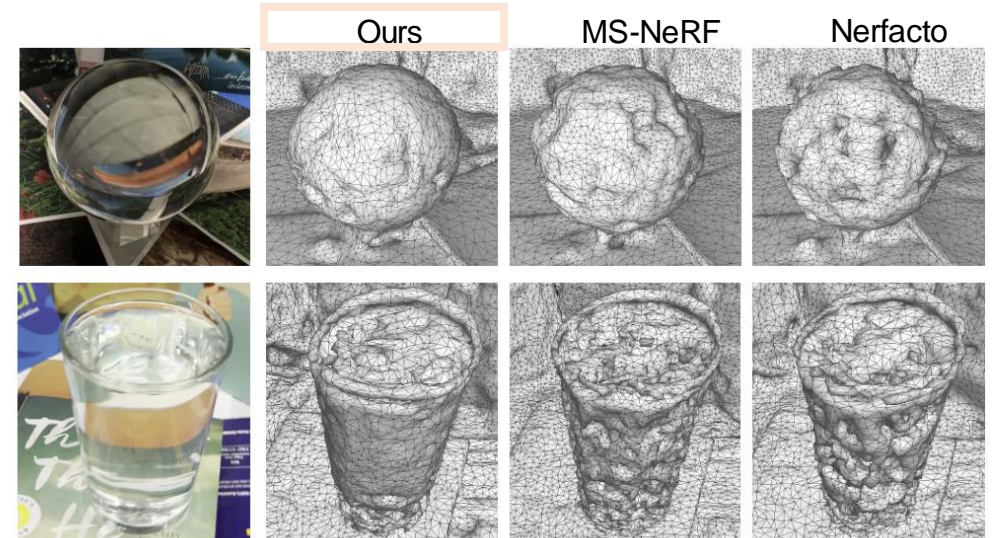
Improved Novel View Synthesis



Robust to Tint and Occlusion



Improved Geometry



Test Set PSNR:

27.30 25.79 23.14

Test Set PSNR:

27.51 26.40 22.40