CoMapGS: Covisibility Map-based Gaussian Splatting for Sparse Novel View Synthesis

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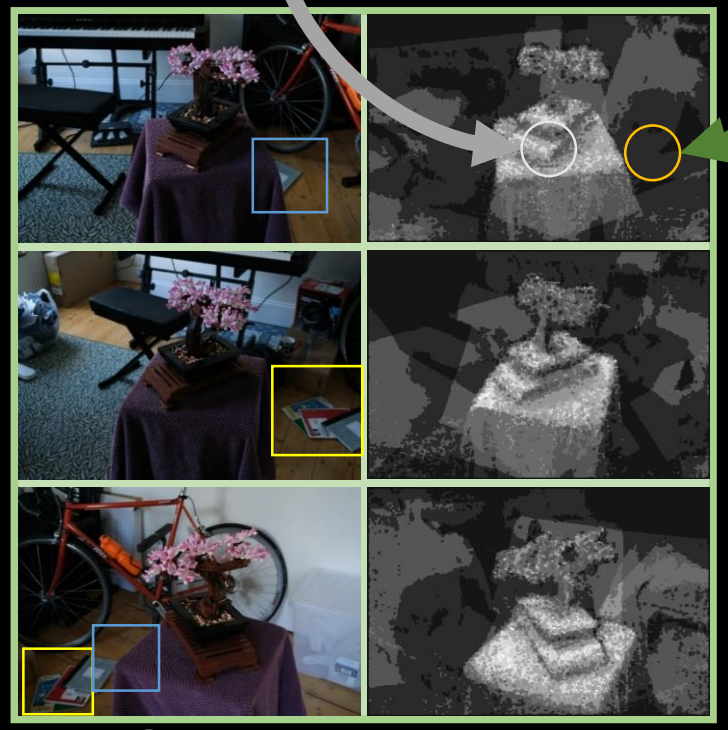
Main Idea

Overrepresented

Underrepresented

Recovered



Books appear in two views

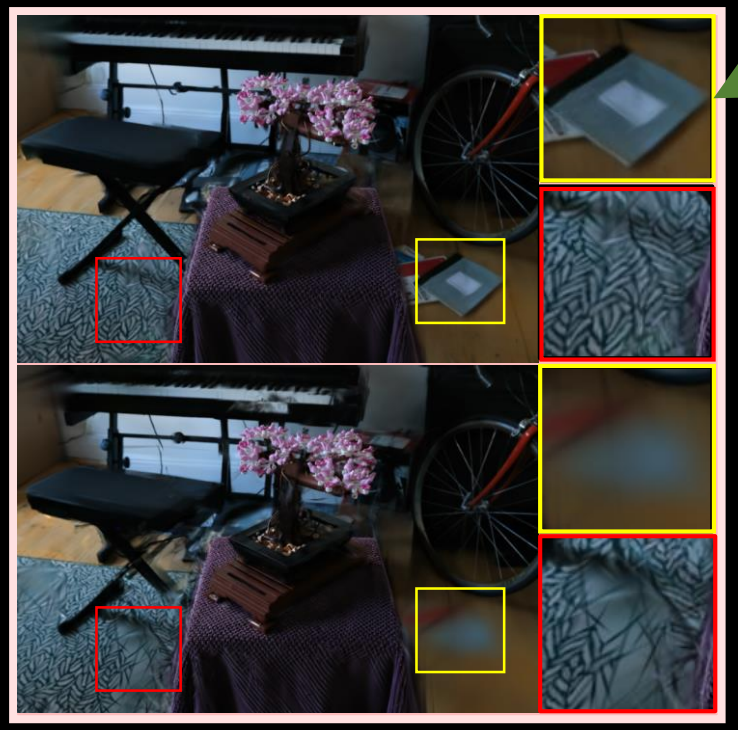
Covisibility map for 12 training views

Balanced Supervision

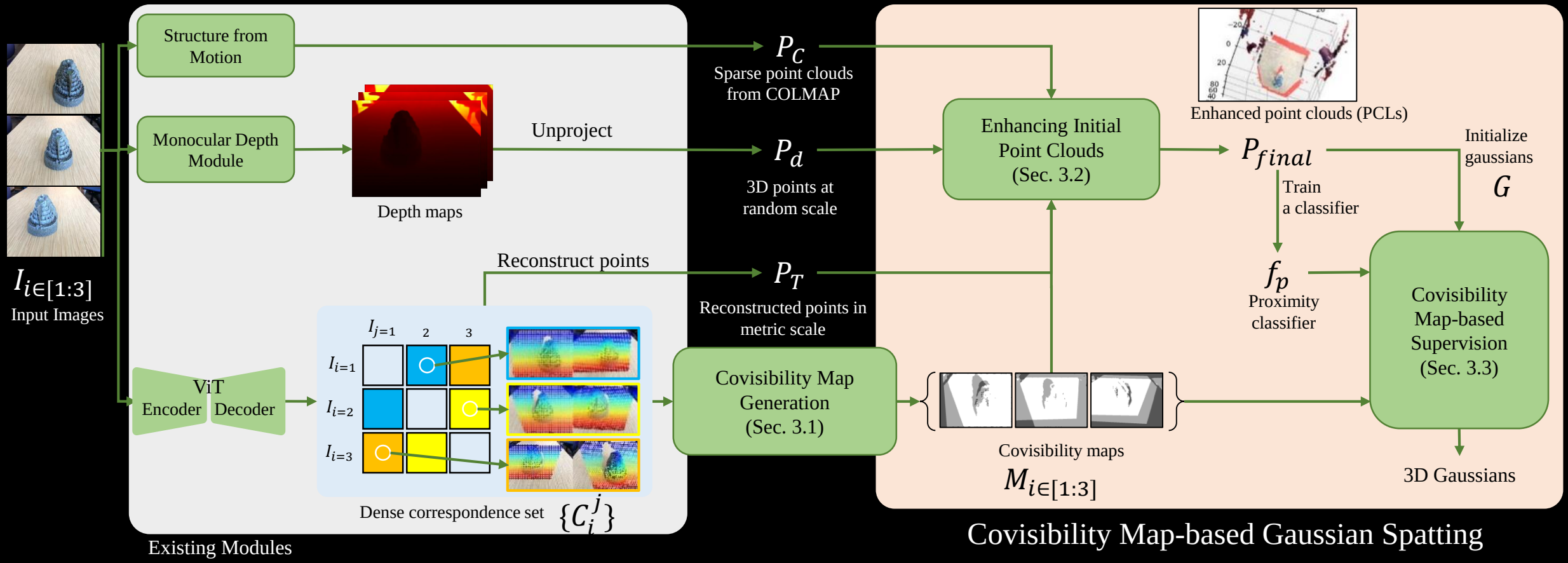
Unbalanced Supervision

CoMapGS

CoR-GS

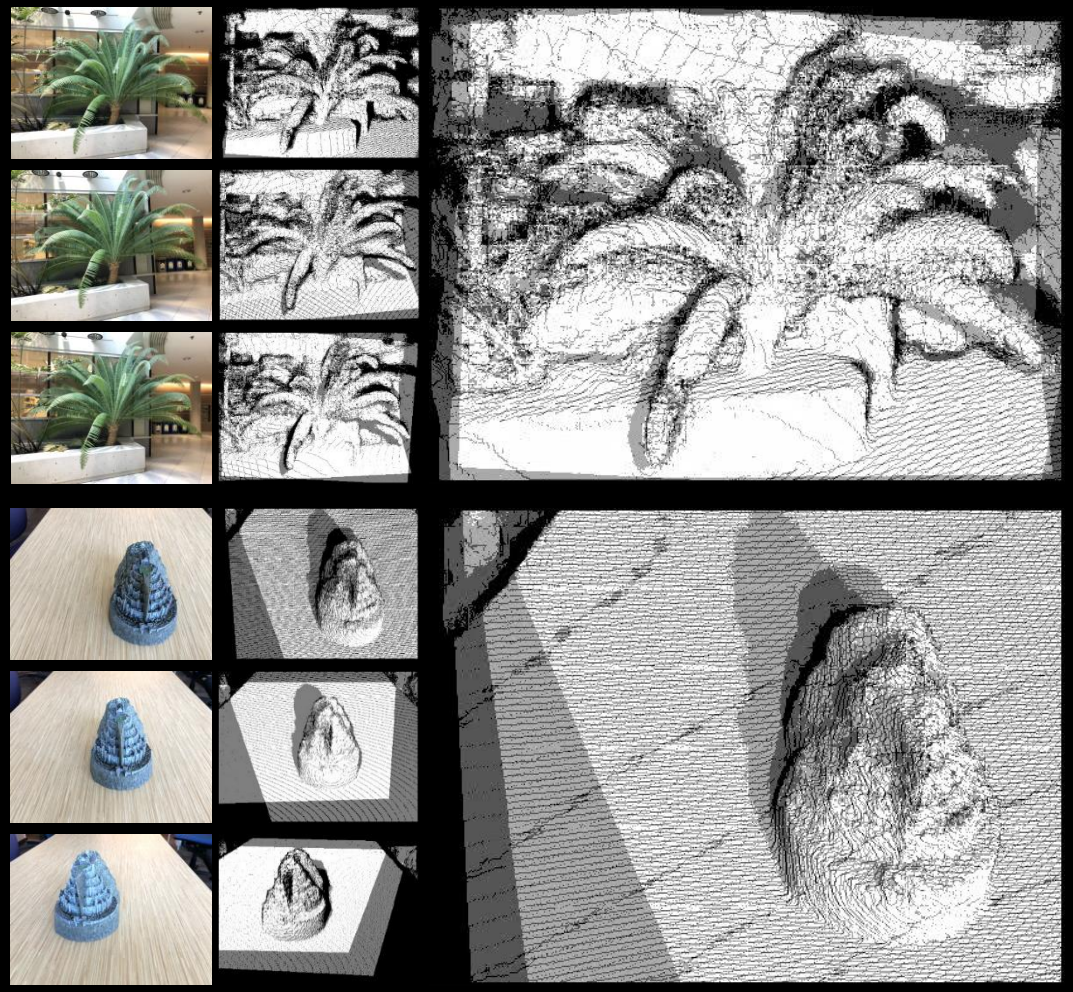


Example of a rendered test view



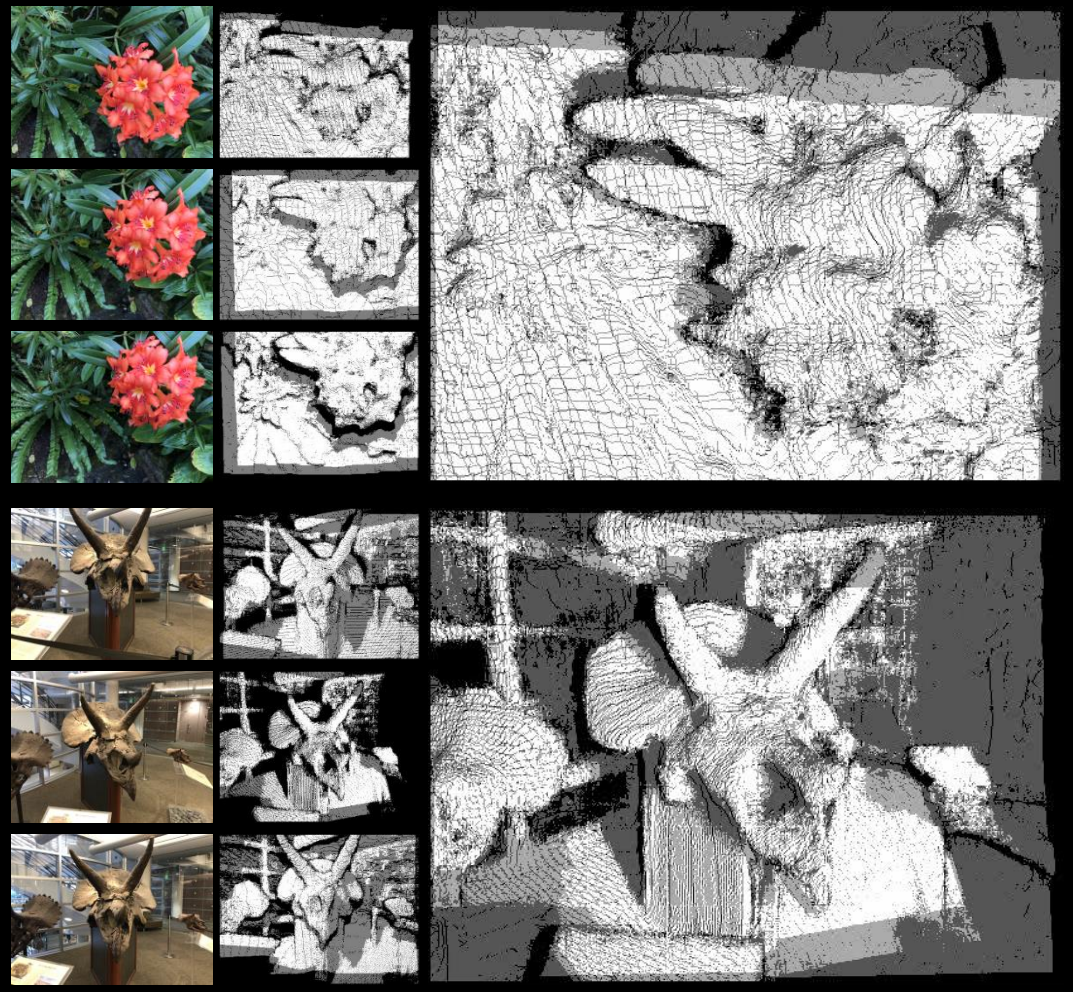
Sec. 3.1. Covisibility Map Generation

Covisibility Map Generation for LLFF



Three training views and their covisibility maps

Example test view covisibility maps



Three training views and their covisibility maps

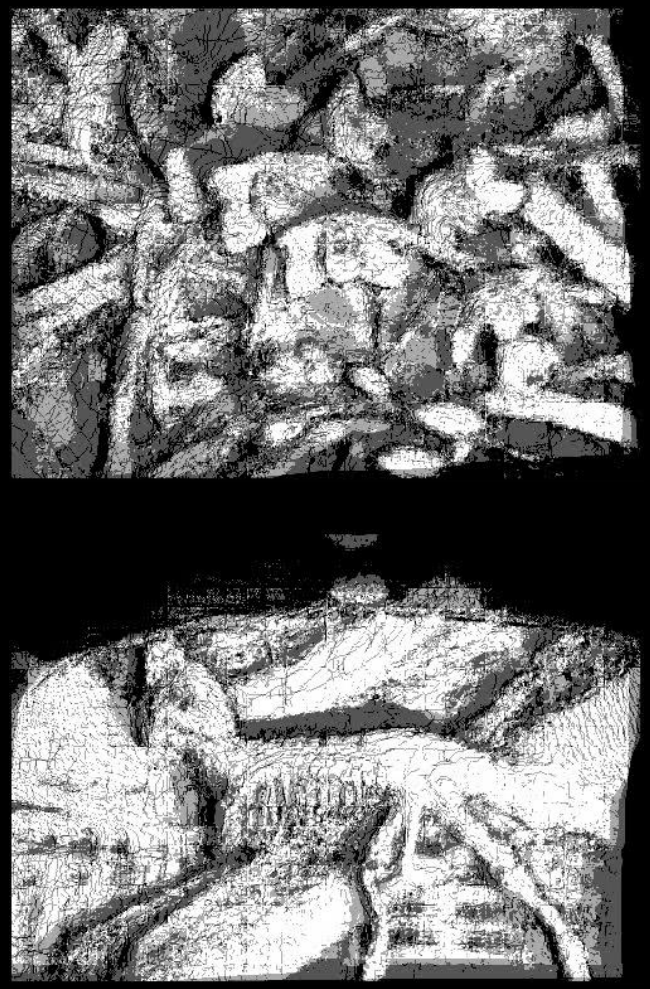
Example test view covisibility maps

Covisibility Map Generation for LLFF

Three training views and their covisibility maps

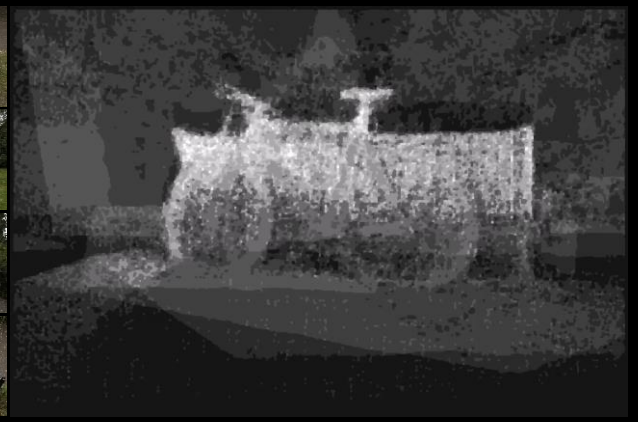
Example test view covisibility maps

Three training views and their covisibility maps



Example test view covisibility maps

Covisibility Map Generation for Mip-NeRF 360



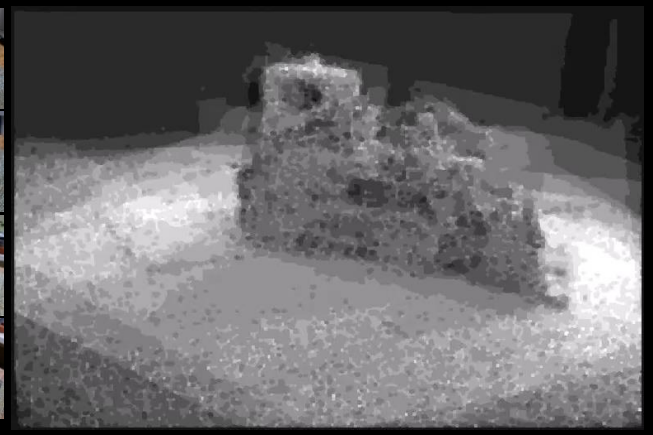
12 training views

Example training and test view covisibility maps

12 training views

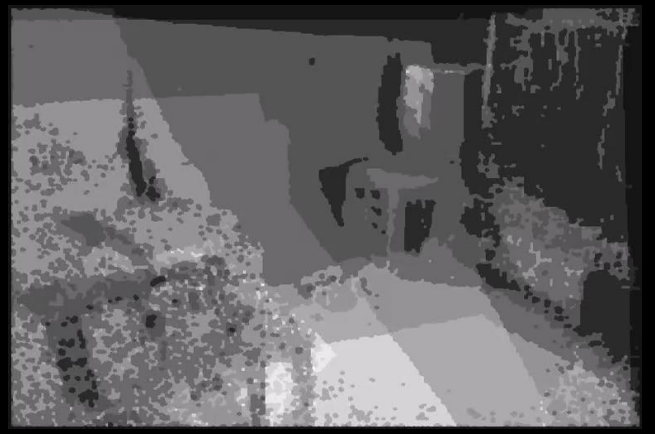
Example training and test view covisibility maps

Covisibility Map Generation for Mip-NeRF 360



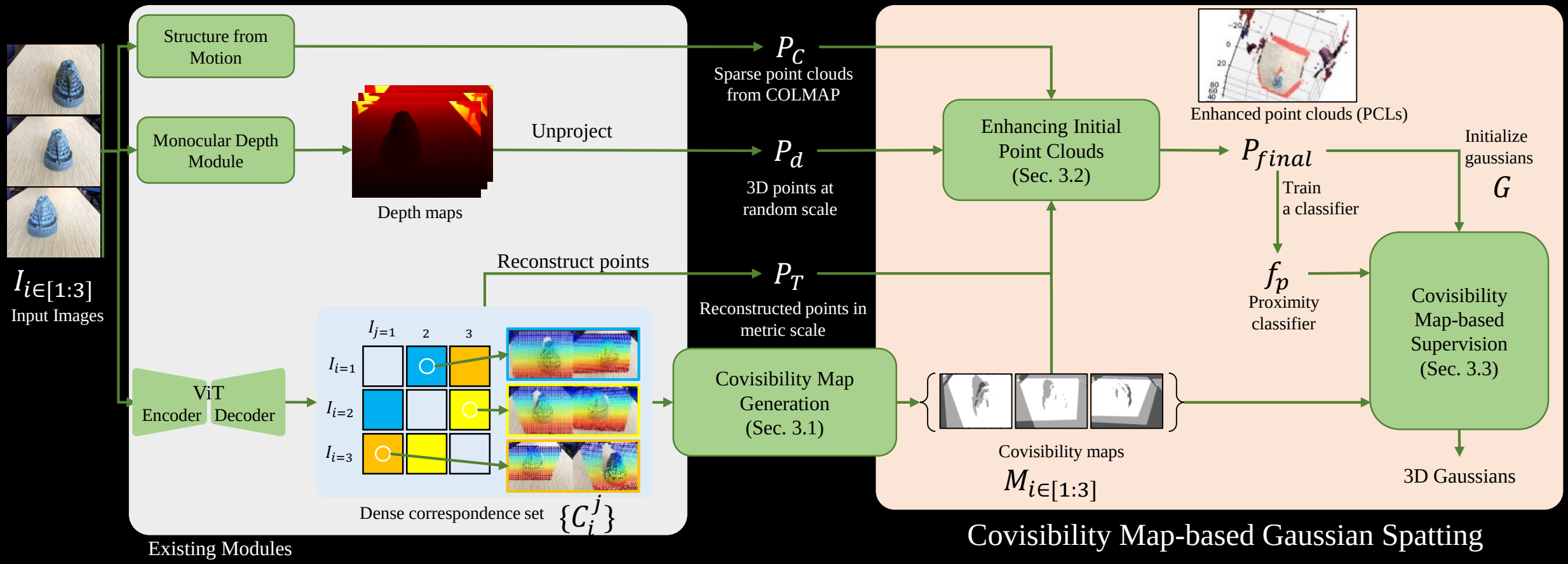
12 training views

Example training and test view covisibility maps



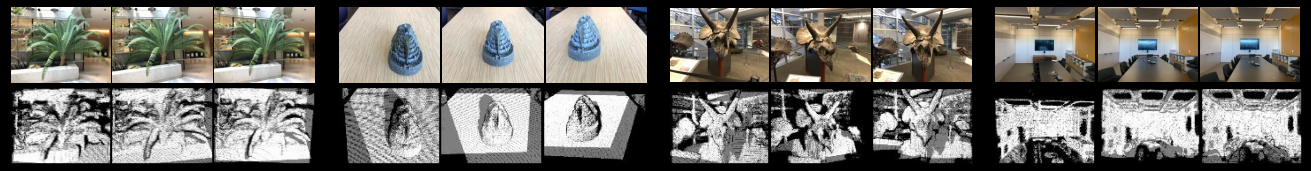
12 training views

Example training and test view covisibility maps

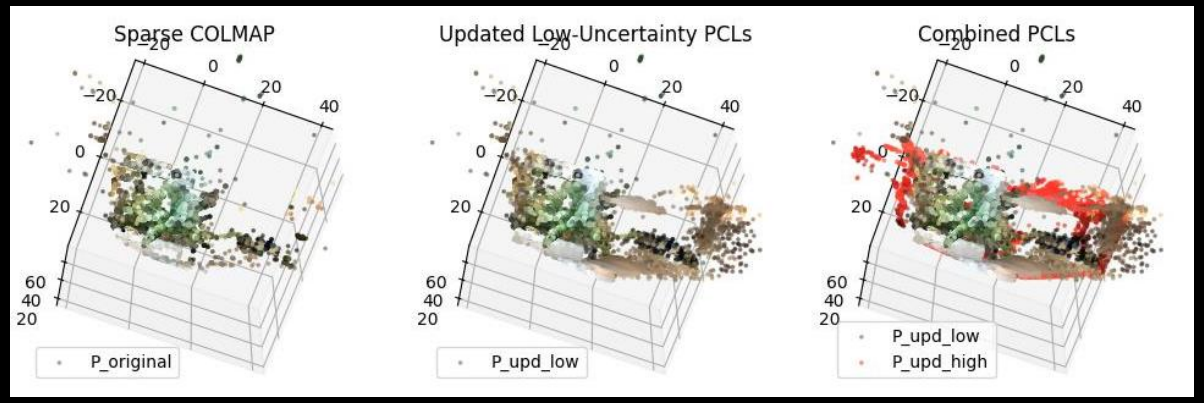


Sec. 3.2. Enhancing Initial Point Clouds

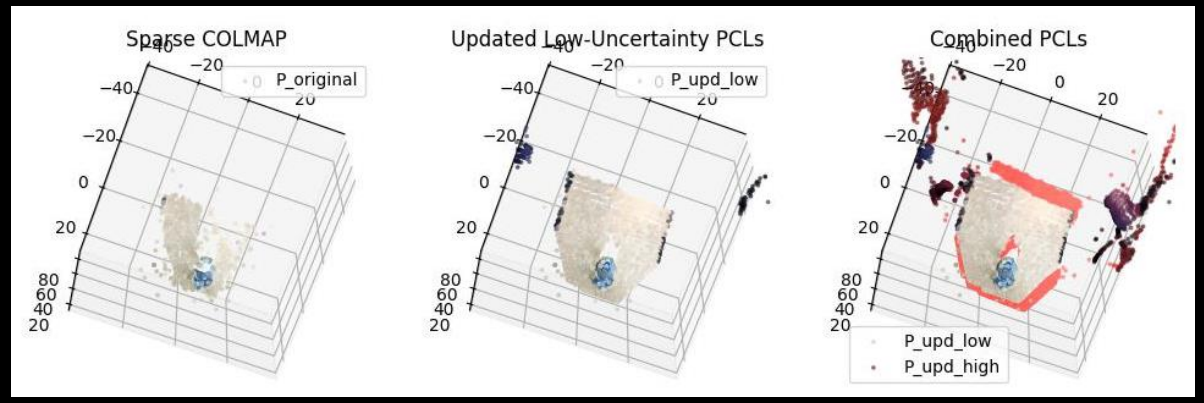
Enhanced Initial PCLs



- Updating low-uncertainty regions using MASt3R and COLMAP
- Updating high-uncertainty regions using linear regression with mono-depth estimation and updated-PCLs

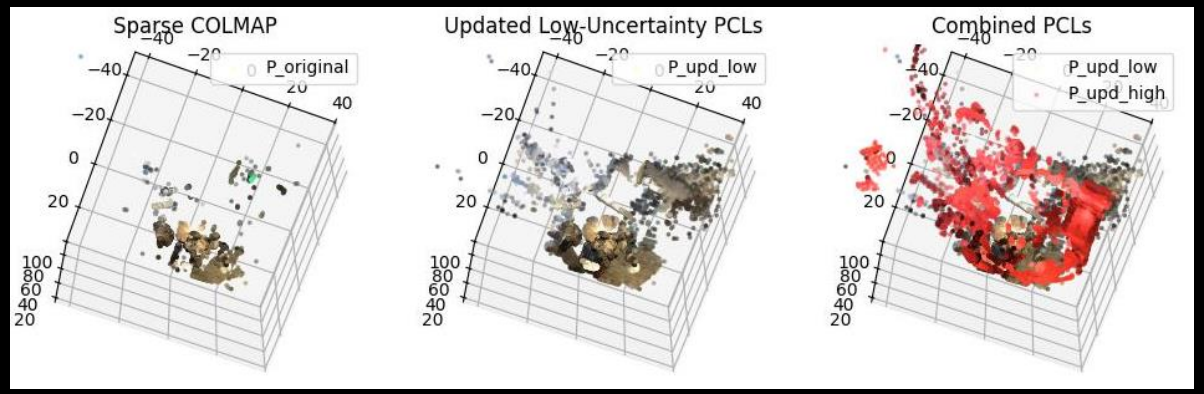


LLFF: Fern

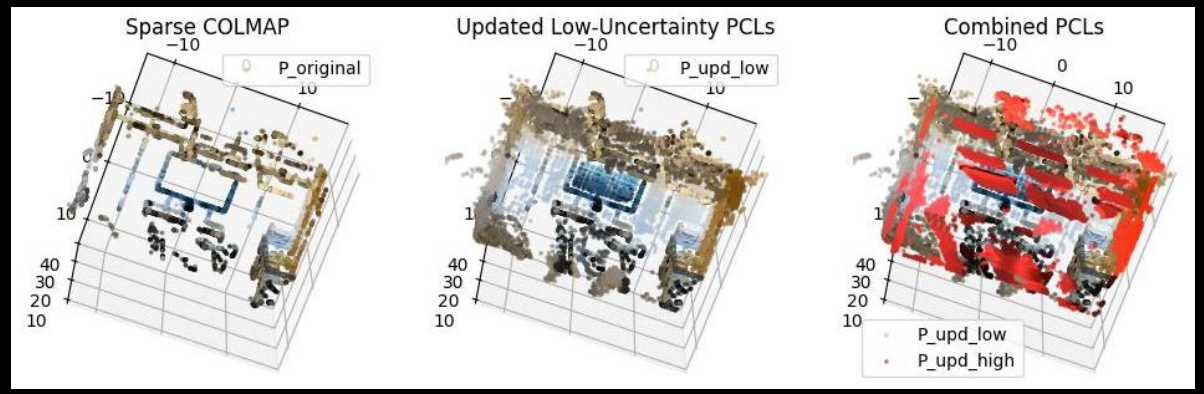


LLFF: Fortress

3 views



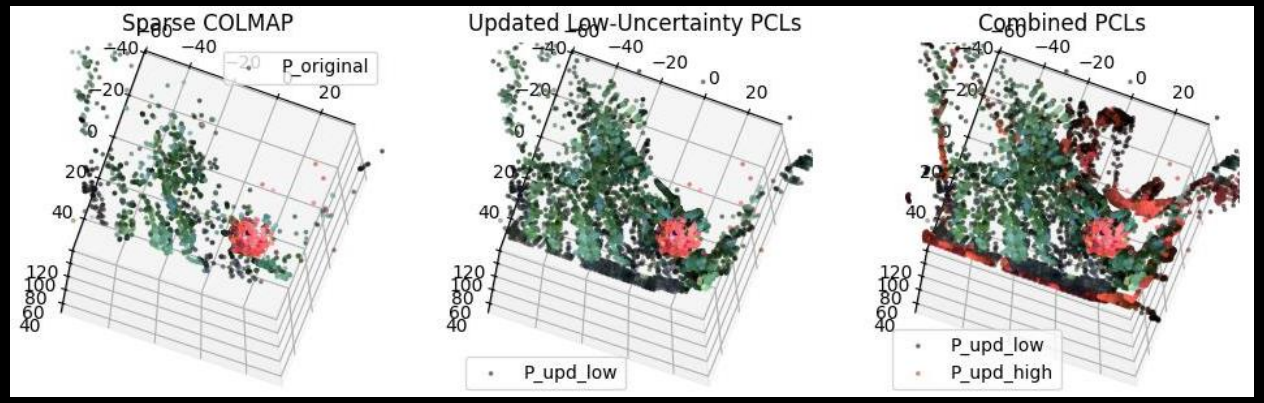
LLFF: Horns



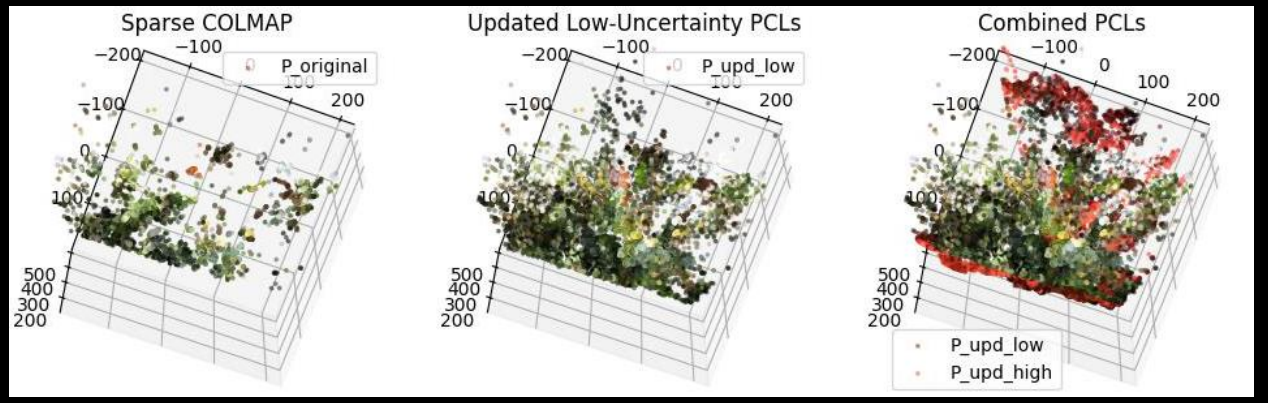
LLFF: Room

Enhanced Initial PCLs

- Updating low-uncertainty regions using MASt3R and COLMAP
- Updating high-uncertainty regions using linear regression with mono-depth estimation and updated-PCLs

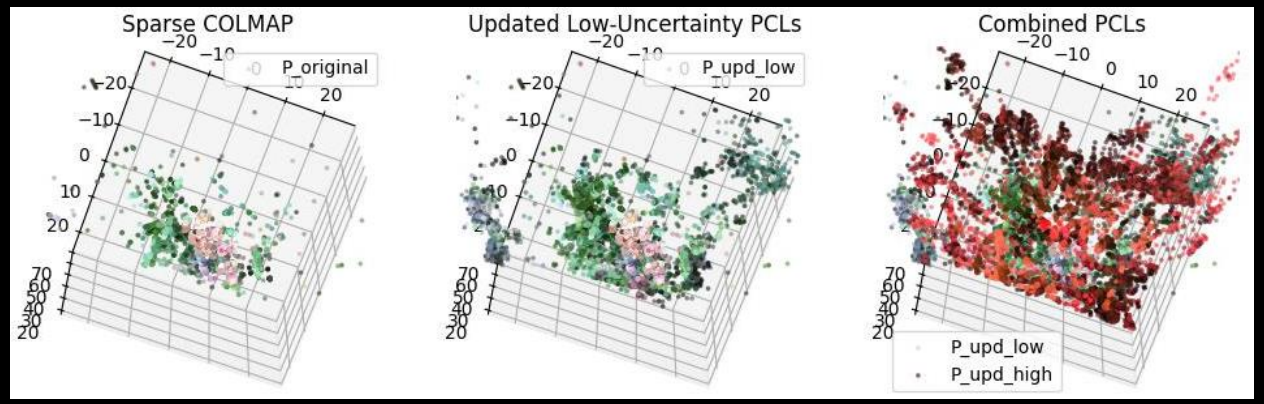


LLFF: Flower

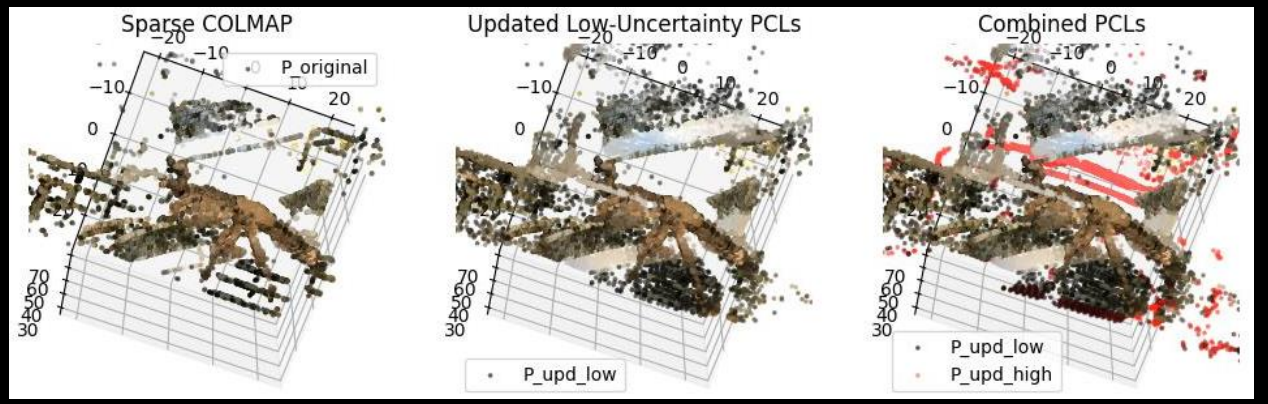


LLFF: Leaves

3 views

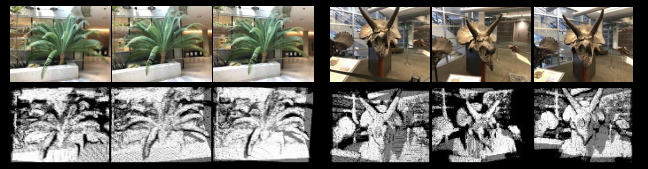


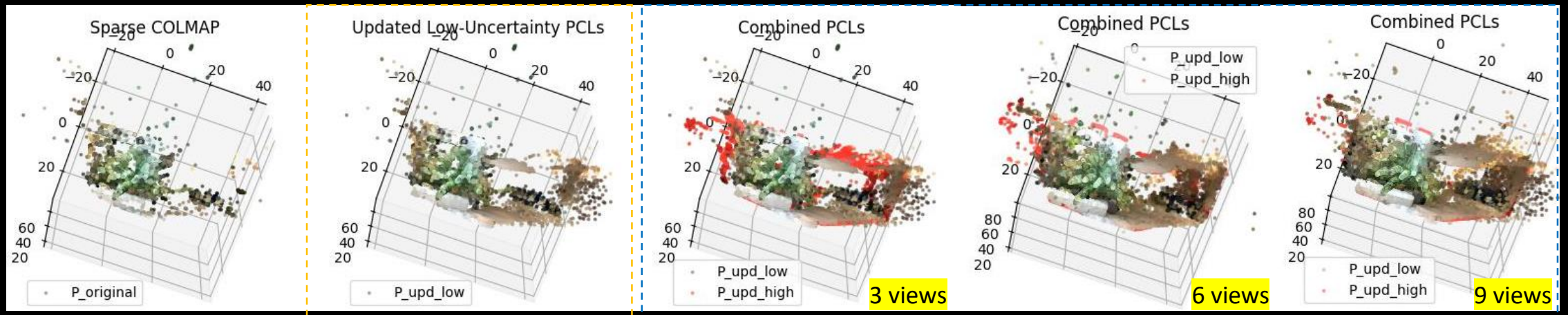
LLFF: Orchids



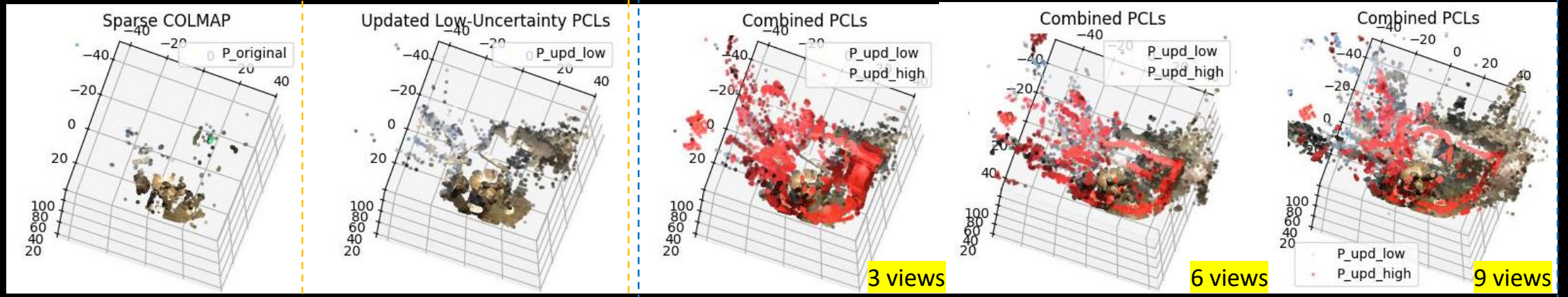
LLFF: Trex

Enhanced Initial PCLs for LLFF





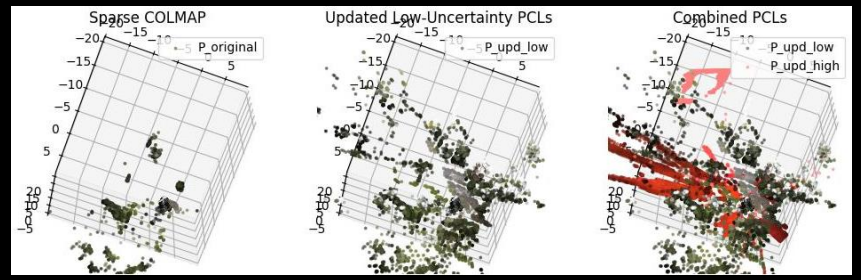
SfM points | SfM + MASt3R | High-uncertainty region update



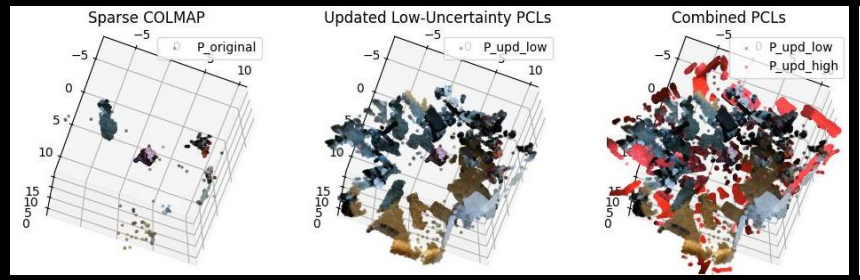
SfM points | SfM + MASt3R | High-uncertainty region update

Enhanced Initial PCLs for Mip-NeRF 360

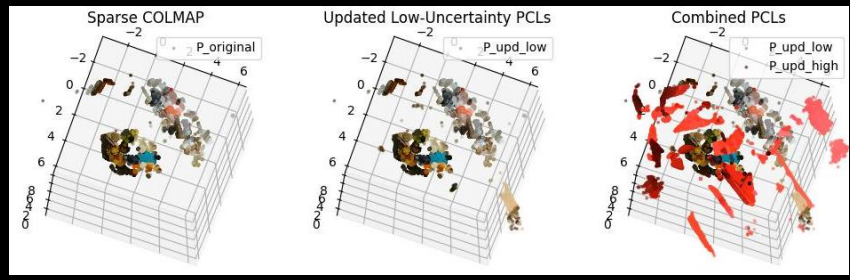
12 views



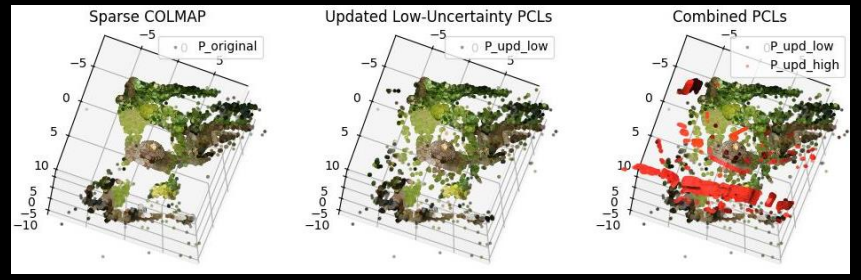
360-V2: Bicycle



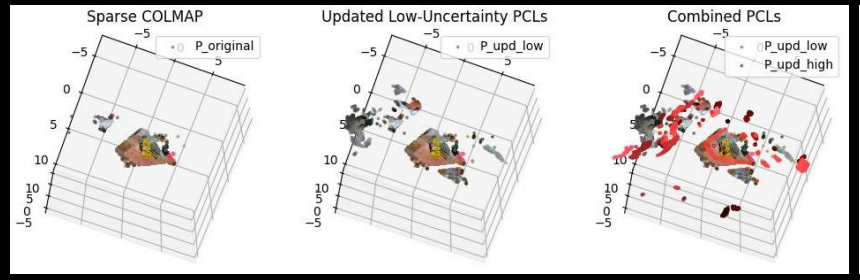
360-V2: Bonsai



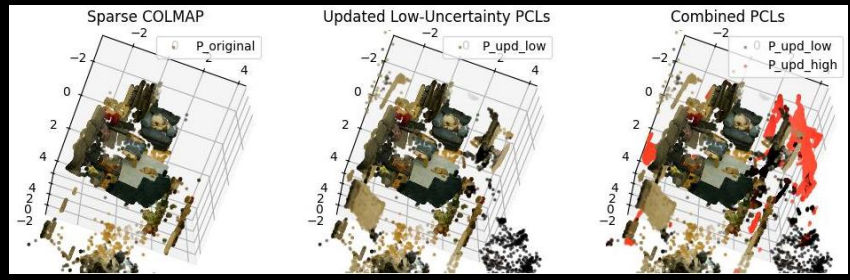
360-V2: Counter



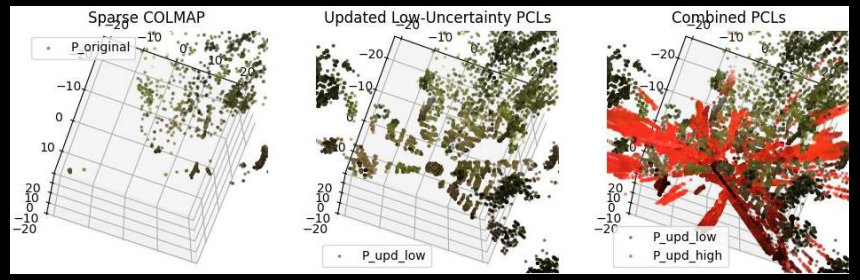
360-V2: Garden



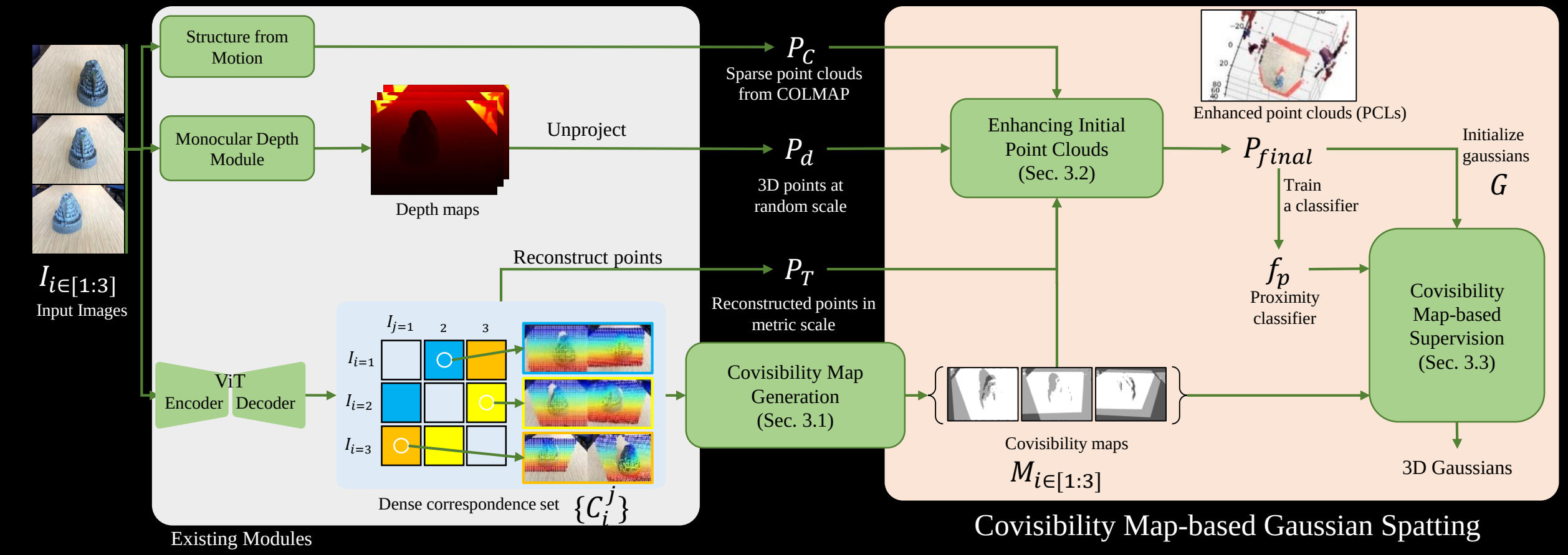
360-V2: Kitchen



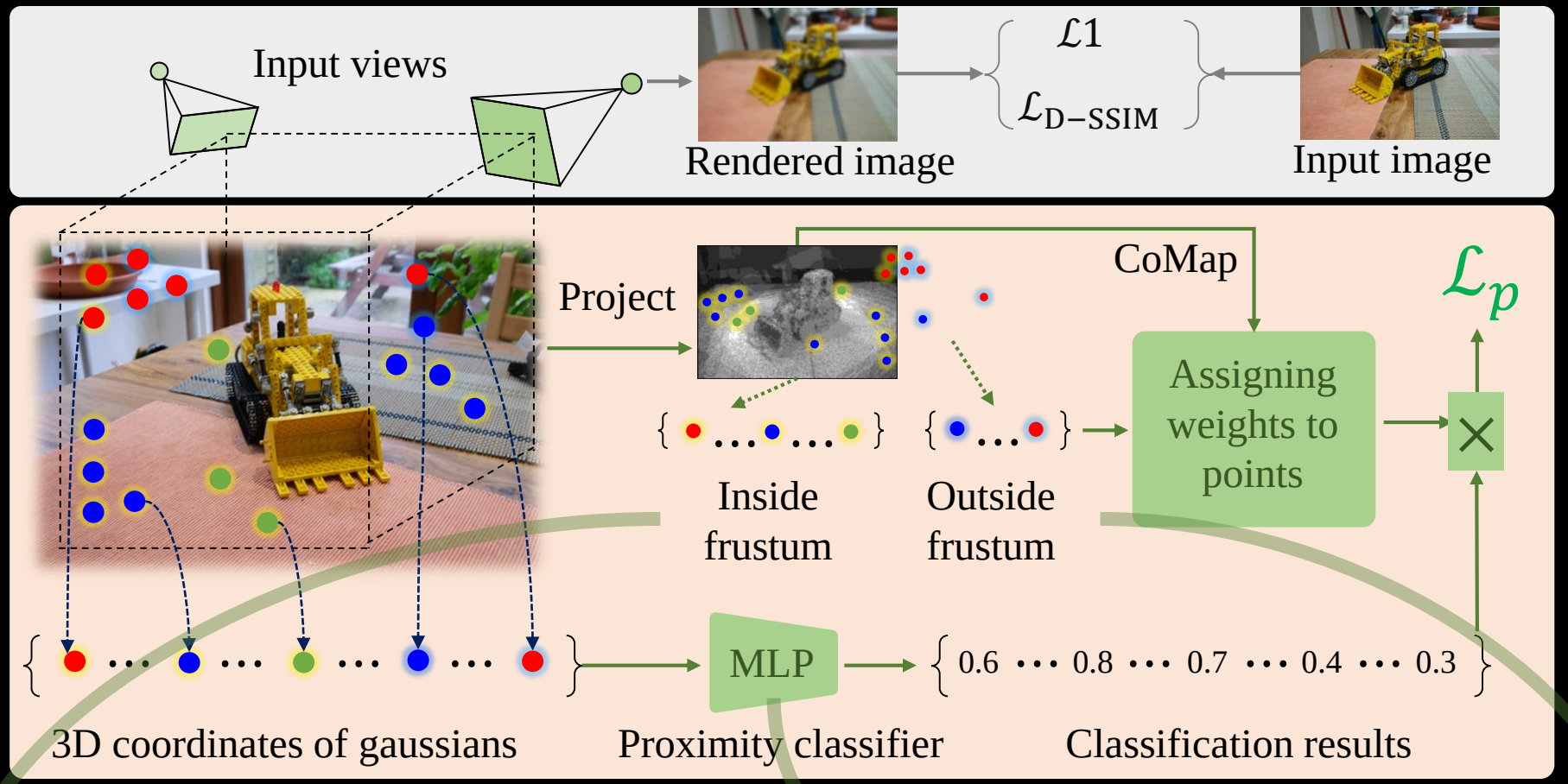
360-V2: Room



360-V2: Stump



Sec. 3.3. Covisibility Map-based Supervision



$$s_g = f_p(g) \in [0,1]$$

$$\omega_{in} = \frac{1}{M_i(\pi(g,\mathbf{H}_i))+1}$$

$$\mathcal{L}_p = \frac{1}{|G|}\sum_{g\in G}(\chi(g)\omega_{in} + (1-\chi(g))\,\omega_{out}) \cdot (1-s_g)$$

$$\omega_{out} = \max\left(0, \frac{S-0.7}{0.3}\right)$$

More Qualitative Results

Comparisons on LLFF

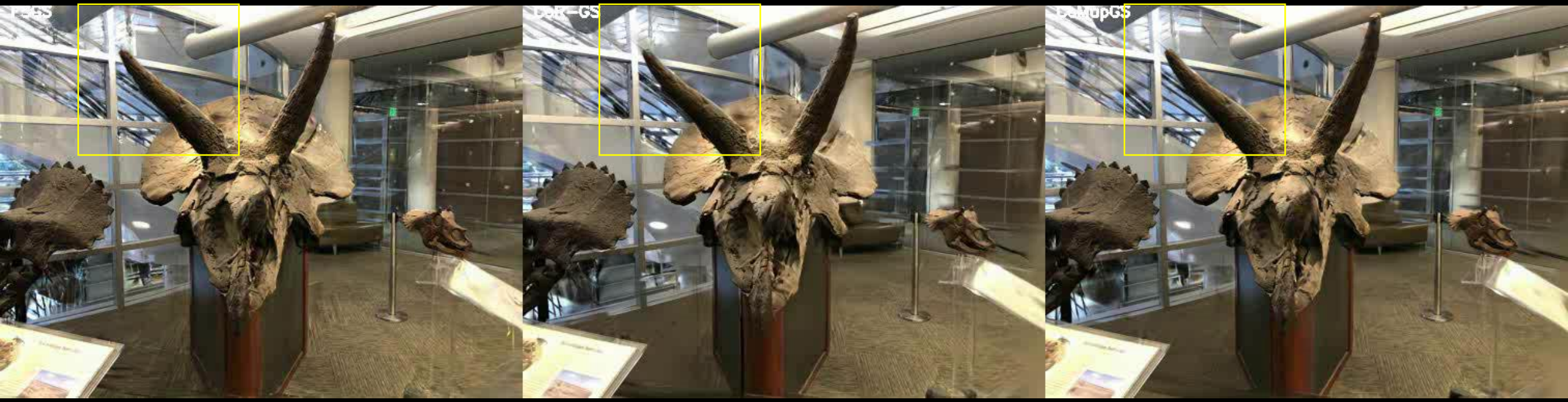
Fern scene trained with 3 views

Comparisons on LLFF

FSGS | CoR-GS | CoMapGS (ours)

Flower scene trained with 3 views

Comparisons on LLFF



FSGS | CoR-GS | CoMapGS (ours)

Horns scene trained with 3 views

Comparisons on LLFF

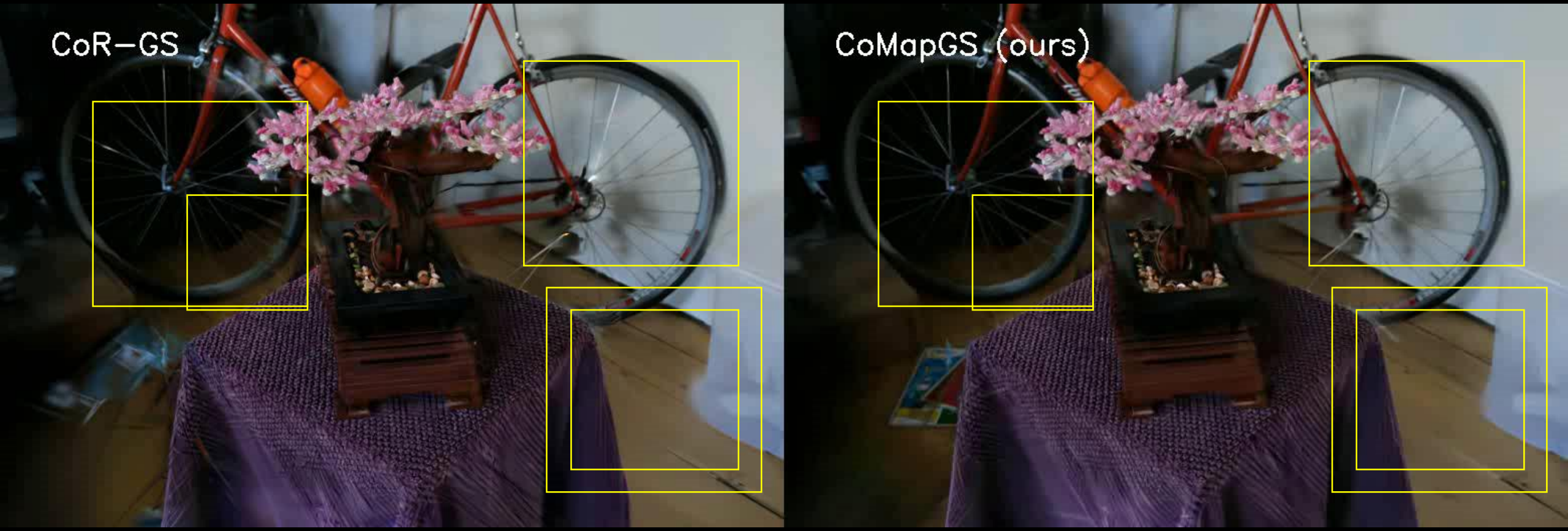
FSGS

CoR-GS

CoMapGS (ours)

Room scene trained with 6 views

Comparisons on Mip-NeRF 360

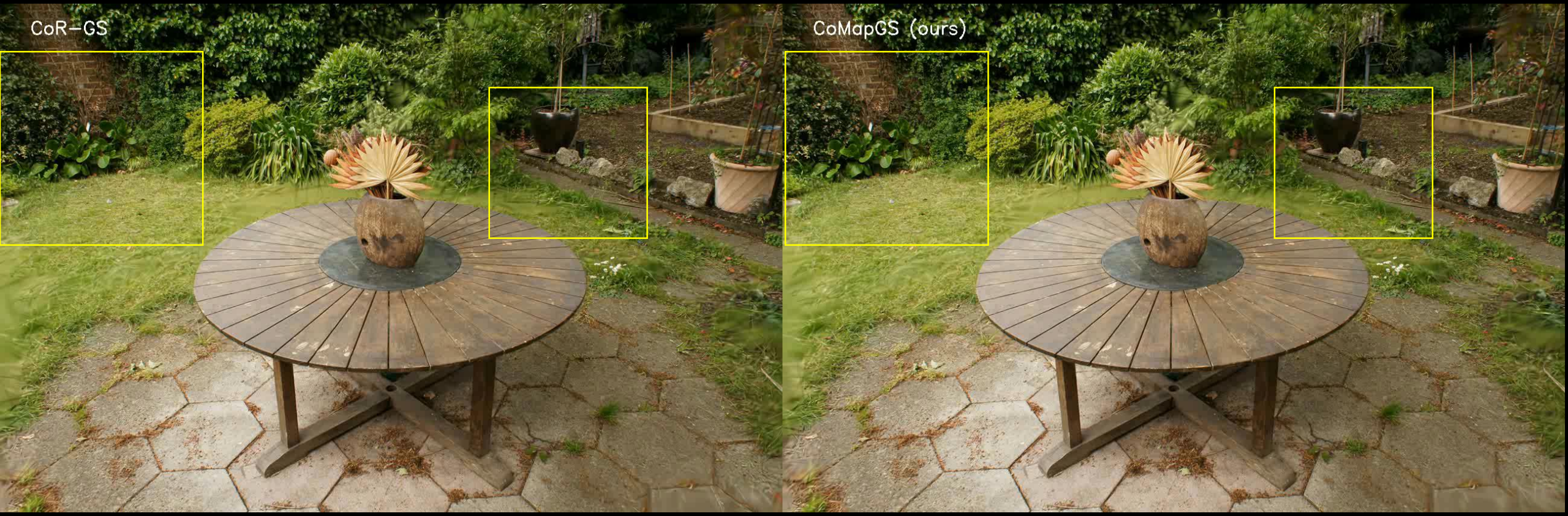


CoR-GS

CoMapGS (ours)

Bonsai scene trained with 12 views

Comparisons on Mip-NeRF 360



CoR-GS

CoMapGS (ours)

Garden scene trained with 12 views

Comparisons on Mip-NeRF 360

CoR-GS

CoMapGS (ours)

Kitchen scene trained with 12 views

Thank you!