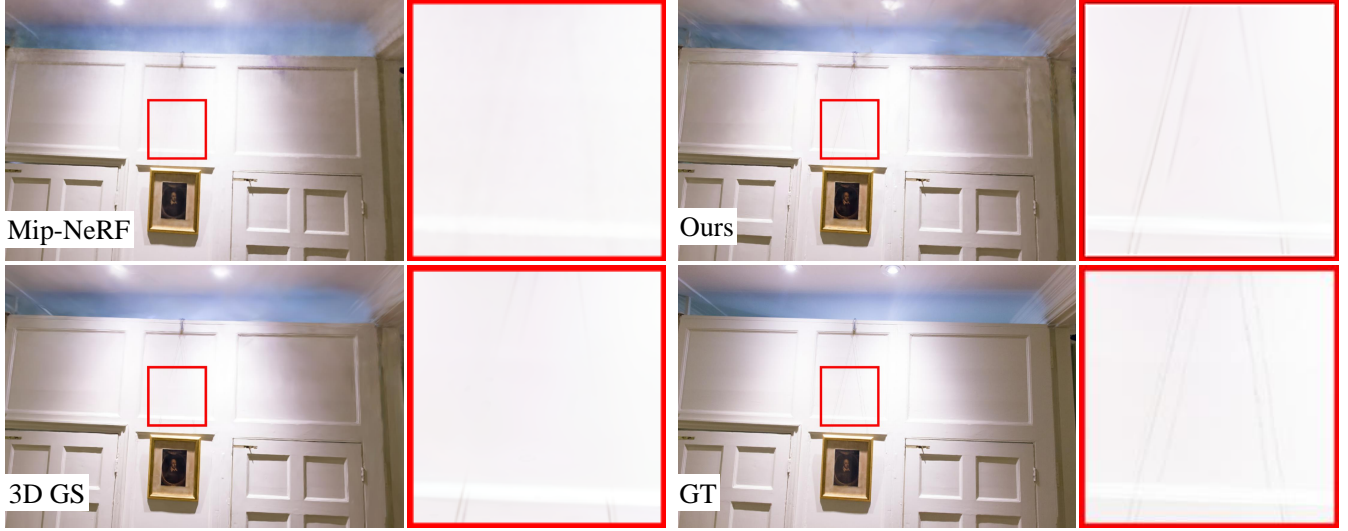# Supplementary Materials

Figure 1: The visualization results of *Dr Johnson* scene from Deep Blending.

1 ADDITIONAL RESULTS

Details of the results of the experiments in the main text. Tab. 2, Tab. 3, Tab. 4, Tab. 5, Tab. 6, Tab. 7, Tab. 8 and Tab. 9 provide a breakdown of the results from Tab. 1 and 2 in the main body, presenting metrics for each scene individually, where bold indicates the best result. 3D-GS* is the model we retrained at a scale threshold of 0.001. Except for the indoor scenes of the Mip-NeRF360 dataset, our method improves on all metrics, especially the LPIPS metric. It is worth noting that compared to PSNR and SSIM, LPIPS is more in line with human eye's perception and more sensitive to over-reconstruction. In addition, our method has significant advantages in memory consumption compared to 3D-GS. Tab. 1 shows the detailed metrics for Fig. 9 in the main body. Fig. 4

Fig. 4 displays some results of the novel view synthesis and point clouds. Our method exhibits a clear advantage in terms of point cloud complementation, particularly in over-reconstructed regions. Even with a significantly lower number of point clouds than 3D-GS in Abs-0008, it outperforms 3D-GS. The comparison for Scene *Truck* is not as obvious, primarily because this scene has a better initial point cloud quality and lower image resolution, making the original over-reconstructed regions of 3D-GS less conspicuous.

Fig. 1 illustrates the visualization results at each threshold. As the threshold increases, the over-reconstruction problem in the yellow box improves, but the area in the blue box remains almost unchanged.

Detail Comparison. Fig. 3 and 1 demonstrate the advantage of our approach in detail representation. In the TRAIN scene, 3DGS almost loses the texture details in the background. Additionally, only our method reconstructs the thin black lines in the *Dr Johnson* scene from Deep Blending.

(a) Ground truth with annotation

(b) 3D-GS

(c) Ours

Figure 3: The visualization results of *train* scene from Tanks & Temples. 3D-GS shows a significant over-reconstruction at the background.
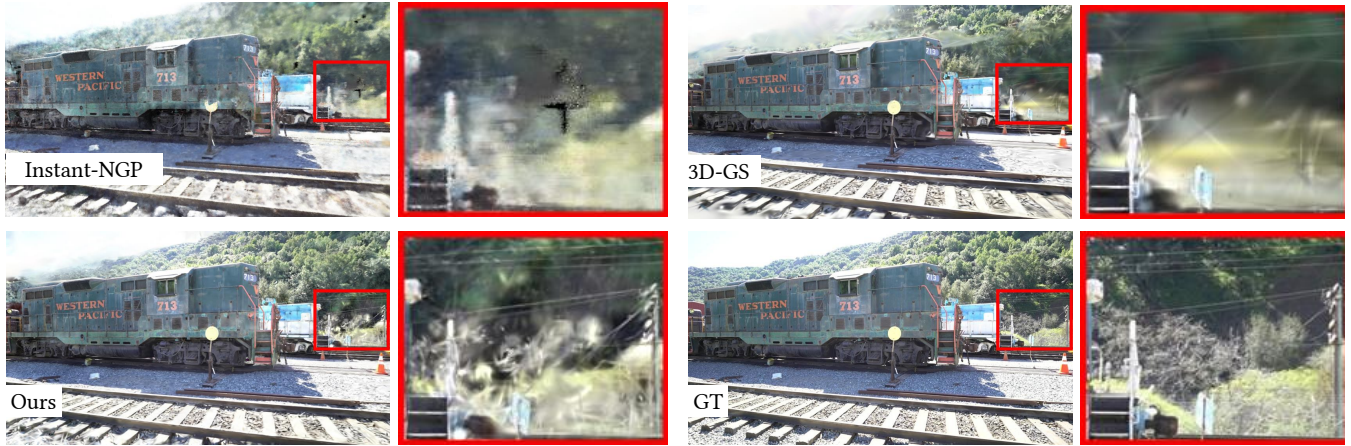
Figure 2: Qualitative comparisons of different methods on less-observed and distant regions. Our proposed AbsGS recovers more detail even when few observations are available, while other methods produce blurry and low-resolution renderings.

Impact of Scale Thresholds. Fig. 5 illustrates the comparison of the results of 3D-GS and AbsGS about scene *bicycle* under different scale thresholds (τ_s). In the main body, we demonstrate the effect of different scale thresholds on our method, illustrating how a scale threshold that is too large can limit our method's potential. As shown in Fig. 5, 3D-GS does not eliminate over-reconstruction by lowering the scale threshold, indicating that the effectiveness of our method is not solely due to lowering the scale threshold.

In addition, lowering the threshold brings an unexpected benefit: the distribution of the point cloud is more rational. All methods in Fig. 5 exhibit more complete bicycle point clouds at small scale thresholds, particularly for bicycle spokes (the yellow circle in the Fig. 5). We explain this phenomenon with Fig. 7, where a large scale threshold limits the splitting of the Gaussian, tending to expand the Gaussian radius to represent the scene when the regions are of the same color. This benefit does not come from AbsGS. The contribution of AbsGS is to fill in the missing point clouds, see the point clouds in the yellow box in Fig. 5. Lowering the scale threshold is only effective for regions of the same color and does not fill in the empty shortcoming clouds in over-reconstructed regions.

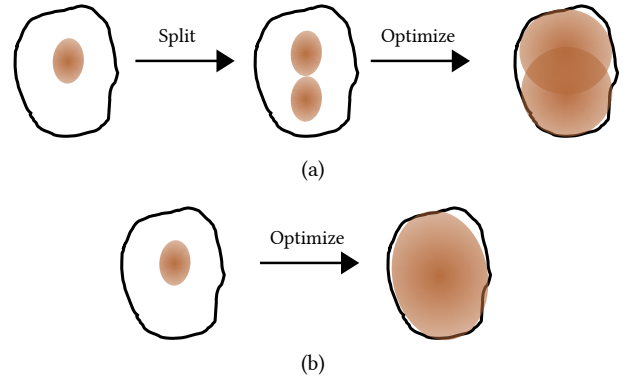

Figure 7: Effect of small-scale threshold on the distribution of point clouds in the region with a single color. (a) At small threshold, the Gaussian splits into multiple Gaussian co-expression regions, resulting in a denser point cloud. (b) Large threshold limits the splitting of the Gaussian and tends to express the whole region using a large Gaussian, resulting in a sparse point cloud.

Table 1: The results of the flowers scene under different gradient thresholds for 3D-GS.

	0.0002	0.00018	0.00016	0.00014	0.00012	0.0001
SSIM	0.600	0.611	0.618	0.624	0.628	0.636
PSNR	21.463	21.633	21.714	21.752	21.762	21.920
LPIPS	0.341	0.326	0.319	0.308	0.299	0.286
Mem	864MB	1018MB	1219MB	1487MB	1889MB	2466MB

Table 2: Per-scene quantitative results(SSIM) from the Mip-NeRF360.

		bicycle	flowers	garden	stump	treehill	room	counter	kitchen	bonsai
Plenoxels		0.496	0.431	0.606	0.523	0.509	0.8417	0.759	0.648	0.814
INGP-Base		0.491	0.450	0.649	0.574	0.518	0.855	0.798	0.818	0.890
INGP-Big		0.512	0.486	0.701	0.594	0.542	0.871	0.817	0.858	0.906
Mip-NeRF360		0.685	0.583	0.813	0.744	0.632	0.913	0.894	0.920	0.941
3D-GS		0.771	0.605	0.868	0.775	**0.638**	0.914	0.905	0.922	0.938
3D-GS*		0.759	0.596	0.858	0.762	0.625	0.917	0.905	0.924	0.939
S=0.01	AbsGS-0008	0.778	0.619	0.860	0.782	0.629	0.918	0.902	0.923	0.938
S=0.001	AbsGS-0008	0.773	0.612	0.863	0.770	0.621	0.919	0.906	0.925	0.941
S=0.01	AbsGS-0004	0.782	0.613	0.870	**0.784**	0.626	0.920	0.908	0.929	0.944
S=0.001	AbsGS-0004	**0.783**	**0.623**	**0.871**	0.780	0.617	**0.925**	**0.911**	**0.9293**	**0.945**

Table 3: Per-scene quantitative results(PSNR) from the Mip-NeRF360.

		bicycle	flowers	garden	stump	treehill	room	counter	kitchen	bonsai
Plenoxels		21.912	20.097	23.495	20.661	22.248	27.594	23.624	23.420	24.669
INGP-Base		22.193	20.348	24.599	23.626	22.364	29.269	26.439	28.548	30.337
INGP-Big		22.171	20.652	25.069	23.466	22.373	29.690	26.691	29.479	30.685
Mip-NeRF360		24.37	**21.73**	26.98	26.40	**22.87**	**31.63**	**29.55**	**32.23**	**33.46**
3D-GS		25.246	21.520	27.410	26.550	22.490	30.632	28.700	30.317	31.980
3D-GS*		25.12	21.439	27.11	26.457	22.385	31.35	28.93	31.312	32.11
S=0.01	AbsGS-0008	25.326	21.54	27.327	26.763	22.230	31.475	28.828	31.299	31.615
S=0.001	AbsGS-0008	25.248	21.468	27.375	26.594	22.215	31.331	28.960	31.485	32.046
S=0.01	AbsGS-0004	**25.373**	21.298	**27.579**	**26.766**	22.074	31.582	28.968	31.774	32.283
S=0.001	AbsGS-0004	25.290	21.347	27.487	26.711	21.986	31.614	29.031	31.621	32.323

Table 4: Per-scene quantitative results(LPIPS) from the Mip-NeRF360.

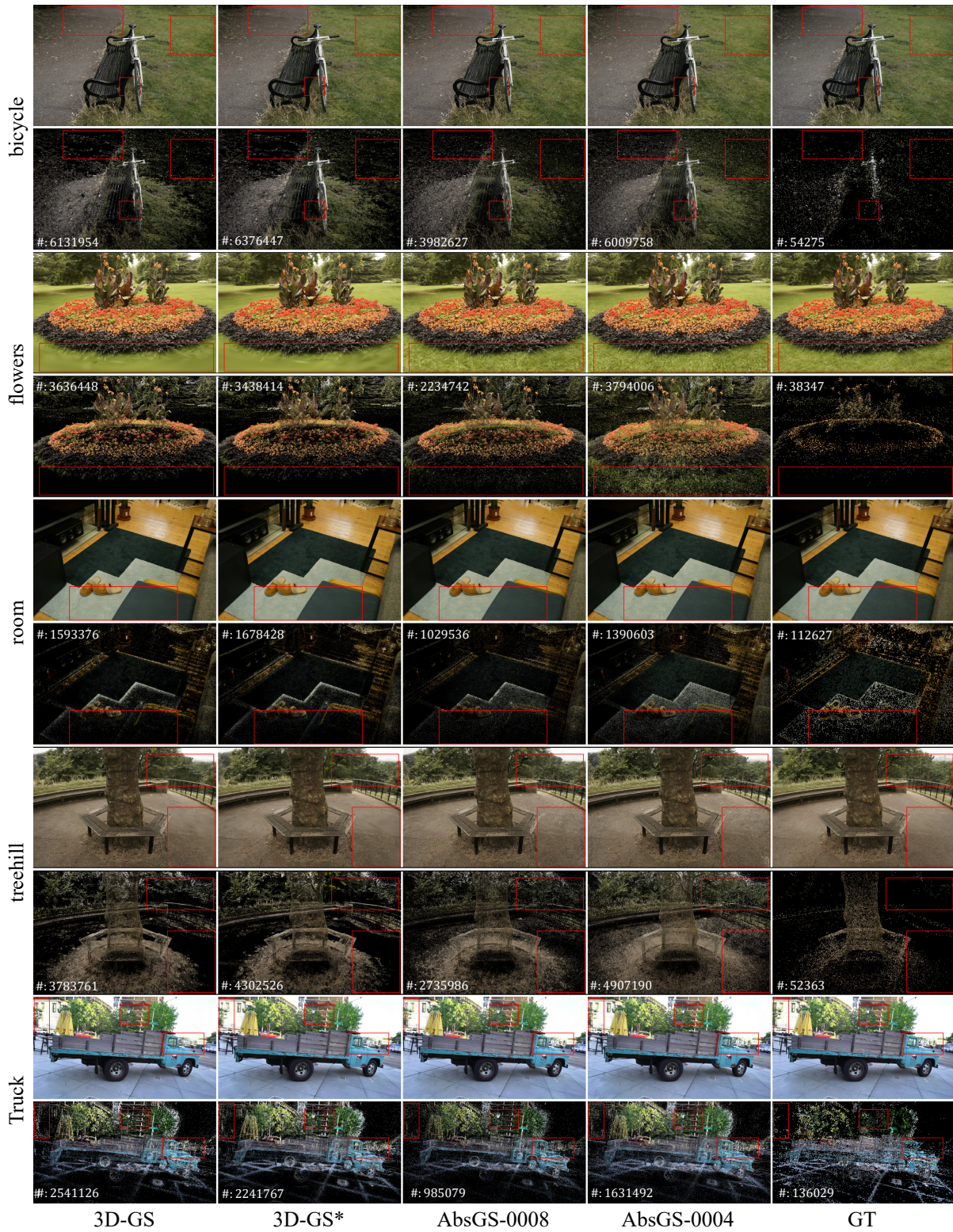|		bicycle	flowers	garden	stump	treehill	room	counter	kitchen	bonsai
Plenoxels		0.506	0.521	0.386	0.503	0.540	0.4186	0.441	0.447	0.398
INGP-Base		0.487	0.481	0.312	0.450	0.489	0.301	0.342	0.254	0.227
INGP-Big		0.446	0.441	0.257	0.421	0.450	0.261	0.306	0.195	0.205
Mip-NeRF360		0.301	0.344	0.170	0.261	0.339	0.211	0.204	0.127	**0.176**
3D-GS		0.205	0.336	0.103	0.210	0.317	0.220	0.204	0.129	0.205
3D-GS*		0.214	0.341	0.113	0.220	0.337	0.220	0.203	0.129	0.206
S=0.01	AbsGS-0008	0.199	0.312	0.118	0.212	0.308	0.218	0.218	0.131	0.207
S=0.001	AbsGS-0008	0.194	0.310	0.118	0.215	0.309	0.217	0.203	0.130	0.202
S=0.01	AbsGS-0004	0.186	0.295	0.104	0.202	0.297	0.216	0.198	0.124	0.194
S=0.001	AbsGS-0004	**0.171**	**0.270**	**0.100**	**0.195**	**0.278**	**0.200**	**0.189**	**0.121**	0.190

Figure 4: Comparison of novel view synthesis quality and point clouds in different scenes. Ground truth point cloud represents the point cloud of SfM

Figure 5: Comparison of 3D-GS and AbsGS results about scene *bicyle* under different thresholds

Figure 6: Rendered images of 3D-GS on *flowers* scene with different gradient thresholds. From left to right, the threshold gradually decreases.

Table 5: Per-scene memory consumption(MB) from the Mip-NeRF360.

		bicycle	flowers	garden	stump	treehill	room	counter	kitchen	bonsai
3D-GS*		1508	813	1073	1100	1018	397	257	412	259
S=0.01	AbsGS-0008	699	439	506	543	543	198	125	183	132
S=0.001	AbsGS-0008	941	529	584	601	647	243	145	213	150
S=0.01	AbsGS-0004	1156	751	932	1021	962	234	192	249	234
S=0.001	AbsGS-0004	1421	897	900	1103	1161	329	225	274	241

Table 6: Per-scene quantitative results(SSIM) from the Tanks & Temples and Deep Blending.

		Truck	Train	Dr Johnson	Playroom
Plenoxels		0.774	0.663	0.787	0.802
INGP-Base		0.779	0.666	0.839	0.754
INGP-Big		0.800	0.689	0.854	0.779
Mip-NeRF360		0.857	0.660	**0.901**	0.900
3D-GS		0.879	0.802	0.899	0.906
3D-GS*		0.877	0.808	0.895	0.898
S=0.01	AbsGS-0008	0.877	0.807	0.9009	0.903
S=0.001	AbsGS-0008	0.882	0.808	0.899	0.907
S=0.01	AbsGS-0004	0.886	**0.820**	0.900	**0.9072**
S=0.001	AbsGS-0004	**0.888**	0.818	0.898	0.907

Table 7: Per-scene quantitative results(PSNR) from the Tanks & Temples and Deep Blending.

		Truck	Train	Dr Johnson	Playroom
Plenoxels		23.221	23.221	23.142	22.980
INGP-Base		23.260	20.170	27.750	19.483
INGP-Big		23.383	20.456	28.257	21.665
Mip-NeRF360		24.912	19.523	29.140	29.657
3D-GS		25.187	21.097	28.766	30.044
3D-GS*		25.430	21.851	29.195	29.935
S=0.01	AbsGS-0008	25.449	21.819	29.155	29.953
S=0.001	AbsGS-0008	25.57	21.51	29.195	**30.19**
S=0.01	AbsGS-0004	25.702	**22.010**	28.930	29.967
S=0.001	AbsGS-0004	**25.735**	21.721	**29.197**	30.141

Table 8: Per-scene quantitative results(LPIPS) from the Tanks & Temples and Deep Blending.

		Truck	Train	Dr Johnson	Playroom
Plenoxels		0.335	0.422	0.521	0.499
INGP-Base		0.274	0.386	0.381	0.465
INGP-Big		0.249	0.360	0.352	0.428
Mip-NeRF360		0.159	0.354	0.237	0.252
3D-GS		0.148	0.218	0.244	0.241
3D-GS*		0.149	0.209	0.241	0.239
S=0.01	AbsGS-0008	0.156	0.224	0.249	0.248
S=0.001	AbsGS-0008	0.152	0.214	0.242	0.240
S=0.01	AbsGS-0004	0.131	0.193	0.240	0.232
S=0.001	AbsGS-0004	**0.116**	**0.157**	**0.156**	**0.179**

Table 9: Per-scene memory consumption(MB) from the Tanks & Temples and Deep Blending.

		Truck	Train	Dr Johnson	Playroom
3D-GS*		530	218	744	504
S=0.01	AbsGS-0008	204	115	328	201
S=0.001	AbsGS-0008	233	170	523	237
S=0.01	AbsGS-0004	419	210	457	316
S=0.001	AbsGS-0004	**386**	**222**	**558**	**330**