

Tangram-Splatting: Optimizing 3D Gaussian Splatting Through Tangram-inspired Shape Priors

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A ADDITIONAL RESULTS

A.1 Metrics of Each Scene

To assess the reconstruction quality of each scene, we present the quantization results for scenes from the Mip-NeRF360 dataset [1], the Tanks&Temples dataset [5], and two scenes from the Deep Blending [3], as detailed in Tables 1, 2, 3, 4, 5, and 6. Notably, we mark results sourced from the original paper with †, and those from the 3DGS [4] paper with ‡. The symbol ‘/’ indicates that the data is not provided.

Table 1: SSIM scores for Mip-NeRF360 scenes. † copied from original paper. ‡ copied from 3DGS paper.

	bicycle	flowers	garden	stump	treehill	room	counter	kitchen	bonsai
Plenoxels†	0.496	0.431	0.606	0.523	0.509	0.842	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
Mip-NeRF360‡	0.685	0.584	0.809	0.745	0.631	0.910	0.892	0.917	0.938
3DGS-7k‡	0.675	0.525	0.836	0.728	0.598	0.884	0.873	0.900	0.910
3DGS-30k‡	0.771	0.605	0.868	0.775	0.638	0.914	0.905	0.922	0.938
GES-40k	0.730	/	0.848	0.743	/	0.912	0.900	0.921	0.936
Ours	0.712	0.541	0.846	0.725	0.598	0.912	0.913	0.943	0.950

Table 2: PSNR scores for Mip-NeRF360 scenes. † copied from original paper. ‡ copied from 3DGS paper.

	bicycle	flowers	garden	stump	treehill	room	counter	kitchen	bonsai
Plenoxels†	21.912	20.097	23.4947	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
Mip-NeRF360‡	24.305	21.649	26.875	26.175	22.929	31.467	29.447	31.989	33.397
3DGS-7k‡	23.604	20.515	26.245	25.709	22.085	28.139	26.705	28.546	28.850
3DGS-30k‡	25.246	21.520	27.410	26.550	22.490	30.632	28.700	30.317	31.980
GES-40k	24.801	/	26.953	26.003	/	31.172	28.735	30.682	31.702
Ours	24.386	20.377	26.739	25.363	22.000	30.867	29.101	31.628	32.075

Table 3: LPIPS scores for Mip-NeRF360 scenes. † copied from original paper. ‡ copied from 3DGS paper.

	bicycle	flowers	garden	stump	treehill	room	counter	kitchen	bonsai
Plenoxels†	0.506	0.521	0.3864	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
Mip-NeRF360‡	0.305	0.346	0.171	0.265	0.347	0.213	0.207	0.128	0.179
3DGS-7k‡	0.318	0.417	0.153	0.287	0.404	0.272	0.254	0.161	0.244
3DGS-30k‡	0.205	0.336	0.103	0.210	0.317	0.220	0.204	0.129	0.205
GES-40k	0.267	/	0.137	0.262	/	0.235	0.216	0.135	0.217
Ours	0.284	0.403	0.138	0.276	0.394	0.225	0.123	0.073	0.106

¹Additionally, it is important to mention that the results from GES [2] were graciously provided by the authors of GES [2].

Table 4: SSIM scores for Tanks&Temples and Deep Blending scenes. ‡ copied from 3DGS paper.

	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
3DGS-7k‡	0.840	0.694	0.853	0.896
3DGS-30k‡	0.879	0.802	0.899	0.906
GES-40k	0.875	0.804	0.899	0.901
Ours	0.865	0.773	0.898	0.905

Table 5: PSNR scores for Tanks&Temples and Deep Blending scenes. ‡ copied from 3DGS paper.

	Truck	Train	Dr Johnson	Playroom
Plenoxels‡	23.221	18.927	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
3DGS-7k‡	23.506	18.892	26.306	29.245
3DGS-30k‡	25.187	21.097	28.766	30.044
GES-40K	25.233	21.892	29.259	29.914
Ours	24.786	21.659	29.221	29.961

Table 6: LPIPS scores for Tanks&Temples and Deep Blending scenes. ‡ copied from 3DGS paper.

	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
3DGS-7k‡	0.209	0.350	0.343	0.291
3DGS-30k‡	0.148	0.218	0.244	0.241
GES-40K	0.159	0.227	0.249	0.252
Ours	0.163	0.272	0.253	0.252

To compare the memory consumption of each scene, we provide the memory cost for scenes from the Mip-NeRF360 dataset [1], the Tanks&Temples dataset [5], and two scenes from Deep Blending [3], detailed in Tables 7 and 8. The memory results of 3DGS [4] were acquired using the models released by the authors on their GitHub repository². The symbol ‘/’ indicates that the data is not provided.

²<https://github.com/graphdeco-inria/gaussian-splatting>

Table 7: Memory consumption for Mip-NeRF360 scenes.

	bicycle	flowers	garden	stump	treehill	room	counter	kitchen	bonsai
3DGS-7k	855.25MB	582.19MB	1.01GB	900.53MB	567.59MB	267.29	243.47MB	398.44MB	273.68MB
3DGS-30k	1.42GB	860.06MB	1.35GB	1.15GB	894.90MB	376.85MB	289.24MB	438.10MB	294.42MB
GES-40k	652.42MB	/	621.16MB	554.20MB	/	177.77MB	142.47MB	191.08MB	147.37MB
Ours	462.07MB	291.64MB	605.06MB	524.08MB	253.27MB	57.22MB	133.79MB	208.43MB	149.70MB

Table 8: Memory consumption for Tanks&Temples and Deep Blending scenes.

	Truck	Train	Dr Johnson	Playroom
3DGS-7k	409.73MB	132.27MB	449.91MB	410.26MB
3DGS-30k	601.03MB	242.78MB	805.36MB	602.19MB
GES-40k	294.75MB	129.98MB	470.25MB	289.98MB
Ours	255.95MB	44.94MB	244.31MB	228.13MB

B IMPLEMENTATION DETAILS

Given that some parameters overlap with those in the 3DGS [4] and GES [2] algorithms, we exclusively enumerate the parameters specifically defined by Tangram-Splatting:

- (1) Iterations: The iterations for all scenes are set to 40,000 in our Tangram-Splatting.
- (2) Learning Rates
 - Step (v) learning rate: 0.00025
- (3) Intervals
 - Step (v) reset interval: 1000
- (4) Iterations of *density and clone* operation on each scene
 - TRAIN, ROOM: 1000
 - TRUCK, BICYCLE, STUMP, KITCHEN, GARDEN, BONSAI, COUNTER, FLOWERS, TREEHILL, PLAYROOM, DR-JOHNSON: 8000
- (5) Initialization of shape (β) and step (v):
 - The shape is initialized to 0.
 - The step is initialized to 2.

The remaining parameters are configured following the GES [2] algorithm. It is noteworthy that the Image Laplacian Parameters in GES [2] are omitted in our Tangram-Splatting.

REFERENCES

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