Supplementary Materials: F-3DGS: Factorized Coordinates and Representations for 3D Gaussian Splatting

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1 FACTORIZED-3D GAUSSIAN SPLATTING REPRESENTATION DETAILS

Our main paper presents a method for factorizing all features in 3DGS. We analyze the various components of our model, which comprise feature size d, scale, rotation, and factorized coordinates components. To analyze more deeply, in Tab. 1, we conduct an ablation study based on CP and VM decomposition, varying the length of feature components. Both Factorize-CP and Factorize-VM achieve consistently better rendering quality with more feature dimensions.

2 MORE EXPERIMENTAL RESULTS

In this section, we provide the experimental results that are not included in the main text, the performance of our proposed method on the Tanks&Temples and the Forward-Facing datasets. Our F-3DGS method, which is based on 3D Gaussian splatting, achieves great performance on the Tanks&Temples dataset while maintaining compact model sizes. We achieve the visual quality of PSNR(30.29) with 10.94 megabytes of storage. Furthermore, our method is still real-time rendering with competitive quality, more than 60 fps. However, TensoRF and Strivec fall short of achieving real-time rendering on the Tanks&Temples dataset. The results are shown in Tab. 2. Our method achieves better PSNR and LPIPS than TensoRF and Strivec in all scenes. We also evaluate our method on the Forward-Facing dataset. The results are shown in Tab. 6. We show the per-scene detailed quantitative results of the comparisons on the synthetic-NeRF dataset in Tab. 4. With the more compact model representations, our method outperforms TensoRF and achieves better PSNR and SSIM in most of the scenes. Ours-Fac-coord denotes the model, which we only factorize the coordinates of Gaussians (while using the original per-point attributes) to evaluate the model performance. And in Tab. 3, we show the rendering FPS and model size to demonstrate our real-time rendering on the synthetic-NeRF dataset.

Table 1: We compare our model on CP and VM methods. We use different sizes of voxel, which do not influence the performance.

	voxel	Model Size (avg) ↓	PSNR ↑
CP-16	5×5×5	6.06MB	32.42
CP-24	5×5×5	8.10MB	32.56
CP-48	6×6×6	13.97MB	32.88
CP-96	6×6×6	25.83MB	33.13
VM-8	5×5×5	16.20MB	32.80
VM-16	6×6×6	28.75MB	33.21
VM-48	6×6×6	81.46MB	33.33

Table 2: We show the average rendering FPS (Frames per second), the average model size, and PSNR on the Tanks&Temples dataset.

	FPS ↑	Model size ↓	PSNR ↑
TensoRF-CP	<20	3.9MB	27.59
TensoRF-VM	<20	71.8MB	28.56
Strivec-48	<20	54.08MB	28.70
3DGS	170.8	105.15MB	30.88
Ours-CP-16	138.8	10.94MB	30.29

Table 3: We show the average rendering FPS (Frames per second), the average model size, and PSNR on the synthetic-NeRF dataset.

	FPS ↑	Model size ↓	PSNR ↑
TensoRF-CP	<30	3.9MB	31.56
TensoRF-VM	<30	71.8MB	33.14
Strivec-48	<30	54.08MB	33.55
3DGS	345.8	68.88MB	33.31
Ours-CP-16	237.4	6.06MB	32.42

3 MIP-NERF360 DATASET

We also demonstrate our method performance on Mip-NeRF360 dataset. The qualitative and quantitative results are shown in Fig. 3 and Tab. 7. TensoRF did not provide the results on 360 scenes, and Strivec only have results on the room scene. Please note that this is our very early attempt at the 360 scene dataset, and we believe further training and algorithmic techniques can improve the performance of 360 scenes. This will be a very promising research subject for subsequent studies.

4 QUALITATIVE RESULTS

Also, We provided a few qualitative results on Mip-NeRF360 and Tanks&Temple datasets (Fig. 3, Fig. 1 and Fig. 2).

Table 4: Per-scene results evaluated on synthetic-NeRF dataset.

	Chair	Drums	Lego	Mic	Materials	Ship	Hotdog	Ficus	Average	Model size (avg)
PSNR ↑										
NeRF	33.00	25.01	32.54	32.91	29.62	28.65	36.18	30.13	31.01	-
InstantNGP	35.42	24.24	34.82	35.98	28.99	30.72	37.45	32.09	32.46	-
TensoRF-CP-384	33.60	25.17	34.05	33.77	30.10	28.84	36.24	30.72	31.56	3.90MB
TensoRF-VM-192	35.76	26.01	36.46	34.61	30.12	30.77	37.41	33.99	33.14	71.80MB
3D GS	35.83	26.15	35.78	35.36	30.00	30.80	37.72	34.87	33.52	68.88MB
Ours-CP-16	34.39	25.76	34.39	34.25	29.42	30.79	36.52	34.30	32.48	6.06MB
Ours-VM-16	34.87	26.20	35.54	34.98	30.42	31.38	37.31	**35.22**	33.24	28.75MB
Ours-VM-48	35.31	**26.30**	35.93	**35.14**	**30.67**	**31.59**	**37.79**	35.19	33.49	61.46MB
Ours-Fac-coord	35.08	26.23	36.03	35.97	30.33	31.59	37.79	35.11	33.52	-
SSIM ↑										
NeRF	0.967	0.925	0.961	0.980	0.949	0.856	0.974	0.964	0.947	
InstantNGP	0.985	0.924	0.979	0.990	0.945	0.892	0.982	0.977	0.959	
TensoRF-CP-384	0.973	0.921	0.971	0.983	0.950	0.857	0.975	0.965	0.949	
TensoRF-VM-192	0.985	0.937	0.983	0.988	0.952	0.895	0.982	0.982	0.963	
Ours-CP-16	0.980	0.949	0.977	0.987	0.953	0.898	0.981	0.983	0.964	
Ours-VM-16	0.984	**0.952**	0.981	**0.990**	**0.959**	**0.903**	**0.984**	**0.985**	0.967	
LPIPS ↓										
NeRF	0.046	0.091	0.050	0.028	0.063	0.206	0.121	0.044	0.081	
InstantNGP	0.022	0.092	0.025	0.017	0.069	0.137	0.037	0.026	0.053	
TensoRF-CP-384	0.044	0.114	0.038	0.035	0.068	0.196	0.052	0.058	0.076	
TensoRF-VM-192	0.022	0.073	0.018	0.015	0.058	0.138	0.032	0.022	0.047	
Ours-CP-16	0.019	0.047	0.023	0.012	0.052	0.122	0.029	0.018	0.040	
Ours-VM-16	0.014	0.041	0.018	0.009	0.043	0.111	0.024	0.015	0.034	

Table 5: Per-scene results evaluated on Tanks&Temples dataset.

	Ignatius	Truck	Barn	Caterpillar	Family	Average	Model size (avg)
PSNR ↑							
NeRF	25.43	25.36	24.05	23.75	30.29	25.78	-
NSVF	27.91	26.92	27.16	26.44	33.58	28.40	-
TensoRF-CP	27.86	26.25	26.74	24.73	32.39	27.59	3.9MB
TensoRF-VM	28.34	27.14	27.22	26.19	33.92	28.56	71.8MB
Strivec-48	28.39	27.32	28.09	26.58	33.13	28.70	54.08MB
3D GS	28.96	29.89	30.31	28.76	36.48	30.88	105.15MB
Ours-CP-16	**28.65**	**29.65**	**29.44**	**27.93**	**35.77**	**30.29**	10.94MB
SSIM ↑							
NeRF	0.920	0.860	0.750	0.860	0.932	0.864	
NSVF	0.930	0.895	0.823	0.900	0.954	0.900	
TensoRF-CP	0.934	0.885	0.839	0.879	0.948	0.897	
TensoRF-VM	0.948	0.914	0.864	0.912	0.965	0.920	
Strivec-48	0.948	0.915	0.884	0.917	0.957	0.924	
Ours-CP-16	**0.955**	**0.958**	**0.935**	**0.951**	**0.985**	**0.957**	
LPIPS ↓							
NeRF	0.111	0.192	0.395	0.196	0.098	0.198	
NSVF	0.106	0.148	0.307	0.141	0.063	0.153	
TensoRF-CP	0.089	0.154	0.237	0.176	0.063	0.144	
TensoRF-VM	0.081	0.129	0.217	0.139	0.057	0.125	
Strivec-48	0.083	0.123	0.167	0.125	0.065	0.113	
Ours-CP-16	**0.052**	**0.055**	**0.112**	**0.063**	**0.023**	**0.061**	

Table 6: Per-scene results evaluated on Forward-Facing dataset.

	Room	Fern	Leaves	Fortress	Orchids	Flower	T-Rex	Horns	Average	Model size (avg)
PSNR ↑										
NeRF	32.70	25.17	20.92	31.16	20.36	27.40	26.80	27.45	26.50	-
Plenoxel	30.22	25.46	21.41	31.09	20.24	27.83	26.48	27.58	26.29	-
TensoRF-VM	31.80	25.31	21.34	31.14	20.02	28.22	26.61	27.64	26.51	18.90MB
3DGS	31.95	25.92	21.22	32.34	20.71	28.76	26.87	27.25	26.88	79.36MB
Ours-CP-16	31.40	**25.54**	20.07	**31.49**	20.17	**28.26**	26.43	26.84	26.28	10.88MB

Table 7: Our method performance on 360 indoor scenes.

	room	kitchen	counter	bonsai	Model size (avg)
Strivec	28.11	-	-	-	12.6MB
DVGO	28.35	-	-	-	5.1GB
3DGS	31.7	30.32	28.70	31.98	334.75MB
Ours	30.84	30.14	28.14	31.23	70.50MB

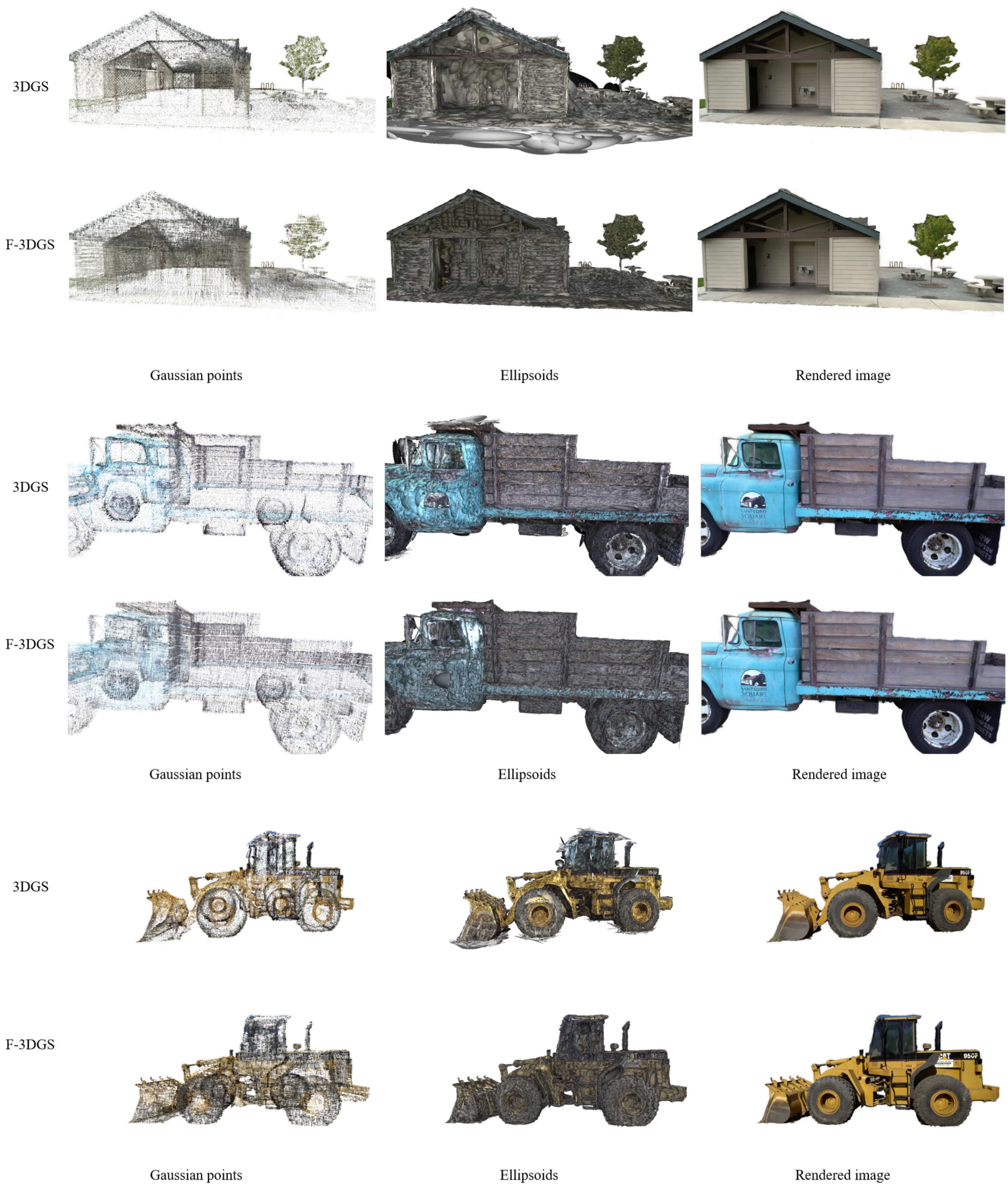

Figure 1: Visualiztion of F-3DGS and 3DGS. These visualize Gaussian points, ellipsoids, and rendered images of three objects in Tanks&Temples dataset.

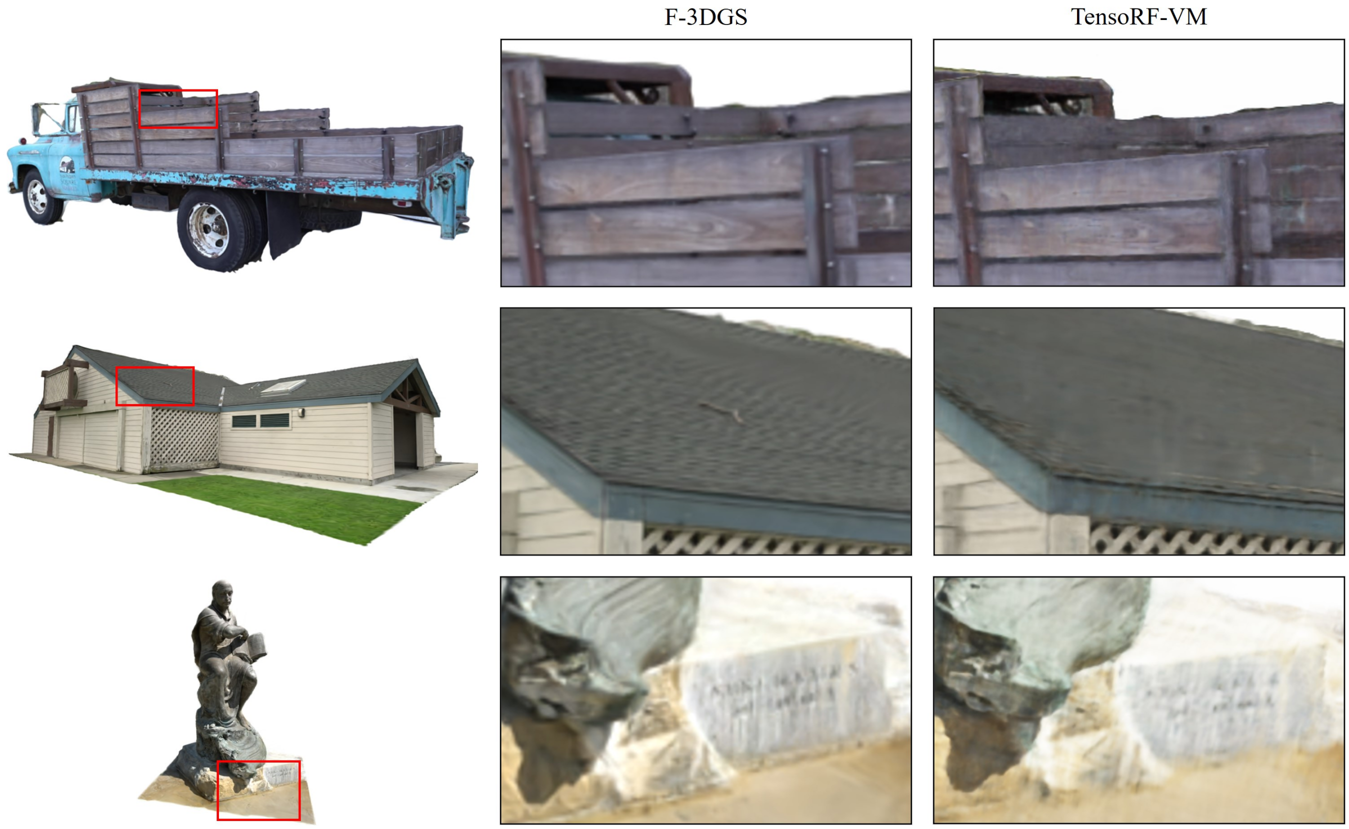

Figure 2: The qualitative results on Tanks&Temples dataset. With only $\frac{1}{7}$ of model size, our method achieved better image quality and significantly faster rendering speed.

Figure 3: The qualitative results on Mip-NeRF360 dataset.