DropGaussian: Structural Regularization for Sparse-view Gaussian Splatting

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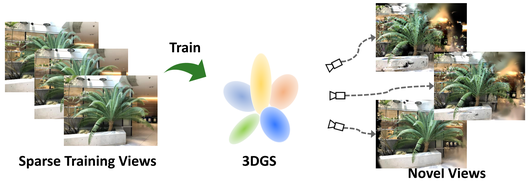
Task

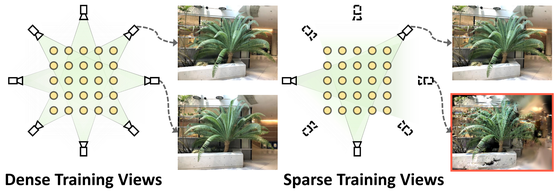
Sparse-view Gaussian Splatting

- Sparse-view Gaussian Splatting aims to reconstruct high-quality 3D scenes from only a few input images.



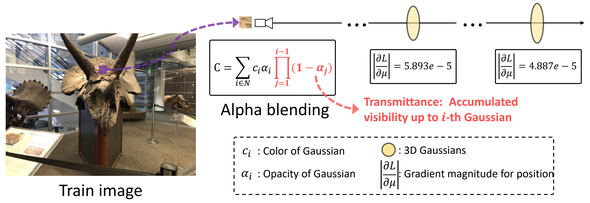
Challenge in Sparse-view Gaussian Splatting

- **Insufficient view coverage**: Limited viewpoints result in ambiguities and incomplete scene reconstruction.



→ Sparse training views easily cause overfitting to observed views, leading to artifacts in unseen areas.

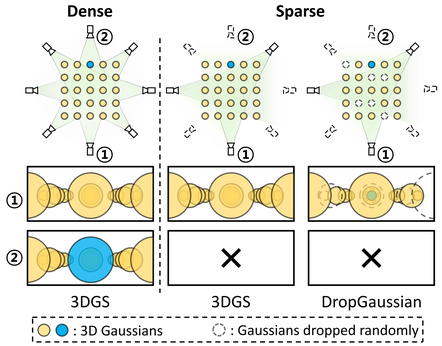
- **Alpha blending and gradient flow in 3DGS**: As Gaussians are occluded, their contributions and corresponding gradients decrease.



Proposed Method

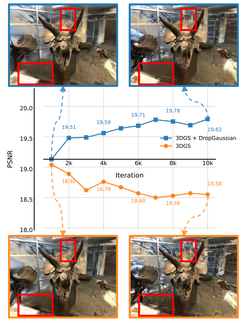
Key Idea: DropGaussian

- Randomly dropping Gaussians during training

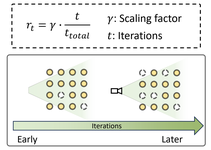


Progressive dropping

- Scale the dropping rate progressively



PSNR along training iterations



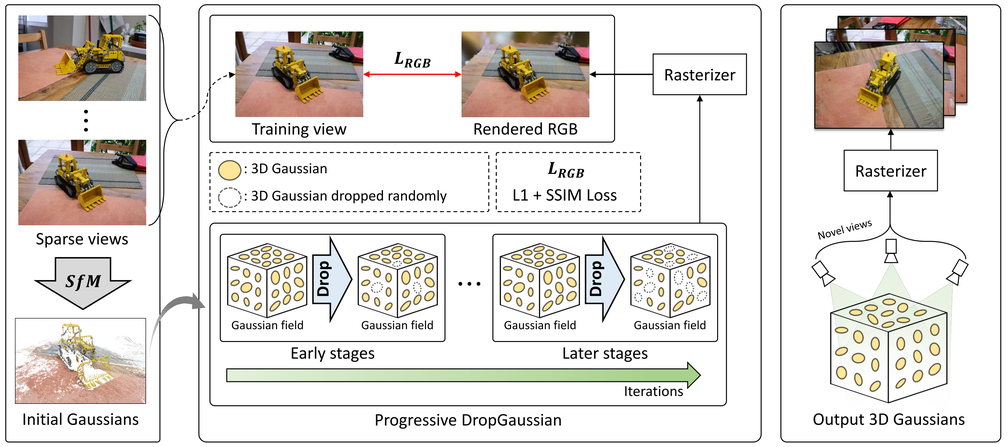
Progressive dropping

Methods	LLFF (3-view)		
	PSNR(↑)	SSIM(↑)	LPIPS(↓)
3DGS	19.22	0.649	0.229
Ours (Prog. X)	20.16	0.700	0.216
Ours (Prog. O)	20.56	0.708	0.207

Ablation study on progressive dropping

Overall Architecture

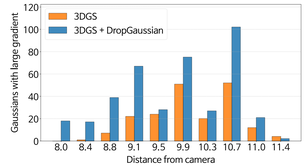
- Initial Gaussians are generated via SfM from sparse views and optimized using photometric loss following baseline 3DGS. Note that dropping is only applied during training.

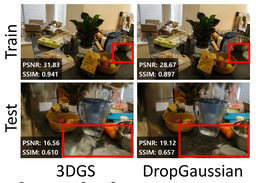


Results

Comparison of Large-Gradient Gaussians between baseline 3DGS and DropGaussian

- *'Counter'* of MipNeRF-360 dataset





Quantitative results on benchmark datasets

- Comparison on LLFF dataset

Methods	3-view			6-view			9-view		
	PSNR(↑)	SSIM(↑)	LPIPS(↓)	PSNR(↑)	SSIM(↑)	LPIPS(↓)	PSNR(↑)	SSIM(↑)	LPIPS(↓)
Mip-NeRF	16.11	0.401	0.460	22.91	0.756	0.213	24.88	0.826	0.170
DietNeRF	14.94	0.370	0.496	21.75	0.717	0.248	24.28	0.801	0.183
RegNeRF	19.08	0.587	0.336	23.10	0.760	0.206	24.86	0.820	0.161
FreeNeRF	19.63	0.612	0.308	23.73	0.779	0.195	25.13	0.827	0.160
SparseNeRF	19.86	0.624	0.328	-	-	-	-	-	-
3DGS	19.22	0.649	0.229	23.80	0.814	0.125	25.44	0.860	0.096
DNGaussian	19.12	0.591	0.294	22.18	0.755	0.198	23.17	0.788	0.180
FSGS	20.43	0.682	0.248	24.09	0.823	0.145	25.31	0.860	0.122
CoR-GS	20.45	0.712	0.196	24.49	0.837	0.115	26.06	0.874	0.089
Ours	20.76	0.713	0.200	24.74	0.837	0.117	26.21	0.874	0.088

Qaulitative results on benchmark datasets