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Grids of 3DGS attributes



A single Gaussian splat needs 59 attributes to render. We can reshape the attributes of a scene of *n* Gaussians into a grid of shape $\sqrt{n} imes \sqrt{n} imes 59$

Parallel Linear Assignment Sorting



Our novel algorithm: Sorting multi-dimensional data into locally smooth 2D grids. Allows us to group 3D Gaussian Splats with similar attributes close together in 2D.

Key Insight

When compressing 3D scenes, we care about the **fidelity of the rendered 2D views**. We are *not* **bound** to a specific configuration of Gaussian splats. We can mold the splats during training to be **well-compressible**. We leverage this to enforce neighboring splats to share attributes, e.g. neighbors in xyz sharing the same rotation values.

Compact 3D Scene Representation via Self-Organizing Gaussian Grids

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Organize the parameters of **3D Gaussian Splatting** (3DGS) scenes into a 2D grid. Enforce local smoothness during training. Then leverage off-the-shelf image compression to store the attribute images for a high compression rate.



3DGS: PSNR 25.44



Training method

over the training progress. The grid grows

as more Gaussians are added.



3DGS attributes are regularly sorted. A smoothness regularization is applied during training. This enforces the scene to be well-compressible.

Scale	Opacity	
0.499, 0.639, 0.471)	0.722	
0.576, 0.653, 0.913)	0.912	
0.693, 0.551, 0.672)	0.074	
0.192, 0.459, 0.771)	0.667	
0.394, 0.532, 0.026)	0.503	
0.499, 0.639, 0.471)	0.722	
0.877, 0.553, 0.416)	0.587	

22x compression

We are leveraging offthe-shelf image compression to reduce the size of 3DGS attributes.



Sorted

2D Attributes

~28.8 MB

Ours: PSNR 25.56

Compression

Name	$PSNR \uparrow$	$ SSIM\uparrow$	LPIPS \downarrow	Size (MB)
PLY	25.83	0.888	0.140	395.60
JPEG XL lossless w/o quantization	25.83	0.887	0.140	238.41
Ours w/o quantization	25.82	0.887	0.140	227.01
NumPy npz	25.57	0.878	0.149	57.72
JPEG XL lossless	25.57	0.878	0.149	40.19
16-Bit PNG	24.91	0.874	0.152	44.38
OpenEXR	24.31	0.813	0.196	36.56
Ours	25.56	0.878	0.150	28.79

The *Truck* scene, trained with our method, compressed in different formats. Marked in bold is the compression method used in our experiments for all datasets



Contributions

- Novel compact scene representation, structuring the highdimensional features in a smooth 2D grid.
- Efficient 2D sorting algorithm called Parallel Linear Assignment Sorting (PLAS) that sorts millions of parameters in seconds.
- Simple to use interface for (de)-compressing 3D scenes, compatible with 3DGS renderers.
- Storage size reduction by a factor of 17x to 42x while maintaining high visual quality.

		PSNR +	SSIM +		Size
HAC-lowrate	3.9	24.04	0.846	0.187	[MB] 8.1
IAC-highrate	4.0	24.40	0.853	0.177	11.2
splat-1.00M	4.5	24.03	0.857	0.163	15.4
GS-Low	5.2	23.70	0.836	0.227	8.4
GS-High	5.5	24.05	0.849	0.210	12.5
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Datasets. Talks & remples, wipnekr 500, Deepbienung, and SyntheticNeRF (Blender).



3DGS.zip: A survey on 3D Gaussian Splatting Compression Methods