SplatSuRe: Selective Super-Resolution for Multi-view Consistent 3D Gaussian Splatting

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splatsure.github.io

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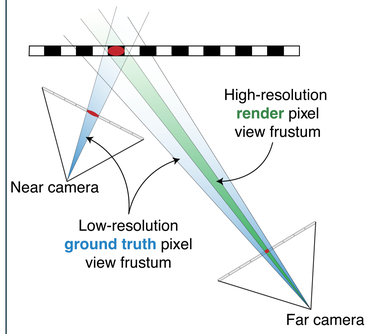
Motivation

Can we use 2D super-resolution to build high-resolution 3DGS models but also remain consistent to the ground truth?

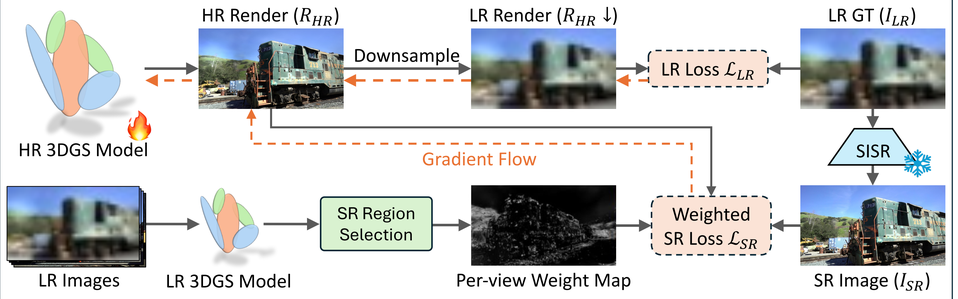


Images of a scene do not sample 3D content uniformly

Near cameras can provide high-resolution information for rendering distant views

We can use this disparity in captured frequency across views to inform where super-resolution is really required

Method



Gaussian Fidelity Score

ρ = Ratio of Gaussian's max to min sceen-space radius across views

$\rho \approx$ Disparity in sampling across views

High $\rho \rightarrow$ High variance in sampled frequency Low $\rho \rightarrow$ Uniform sampling

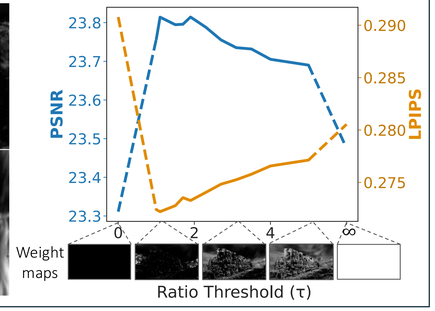
$\text{score} = \text{Sigmoid}\left(\frac{\rho-\tau}{k}\right)$, where τ is a threshold and k controls smoothness

Super-Resolution Region Selection

Convert **per-Gaussian** score to **per-view** weight map for super-resolution selection

$$W_t = \underbrace{\left(1 - \text{Render}\left(\text{score}_{\mathcal{G}}\right)\right)}_{\text{Regions with low fidelity scores}} + \underbrace{\text{Render}\left(\mathbf{1}_{\mathbf{M(t)}}(\mathcal{G})\right)}_{\text{Regions closest to current view}}$$

$\mathcal{L}_{\text{SR}}$ is spatially weighted by this per-view weight map W_t



Results

We achieve consistently sharper novel renders and improved consistency with the ground truth by selectively applying super-resolution!

Method	Tanks & Temples (rendered at 4× input resolution)							
	SSIM ↑	PSNR ↑	LPIPS ↓	FID ↓	CMMD ↓	DreamSim ↓	MUSIQ ↑	NIQE ↓
3DGS (LR)	0.669	19.41	0.350	71.58	2.013	0.0895	57.776	3.412
3DGS + StableSR	0.751	22.47	0.300	59.29	1.123	0.0667	56.748	4.945
Mip-Splatting	0.767	23.10	0.303	52.46	1.137	0.0597	46.571	5.043
SRGS + StableSR	0.771	23.32	0.286	49.11	1.048	0.0535	55.209	4.633
Ours + StableSR	0.784	23.81	0.272	37.72	1.040	0.0413	58.332	3.928

* Please see our website and paper for additional qualitative and quantitative results

Acknowledgements

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