3DGEER: 3D Gaussian Rendering Made Exact and Efficient *for Generic Cameras*

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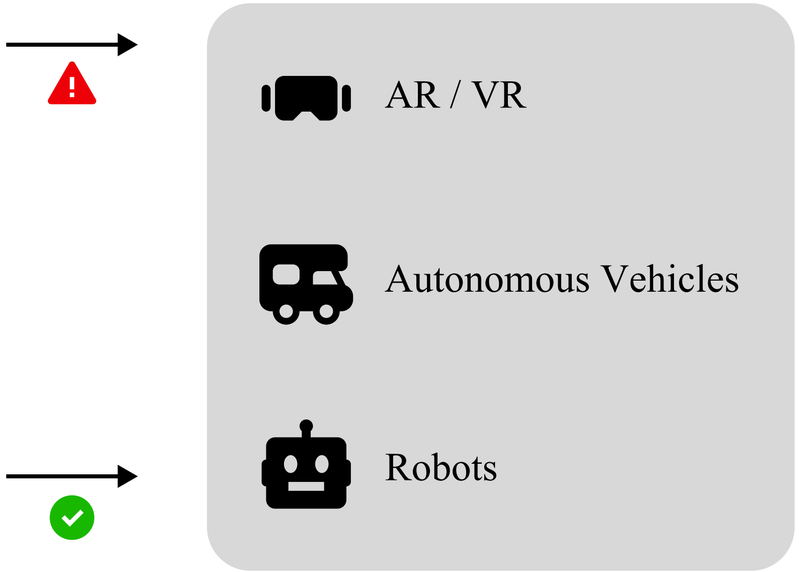
Introduction & Motivation

3D Gaussian Rendering Breaks in Real-World Settings

ATTACHMENT
VIDEO HERE



The Real World Challenge: Why Gaussian rendering breaks in autonomous and robotic systems.

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Introduction & Motivation

3D Gaussian Rendering Breaks in Real-World Settings

FisheyeGS

Limited FoV rendering

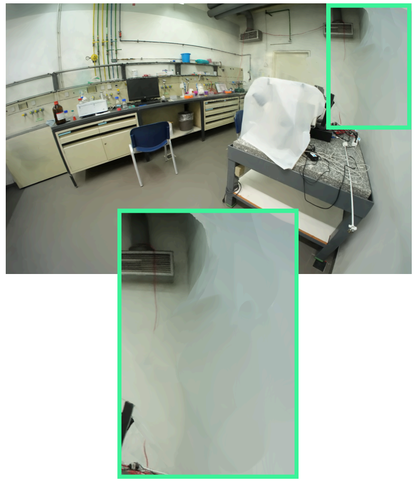
3DGUT

Gridline artifacts

3DGRT

Missing geometry
(e.g., entire leaves) / Slow

EVER



Sharp ellipsoid
edge artifacts / Slow

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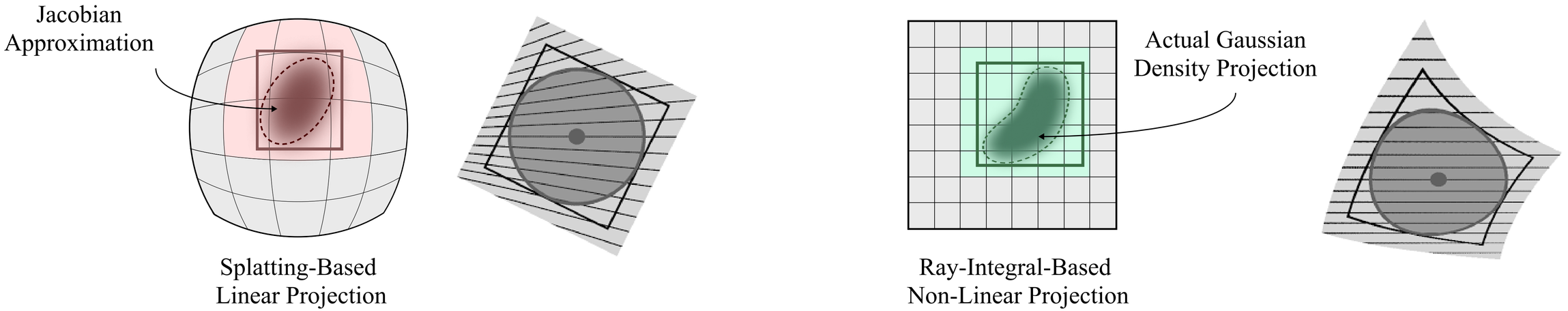
Hidden Assumptions

The Root Causes of Artifacts in Wide-FoV Rendering



Fatal Flaw 1: Gaussian 3D-2D Projection is Locally Linear

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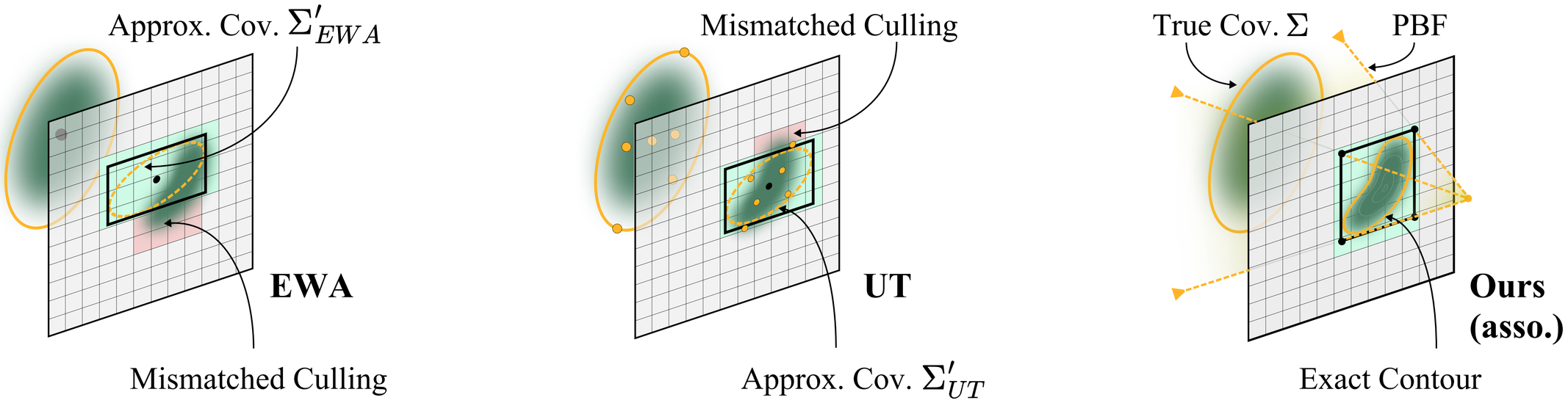
Hidden Assumptions

The Root Causes of Artifacts in Wide-FoV Rendering



Fatal Flaw 2: Ray-Gaussian Association via Conic Culling

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Methodology

Gaussian Rendering, Done Right

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Key Insight 1: Fixing the Math Behind Gaussian Projection

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Methodology

Gaussian Rendering, Done Right

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Key Insight 2: Fixing the Math Behind Gaussian Association

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Methodology

Gaussian Rendering, Done Right

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Key Insight 3: Optimizing the Ray Distribution Behind Pixel-wise Color Supervision

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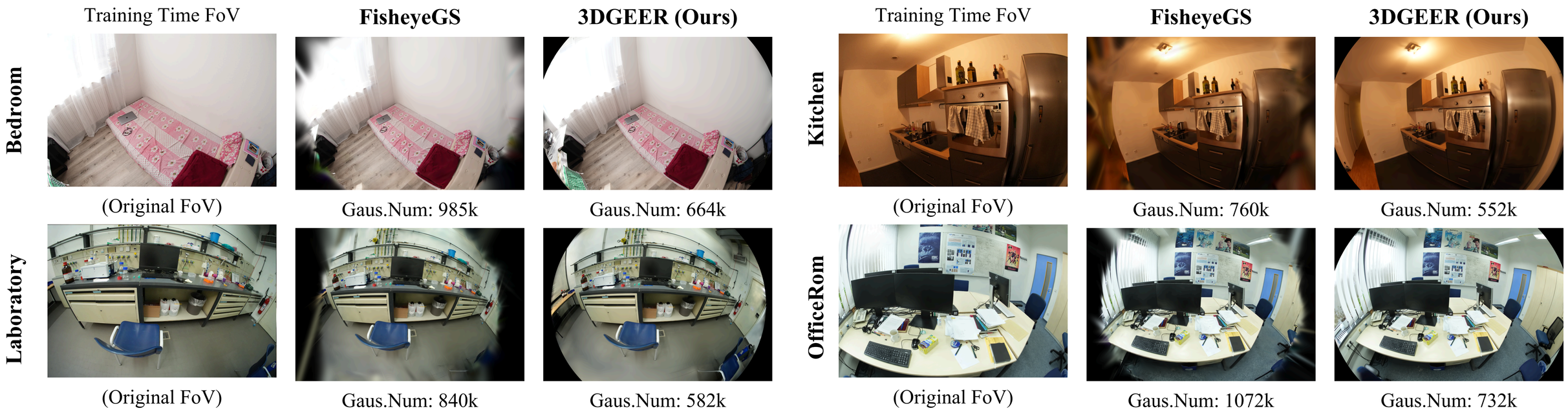
Results

Accurate, Robust and Efficient under Wide FoV



Accurate and Efficient under Extreme FoV

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Results

Accurate, Robust and Efficient under Wide FoV

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Association matters more than you expected

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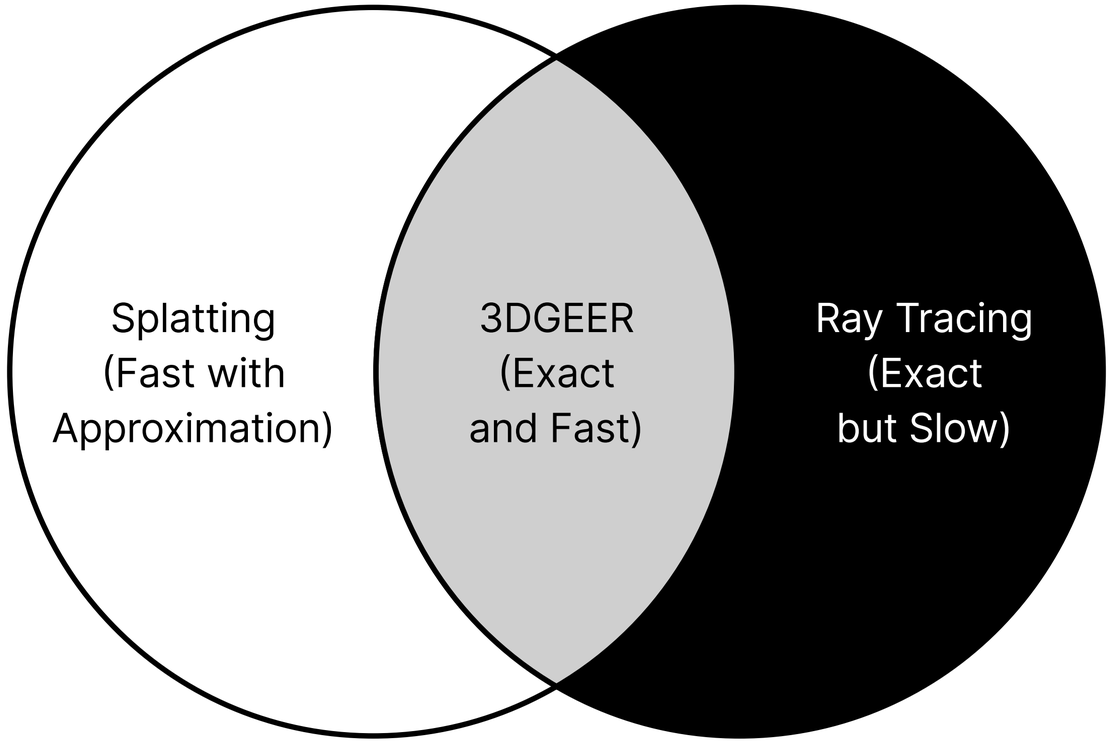
Results

Accurate, Robust and Efficient under Wide FoV



Train Data	1/8 FE		1/8 FE		1/8 FE		1/4 PH		1/4 PH		1/4 PH	
Test Data	FE	PH	FE	PH	FE	PH	FE	PH	FE	PH	FE	PH
Method	PSNR ↑		SSIM ↑		LPIPS ↓		PSNR ↑		SSIM ↑		LPIPS ↓	
FisheyeGS	23.18	26.44	0.858	0.868	0.211	0.239	19.43	26.61	0.791	**0.889**	0.247	**0.212**
EVER	25.17	26.14	0.880	0.851	0.153	0.237	22.90	26.45	0.835	0.862	**0.207**	0.222
3DGUT	24.77	25.59	0.879	0.804	0.183	0.324	18.61	25.96	0.662	0.841	0.300	0.270
3DGEER (Ours)	**26.24**	**27.62**	**0.897**	**0.888**	**0.140**	**0.214**	**23.39**	**27.61**	**0.846**	0.863	0.209	0.254

Generalize across camera models

Dataset	Method	Avg. Timings (ms) ↓				
		Prep.	Dup.	Sort	Render	Total
`MipNeRF360`	3DGS	0.32	0.27	0.65	1.40	2.92
	3DGEER (Ours)	0.37	0.17	0.27	2.10	3.06
`ScanNet++`	FisheyeGS	0.10	0.63	1.45	2.33	4.70
	3DGEER (Ours)	0.13	0.26	0.59	2.89	3.98

Maintaining competitive speed

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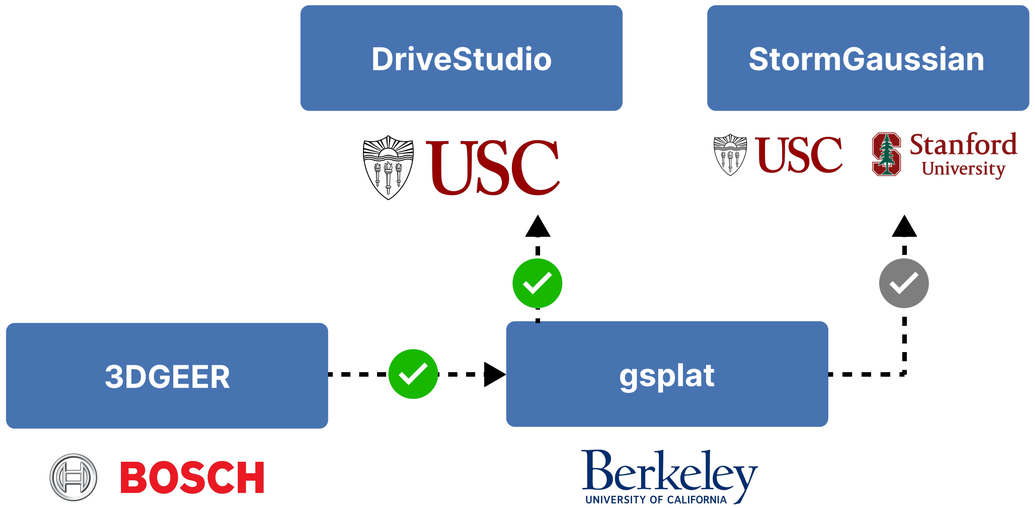
Open-source Community Support

https://github.com/boschresearch/3dgeer



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3DGEER now supports dynamic outdoor scene rendering under wide-FoV fisheye cameras with the integration into DriveStudio.

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