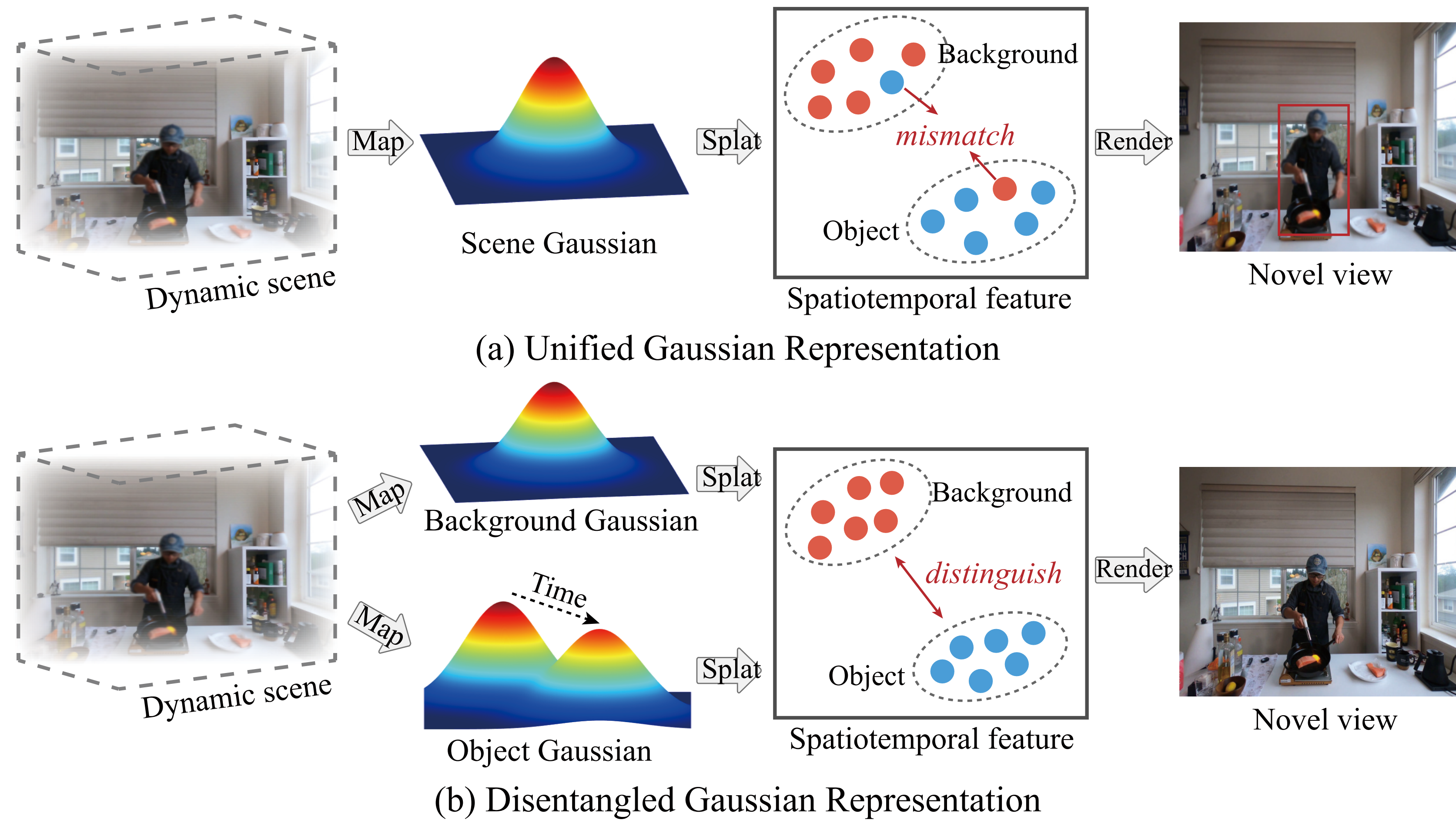


STD-GS: Exploring Frame-Event Interaction for SpatioTemporal-Disentangled Gaussian Splatting to Reconstruct High-Dynamic Scene

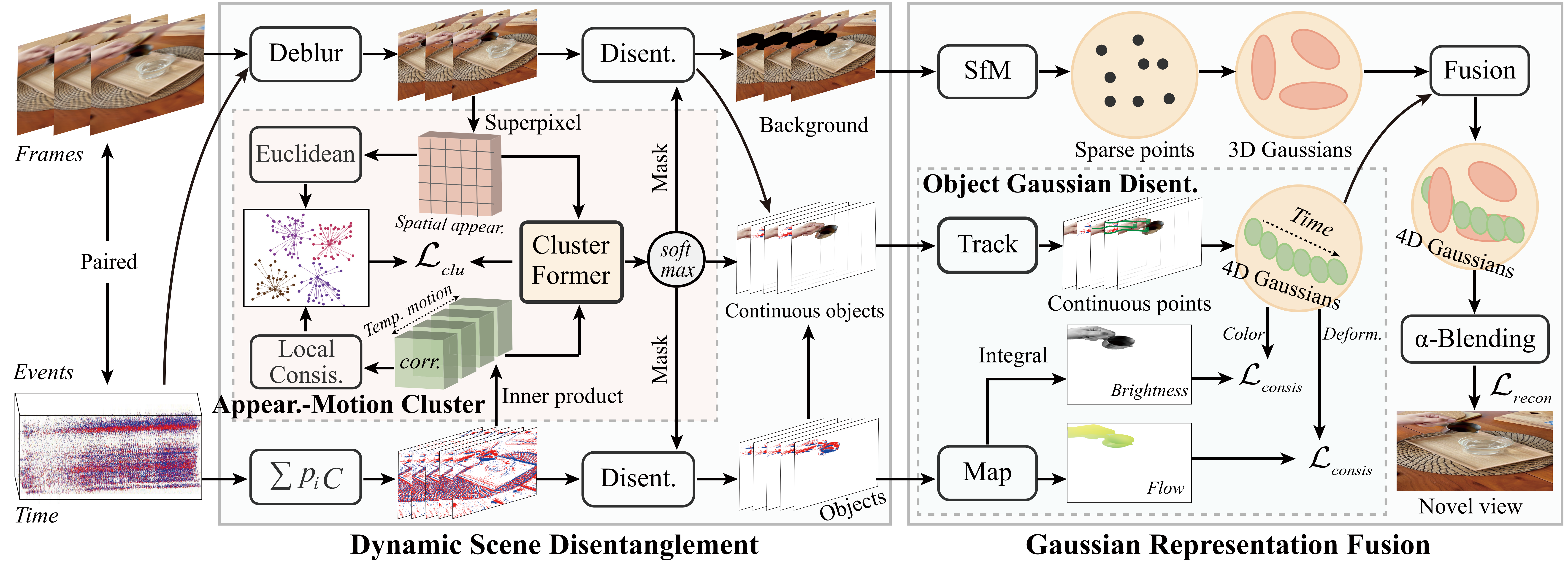
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¹Huazhong University of Science and Technology ²National University of Singapore

Problem and Idea

Unified Gaussian representation suffers the feature mismatch. we explore a disentangled Gaussian representation for distinguishing the spatiotemporal features between background and objects.

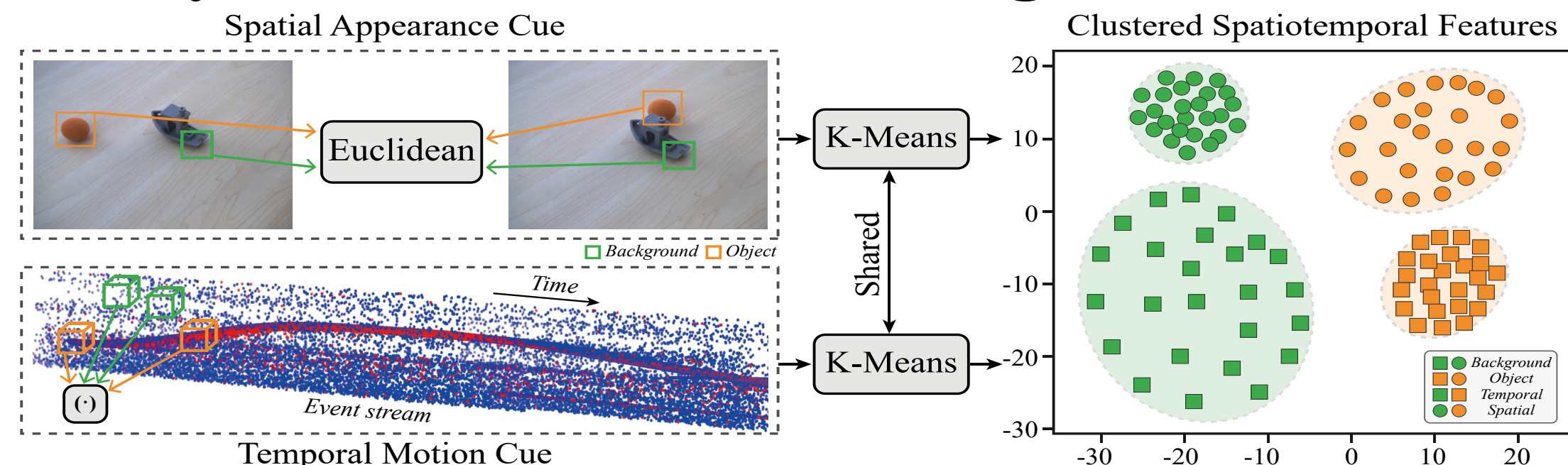


SpatioTemporal-Disentangled Gaussian Splatting

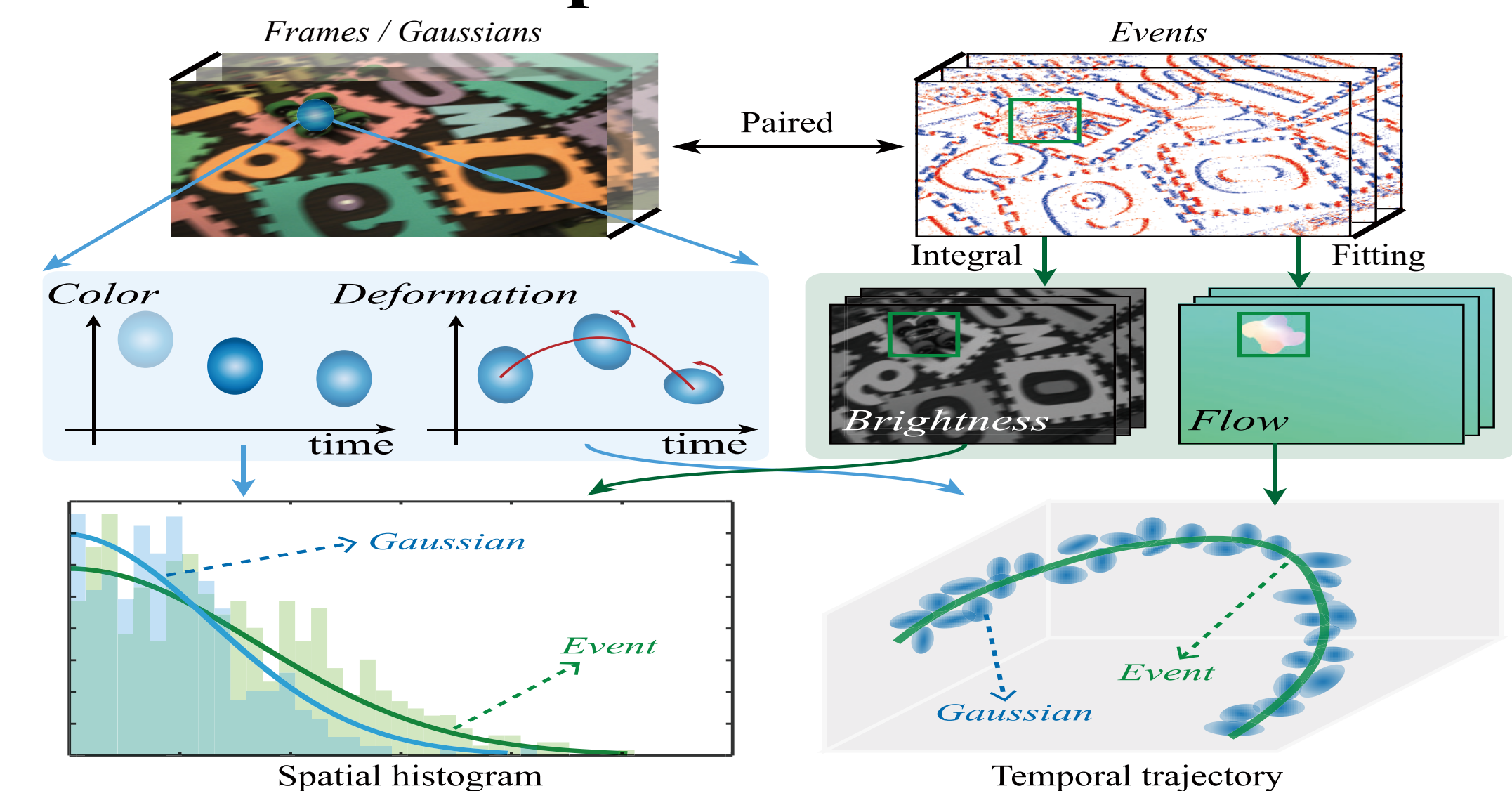


Motivation

Dynamic Scene Disentanglement

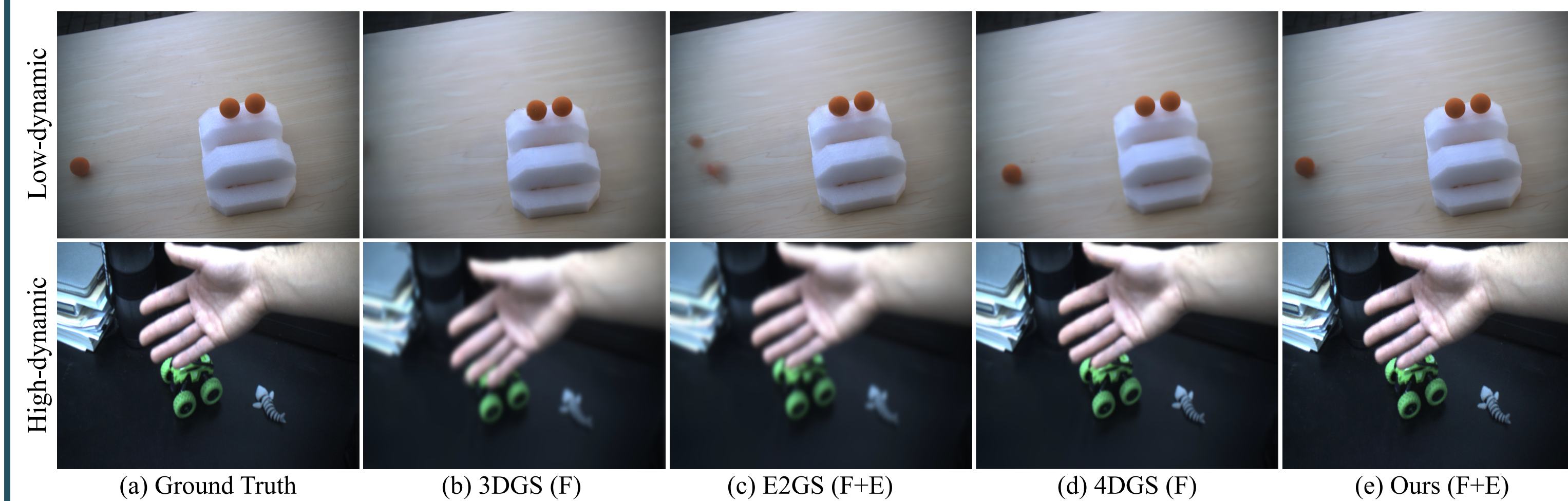


Gaussian Representation Fusion



Quantitative and Qualitative Results

Visual Comparison on Various Dynamic Scenes

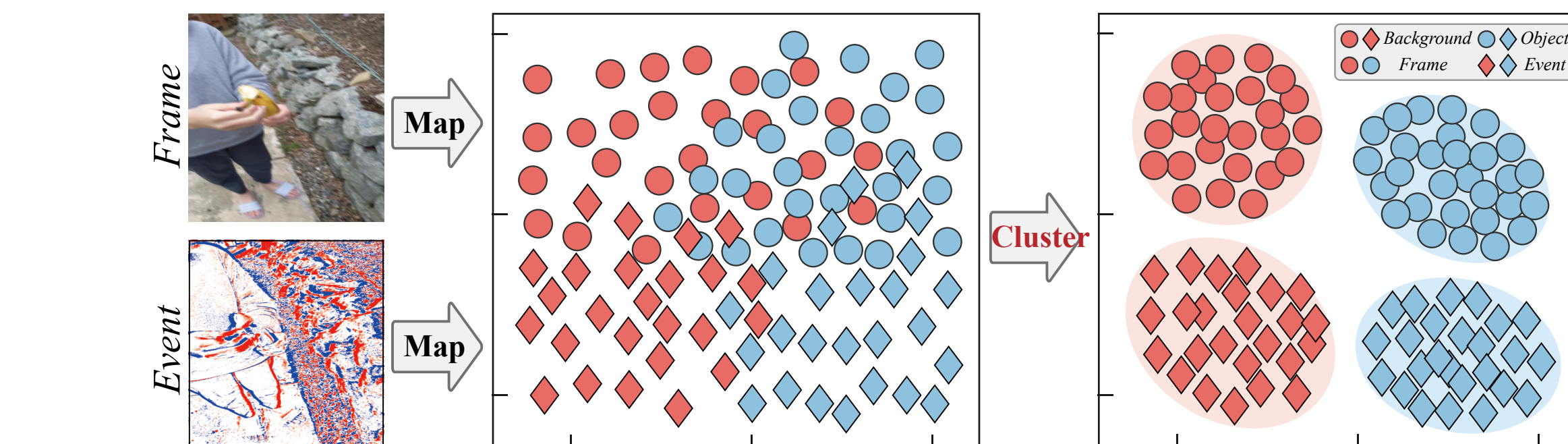


Quantitative Results on Various Dynamic Scenes

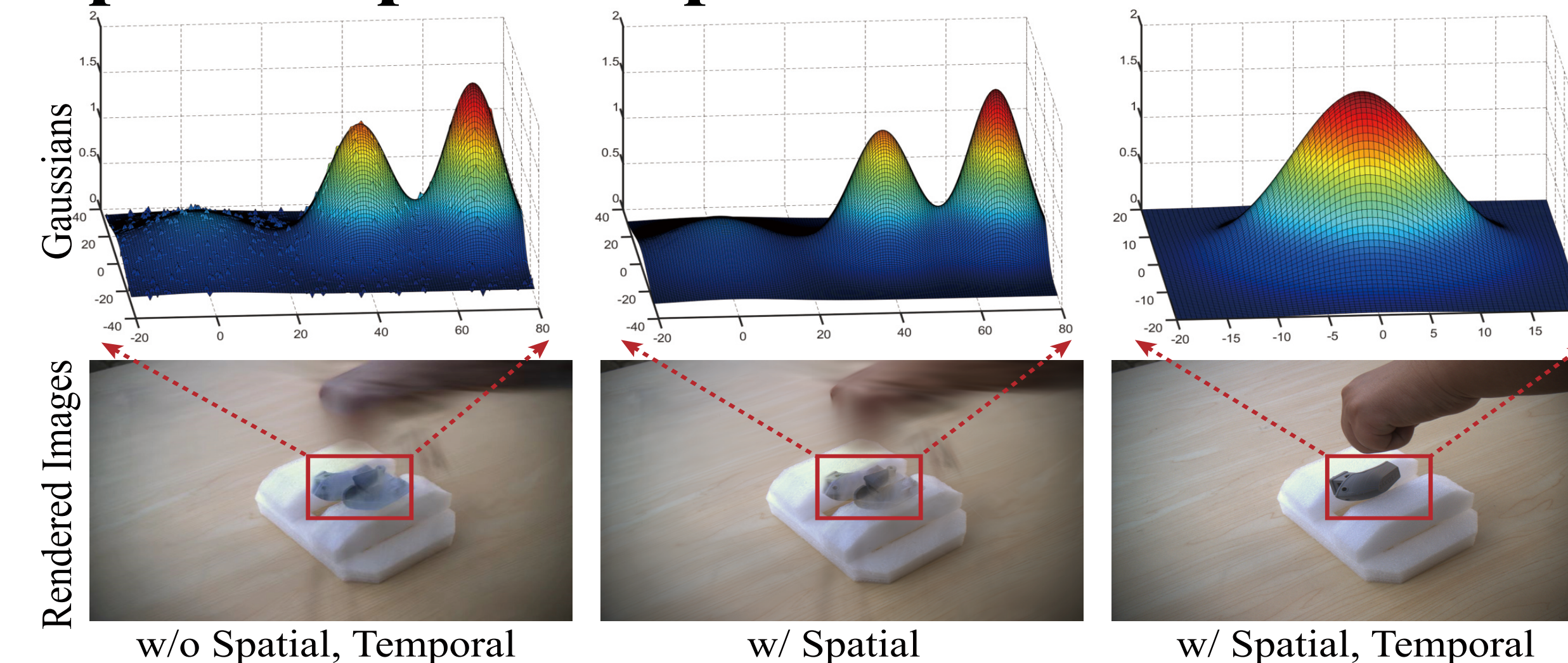
Method	Unified static representation					Unified dynamic representation				Explicit dynamic disentangle	
	3DGS[2]	E2GS[33]	IncEventGS[39]	EvGGS[40]	TiNeuVox[3]	SpacetimeGS[27]	4DGS[41]	E-D3DGS[42]	Ex4DGS[43]	GauFRe[44]	Ours
Low-dynamic	Input	F	F+E	E	E	F	F	F	F	F	F+E
	PSNR↑	21.54	22.83	23.42	22.87	26.54	29.37	28.93	30.65	30.19	31.42
	SSIM↑	0.70	0.72	0.75	0.73	0.77	0.81	0.79	0.84	0.83	0.89
	LPIPS↓	0.46	0.42	0.40	0.41	0.39	0.32	0.32	0.26	0.27	0.24
High-dynamic	Input	F	F+E	E	E	F	F	F	F	F	F+E
	PSNR↑	19.86	21.98	22.37	21.56	23.16	24.79	25.13	24.65	23.81	27.68
	SSIM↑	0.62	0.69	0.71	0.69	0.72	0.76	0.74	0.75	0.73	0.87
	LPIPS↓	0.47	0.43	0.42	0.44	0.43	0.39	0.36	0.37	0.37	0.26

Ablations and Discussion

t-SNE visualization of spatiotemporal features



Impact of spatiotemporal characteristics of events



Ablation on main losses

$\mathcal{L}_{recon}$	$\mathcal{L}_{clu}$	$\mathcal{L}_{cons}$	PSNR ↑	SSIM ↑	LPIPS ↓
✓	×	×	25.78	0.79	0.38
✓	✓	×	26.95	0.84	0.30
✓	×	✓	26.03	0.80	0.36
✓	✓	✓	27.68	0.87	0.26

Ablation on proposed modules

Disentangle	Fusion	PSNR ↑	SSIM ↑	LPIPS ↓
Scene Object	Gaussian Color			
×	×	×	×	24.83 0.75 0.42
✓	×	×	×	26.15 0.80 0.34
✓	✓	×	×	26.89 0.83 0.30
✓	✓	✓	×	27.26 0.85 0.28
✓	✓	✓	✓	27.68 0.87 0.26