Ev4DGS: Novel-view Rendering of Non-rigid Objects from Monocular Event Streams

Takuya Nakabayashi[1], Navami Kairanda[2], Hideo Saito[1], Vladislav Golyanik[2]

1: Keio University **2: Max Planck Institute for Informatics**

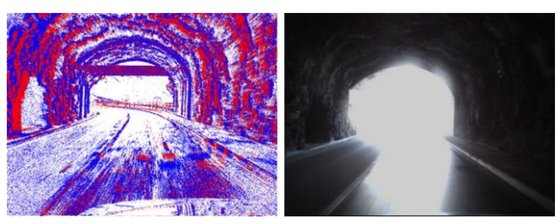
BMVC 2025

Project Page

Event camera

Event cameras capture the brightness changes as "**events**".

High temporal resolution

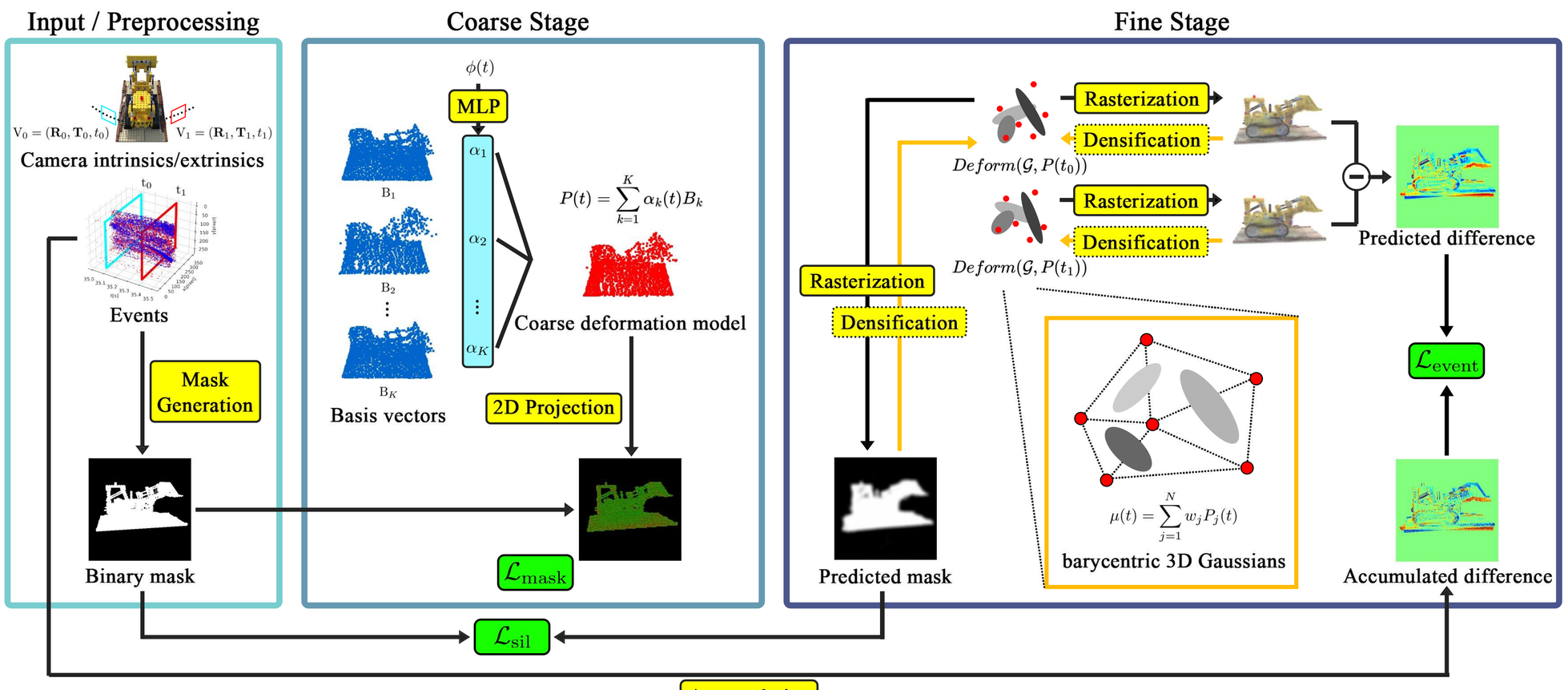


High dynamic range[1]

Contribution

- A first method for 4D reconstruction of **dynamic scenes** from **monocular event streams only** (no additional RGB frames)
- **New synthetic and real-world datasets** for evaluating future methods operating under similar assumptions

Method



Coarse Stage

Reconstruct the 3D structure and temporal changes in the scene.

$$\hat{\theta}, \{\hat{\mathbf{B}}_k\}_{k=1}^{K} = \underset{\theta, \{\mathbf{B}_k\}_{k=1}^{K}}{\operatorname{argmin}} \; \mathcal{L}_{mask}$$

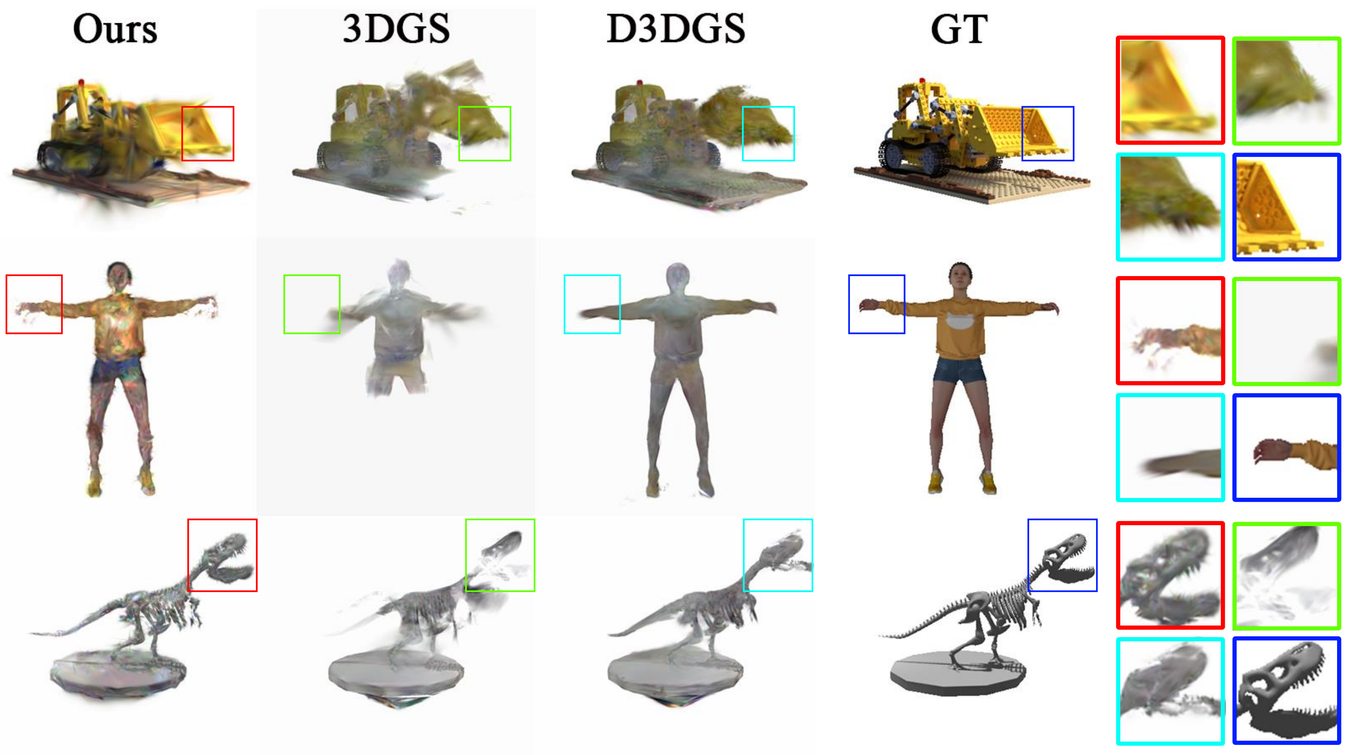
Fine Stage

Reconstruct textures of objects using 3DGS[2].

$$\hat{\mathcal{G}}, \hat{\theta}, \{\hat{\mathbf{B}}_k\}_{k=1}^{K} = \underset{\mathcal{G}, \theta, \{\mathbf{B}_k\}_{k=1}^{K}}{\operatorname{argmin}} \; \mathcal{L}_{event} + w_s \mathcal{L}_{sil}$$

Experiments and Results

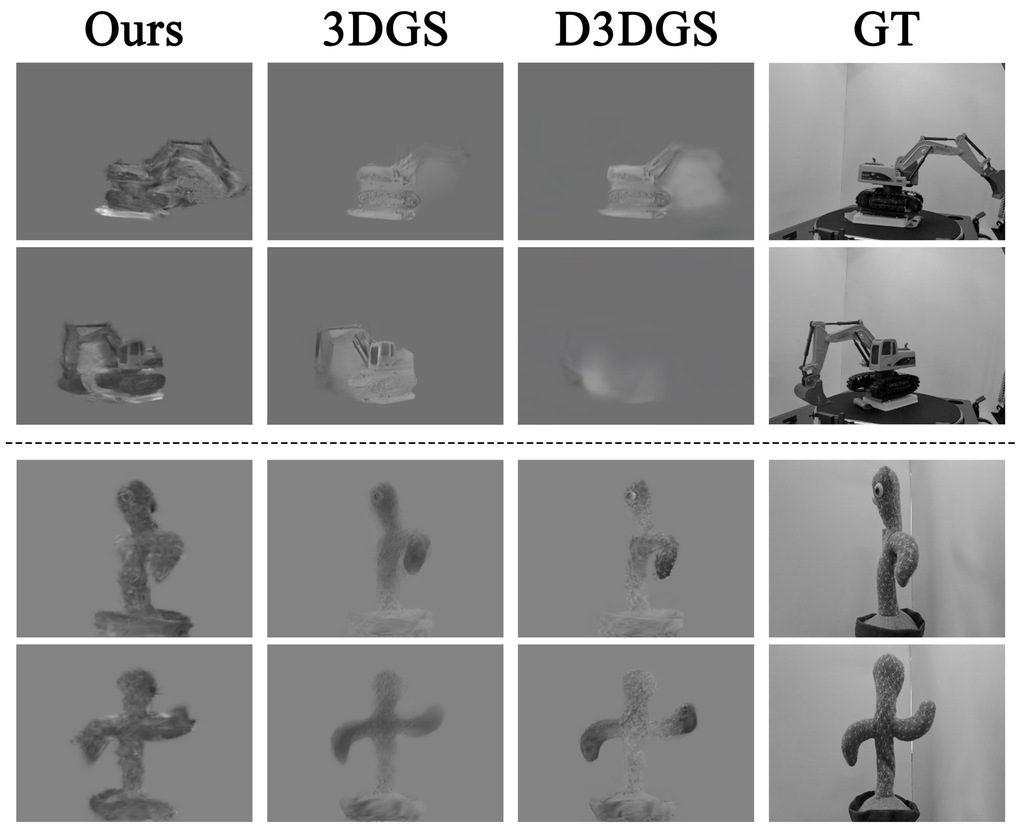
1. Synthetic dataset (novel views)



	E2VID[4]+3DGS[2]	E2VID[4]+D3DGS[3]	Ours
PSNR	17.326	18.962	**20.656**
SSIM	0.857	**0.878**	0.869

2. Real-world dataset (novel views)

- DAVIS346 MONO
- GoPro (for evaluation only)



[1] Gehrig, M., Aarents, W., Gehrig, D., & Scaramuzza, D. (2021). Dsec: A stereo event camera dataset for driving scenarios. IEEE Robotics and Automation Letters, 6(3), 4947-4954.
[2] Kerbl, B., Kopanas, G., Leimkühler, T., & Drettakis, G. (2023). 3d gaussian splatting for real-time radiance field rendering. ACM Trans. Graph., 42(4), 139-1.
[3] Yang, Z., Gao, X., Zhou, W., Jiao, S., Zhang, Y., & Jin, X. (2024). Deformable 3d gaussians for high-fidelity monocular dynamic scene reconstruction. In *Proceedings of the IEEE/CVF conference on computer vision and pattern recognition* (pp. 20331-20341).
[4] Rebecq, H., Ranftl, R., Koltun, V., & Scaramuzza, D. (2019). High speed and high dynamic range video with an event camera. *IEEE transactions on pattern analysis and machine intelligence*, *43*(6), 1964-1980.