

Event-Based Video Reconstruction & Restoration with Diffusion Models

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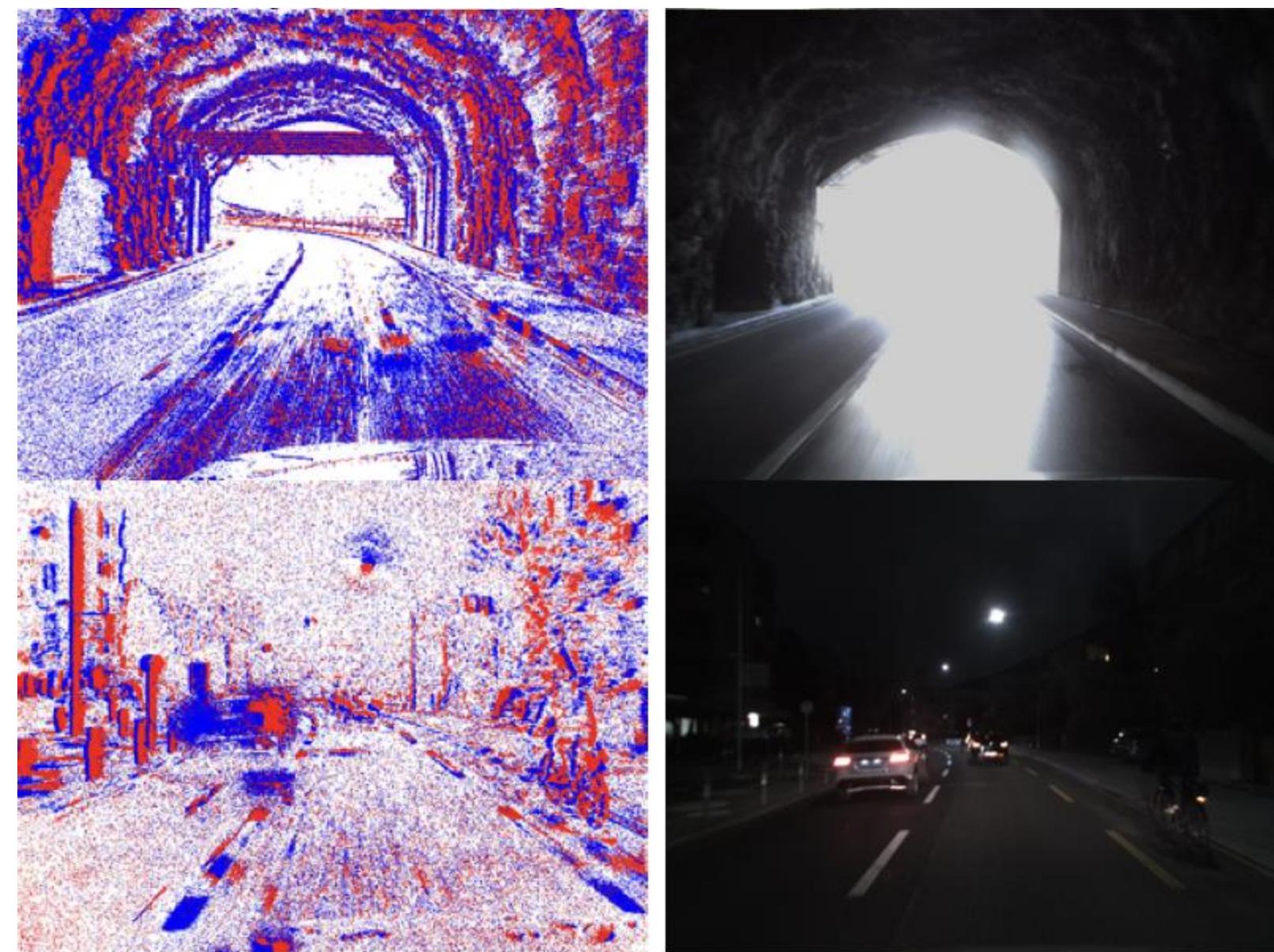
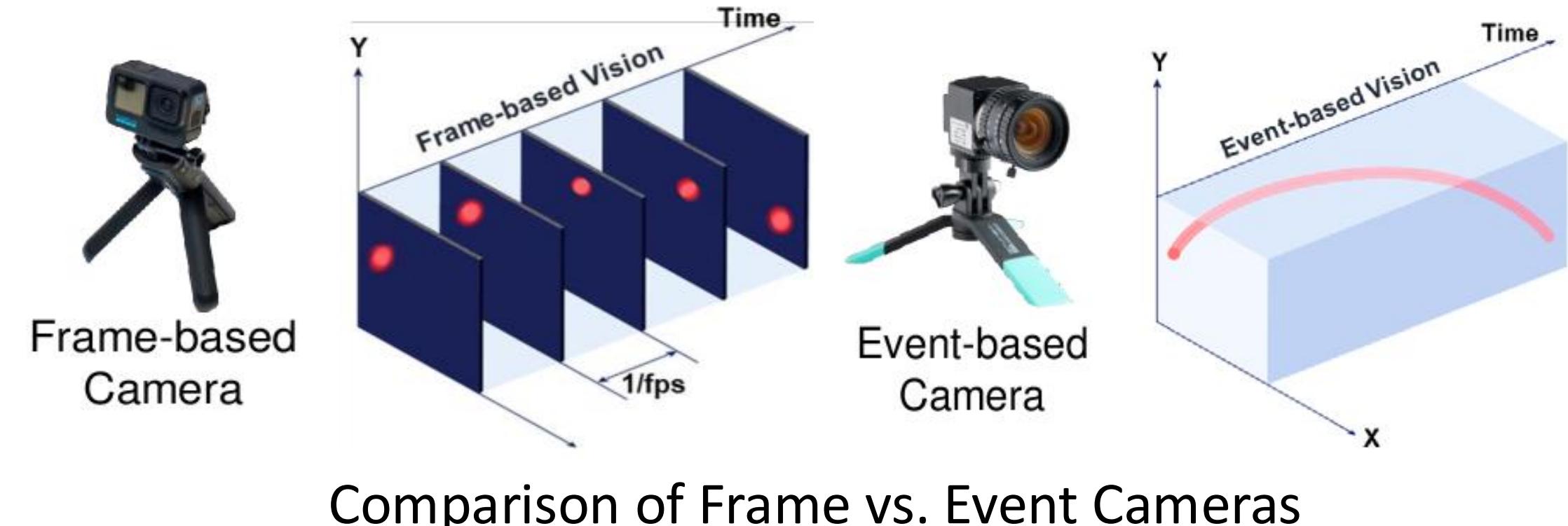
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Research question

How can diffusion models synthesize the asynchronous, data-efficient output of event-based cameras to reconstruct high-fidelity videos in scenarios where traditional methods fail?

Background

Frame-based cameras struggle in dynamic and low-light environments, resulting in motion blur or darkened frames. Event-based cameras asynchronously detect pixel-level brightness changes. They enable high temporal resolution and dynamic range but can generate sparse and unconventional data streams. Diffusion models, however, are known for synthesizing realistic images and can reconstruct photorealistic videos from sparse event streams.



Event Camera vs. Ground-Truth from DSEC Dataset

Data and Methodology

- **DSEC Dataset (2024):** Contains 53 sequences of data from driving scenarios in favorable and challenging illumination conditions with corresponding ground-truth disparity.
- **MVSEC (2018):** Data collected from four different vehicles in indoor/outdoor and day/night environments.
- **Blinking Circular Patterns experiment (Collected using Prophesee EVK4)**
 - Recorded blinking pattern to observe spatial and temporal consistency.

- Captured rapid motion under various bias and focus settings to decrease sparseness of data.



Streams Collected using Event Camera (Prophesee EVK4)

Future Work

- Work on development for a conditional diffusion model using the event-based data as input guidance.
- Train and optimize model with extensive hyperparameter tuning.
- Evaluate model performance by comparing with methods that use established metrics.

Credits and References

Thank you to Dr. Bharatesh and the FURI program for guidance throughout this process.

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