Enhancing Low-Light Traffic Monitoring at Intersections Using Event-Based Vision Systems

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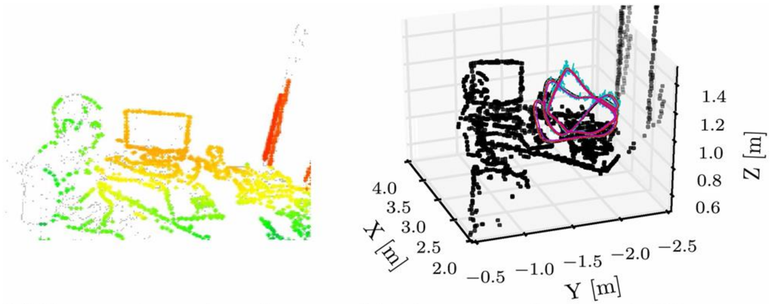
Research Question

How can event-based vision systems enhance the accuracy and efficiency of traffic participant detection and tracking at intersections in low-light and high-contrast conditions compared to traditional frame-based methods?

Background

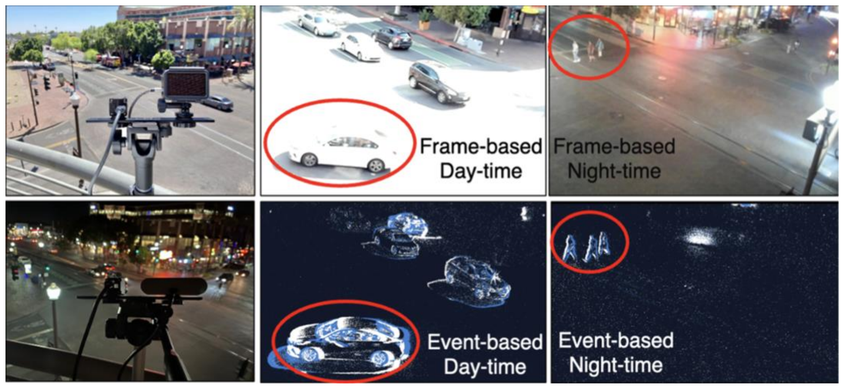
Traditional traffic cameras operate at **fixed frame rates** and often **fail in low-light or glare-heavy scenarios**, leading to **motion blur and missed detections**.

Event cameras mimic **biological vision by capturing pixel changes asynchronously**, resulting in **high temporal resolution and low latency**. Their potential remains underexplored in static traffic monitoring, especially for intersections (Neuromorphic Vision).



(a) Events & projected map. (b) Camera trajectory & 3D map.

1. Events in 4 dimensions



2. Image from the eTraM Dataset

Data Available and Collected

- **eTraM Dataset (2024, CVPR)**
  - 10 hours of annotated static event camera footage from intersections, roadways, and local streets under various lighting and weather conditions.
- **SEVD (2024)** – Synthetic dataset for training under diverse traffic scenarios.
- **DDD17 (2020)** – Event+frame data for driving environments.
- **Flashing Phone Light and Tap-water flow experiment (Collected using Prophesee EVK4)**
  - Recorded variable on/off modulation patterns at 1–10 Hz to evaluate LED flicker capture.
  - Captured continuous high-speed droplet movements and dynamic spray patterns under controlled lighting for detailed spatiotemporal fluid motion analysis.

3. Streams Collected using Event Camera (Prophesee EVK4)

Future Plans

- Benchmark a Recurrent Vision Transformer against conventional vision models on both frame-based and event data
- Rigorously evaluate accuracy, latency, and reliability in low-light and glare
- Fine-tune and validate using real-world data collected.

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