A Systematic Survey of Event Camera Simulators for Neuromorphic Vision Research

Rutuja Patil, BSE Computer Systems Engineering
Bharatesh Chakravarthi, Assistant Professor
School of Computing and Augmented intelligence

Introduction

Event-based vision (EBV) is a transformative paradigm in computer vision that departs from traditional frame-based imaging. Unlike conventional cameras, which capture entire scenes at fixed intervals, **event-based sensors operate asynchronously**, detecting changes in

Key Advantages:

- High temporal resolution (microsecond-level)
- Low latency response
- High dynamic range (120 dB)
- No motion blur
- Energy efficient operation

Key Challenges

Hardware Accessibility
High cost ($1000-$5000) and limited availability

Data Scarcity
Limited annotated datasets for training

Sim-to-Real Gap
Differences between simulated and real events

Technical Expertise
Specialized knowledge for configuration

Major Event Simulators

Year	Simulator	Open Source
2024	**ADV2E**	❌
2024	**PECS**	✅
2024	**Prophesee**	✅
2023	**CARLA**	✅
2022	**DVS-Voltmeter**	✅
2021	**V2E**	✅
2020	**Vid2E**	✅
2018	**ESIM**	✅

Application Areas

- Autonomous Driving
- Robotics
- Surveillance
- AR/VR
- Medical Imaging
- Neuromorphic AI

Commercial Event Cameras

Camera	Resolution	Latency
Prophesee Gen4	1280×720	<4μs
DAVIS240C	240×180	3μs
Samsung DVS	1280×960	<5μs
CeleX-V	1 MP	<5μs
Sony HVS	35.6 MP	<1μs

Simulator classification

Realism-Focused
ADV2E, DVS-Voltmeter, PECS, ICNS
Physical modeling, circuit behaviors

Application-Specific
CARLA, AirSim, Attention-based
Autonomous driving, robotics

General-Purpose
V2E, Vid2E, Prophesee, ESIM
Versatile, easy to use

Event simulator pipeline

1. Input Processing
RGB video frames or 3D rendered scenes

2. Brightness Change Detection
Calculate $\Delta I(x,y,t)$ between frames

3. Threshold Application
Trigger events when $\Delta I > \theta$

4. Event Generation
Output: (x, y, t, pol) stream

Simulator Advantages

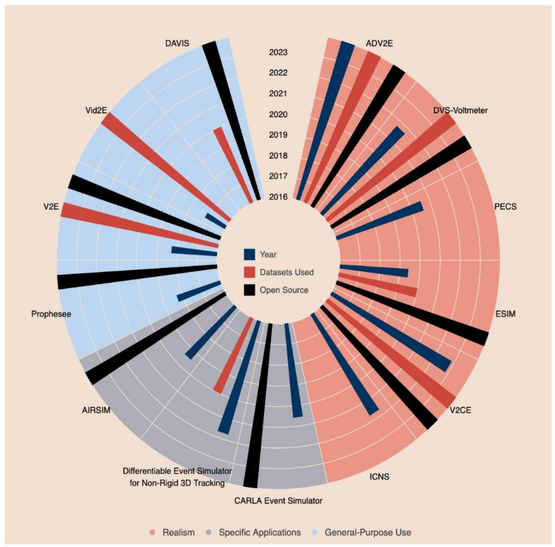
Cost-Effective
No expensive hardware required ($0 vs $1000+)

Data Augmentation
Generate large-scale synthetic datasets

Customizable
Adjust thresholds, noise, refractory periods

Accessible
Easy experimentation and algorithm development

Simulators



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Ira A. Fulton Schools of Engineering
Arizona State University