## Motivation

- Highly evolved frame-based SLAM systems employ **keypoint matching**
- Event-based keypoint matching allows **event camera integration**
- Existing approaches struggle with **motion-dependent appearance** of keypoints and **complex noise**

Contributions

- Scalable **data generation method** to train an even-based keypoint detection and description network
- Novel **event representation** for robust network inference
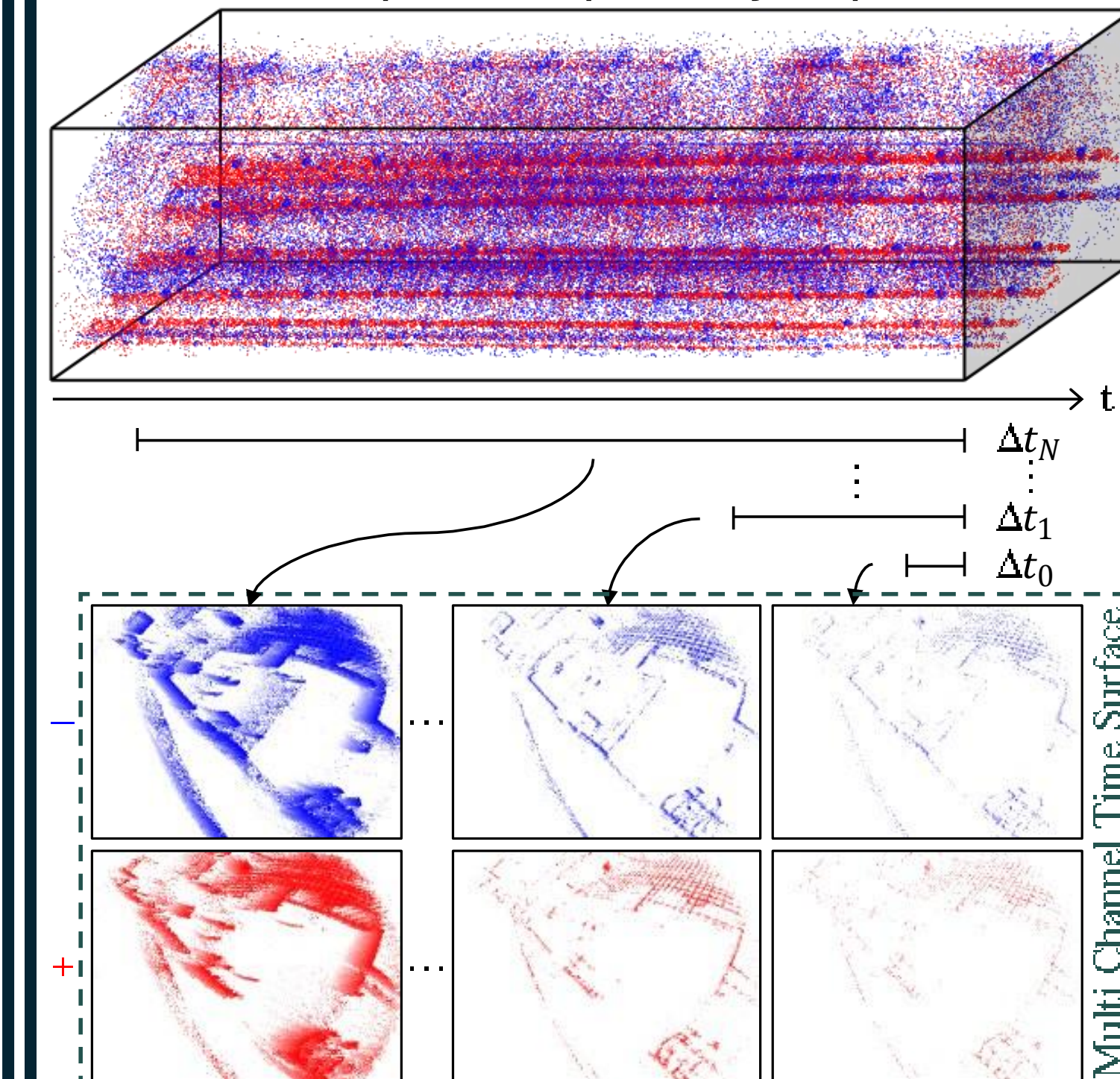- Integration into an existing VI-SLAM system, achieving **SOTA Event-SLAM** performance

Data Processing Pipeline

- Pseudo-label generation using SuperPoint+SuperGlue on event-aligned frames
- SuperEvent is trained on pseudo-labels with only event data as input → robust to motion changes
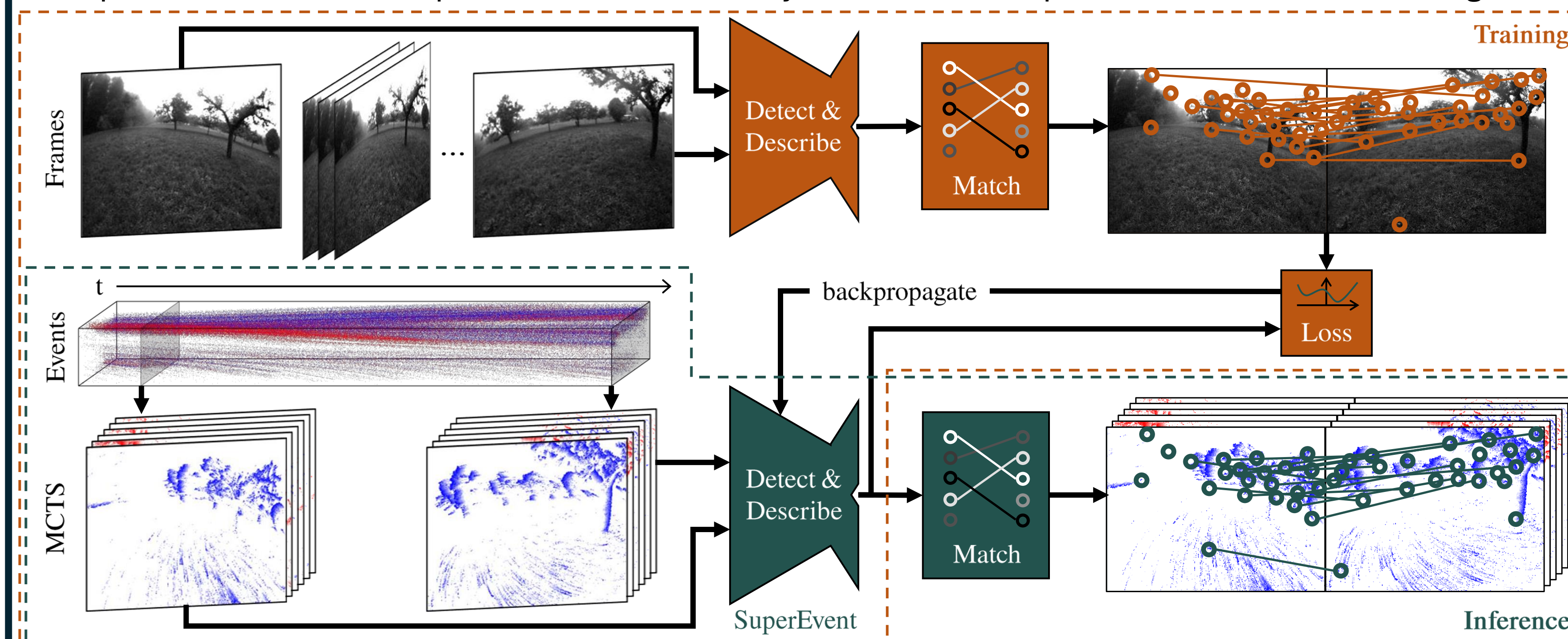
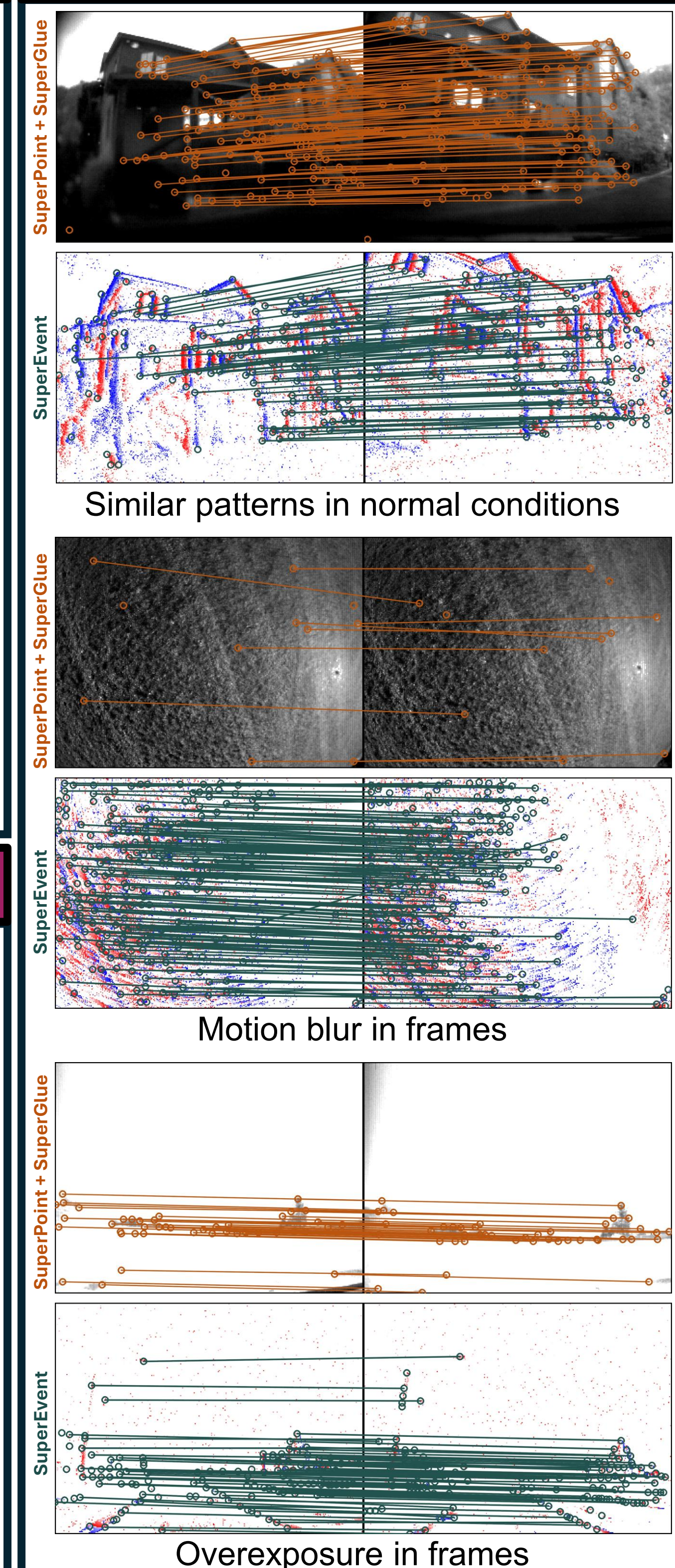## Multi-Channel Time Surfaces

Best time delta depends on scene motion → stack multiple Δt + polarity separation

Qualitative Examples (test set)

Similar patterns in normal conditions

Motion blur in frames

Overexposure in frames

Pose Estimation Experiment

Pose Estimation AUC in %

Event Camera Dataset

Method	@ 5°	@ 10°	@ 20°
LLAK	0.7	1.4	2.1
RATE	3.3	8.4	18.0
EventPoint	1.6	3.0	5.4
SuperEvent (ours)	22.7	35.8	46.7

Event-aided Direct Sparse Odometry

Method	@ 5°	@ 10°	@ 20°
LLAK	0.5	0.7	1.0
RATE	2.1	5.1	10.3
EventPoint	1.6	2.8	5.2
SuperEvent (ours)	15.2	26.8	40.1

Straightforward SLAM Integration (here: OKVIS2)

TUM Visual Inertial Event (TUM-VIE) Dataset (*mocap*-sequences, ATE in cm)

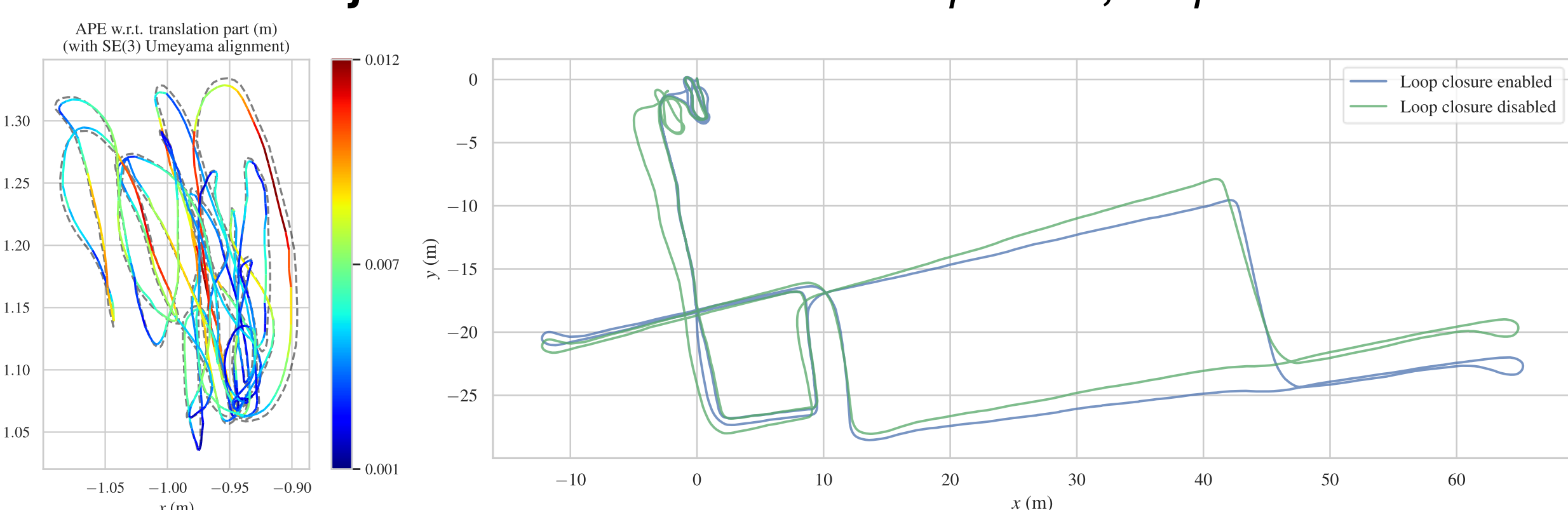| Method	Modality	1d-trans	3d-trans	6dof	desk	desk2	Average
DEIO	Mono E + IMU	1.08	1.12	1.39	1.41	1.19	1.24
ESVO	Stereo E	12.54	17.19	13.46	12.92	4.42	12.11
ES-PTAM	Stereo E	1.05	8.53	10.25	2.50	7.20	5.91
ICRA'24	Stereo E + IMU	3.85	18.90	failed	8.99	9.47	–
ESVO2	Stereo E + IMU	3.33	7.26	3.21	6.16	4.02	4.78
OKVIS2 + SuperEvent (ours)	Stereo E + IMU	**0.44**	**0.89**	**0.43**	**0.58**	**0.41**	**0.55**

Estimated trajectories on TUM-VIE *mocap-desk*, *loop-floor3*

APE w.r.t. translation part (m) (with SE(3) Umeyama alignment)

Loop closure enabled / Loop closure disabled

Loop closure supported (TUM-VIE, ATE in cm)

Sequence: *loop-floor* (estimated length)	0 · 349 m	1 · 316 m	2 · 279 m	3 · 303 m
Loop closure	**4.96**	**4.64**	**8.92**	**4.74**
W/o loop closure	132.11	161.92	116.00	129.17

Comparison to frame-based SLAM

Method	Rate	mocap-shake	mocap-shake2	floor2-dark
OKVIS2 (frame-based)	20 Hz	50.83	66.29	failed
OKVIS2 + SuperEvent (ours)	20 Hz	43.71	43.75	9.58
OKVIS2 + SuperEvent (ours)	40 Hz	**29.14**	**27.37**	**9.37**

IROS 2025 EvSLAM Challenge

Event-only: 🥇 **Winner**

Events+Frames: 🥈 **Second**