



DEIO: Deep Event Inertial Odometry

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*Equal contribution

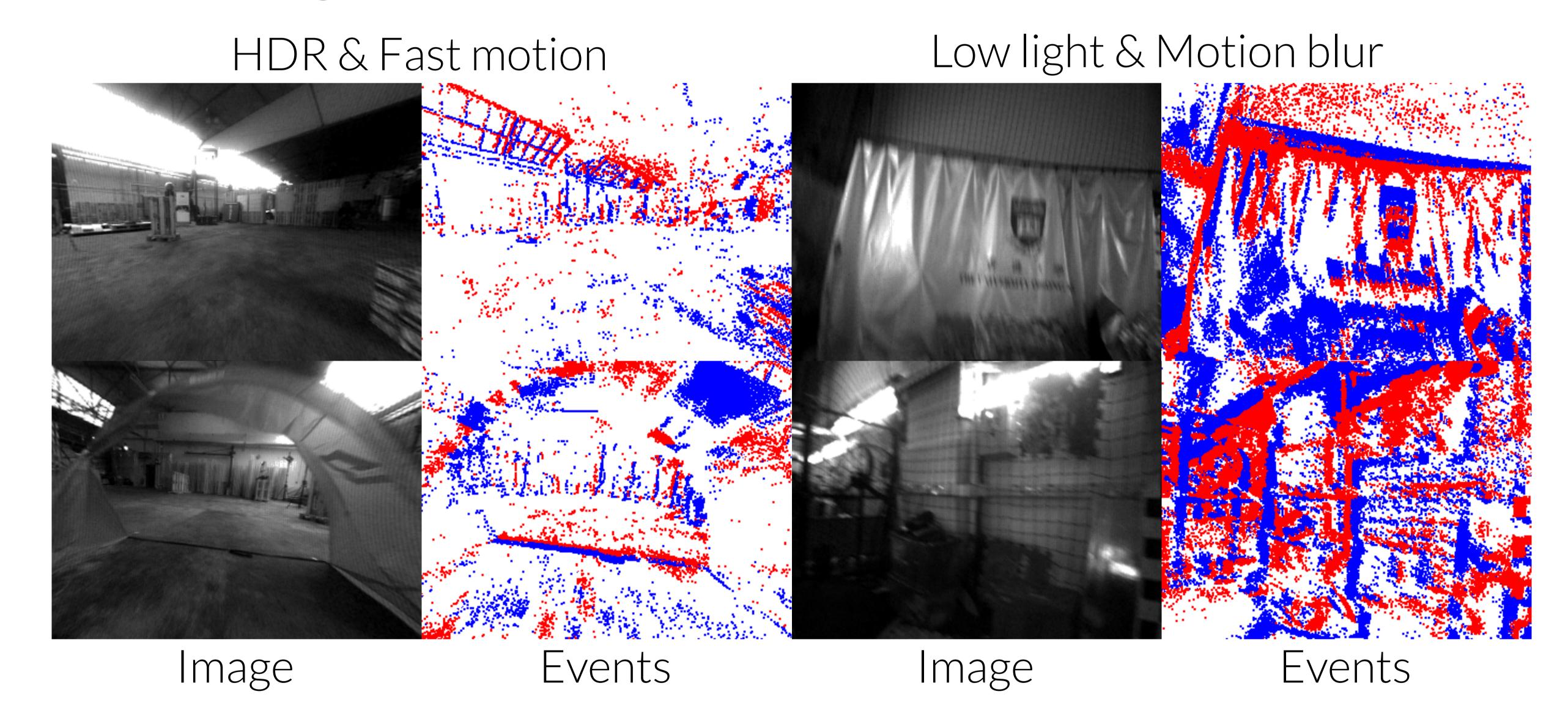
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Overview

O Motivation

- Achieving 6-DoF pose estimation under fast motion or poor lighting using **event-only sensing** without image aid.
- Leveraging deep learning for event data association.
- Addressing **scale ambiguity** in visual-only systems by integrating IMU data.

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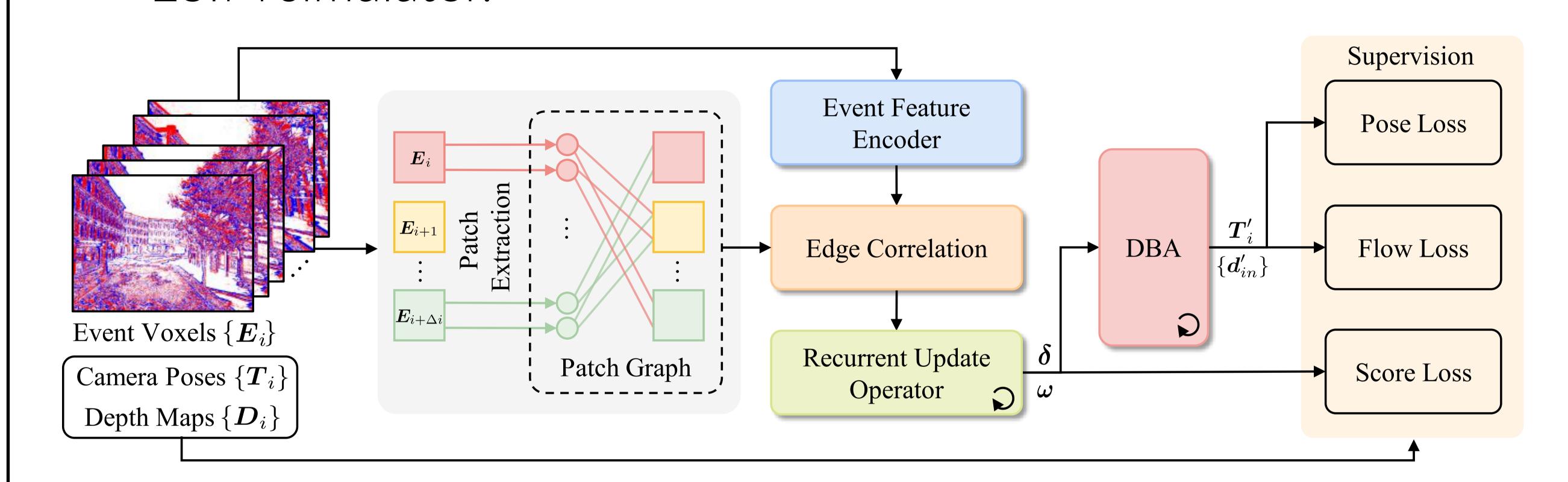
Contributions

- Proposing the **first learning-based event-inertial odometry** framework, benefiting from IMU cues while decoupling network training from IMU data to preserve generalization.
- Conducting extensive experiments on 10 challenging event-based real-world benchmarks, demonstrating superior performance over 20 state-of-the-art methods.

Method

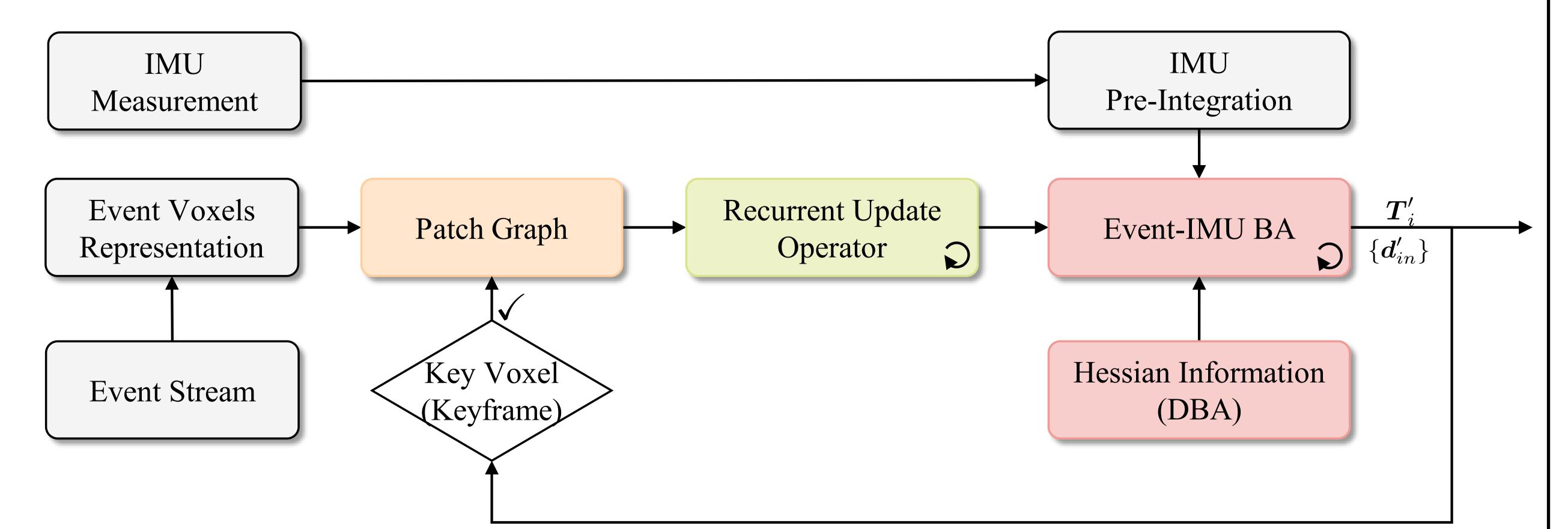
O Learning-based Event-only Odometry

- Deep learning for robust event data association.
- Employing network weights pre-trained solely on the eventbased TartanAir dataset, with synthetic events generated via ESIM simulator.



O DEIO: Deep Event Inertial Odometry

- Deriving Hessian information from the DBA layer and tightly fusing it with IMU pre-integration.
- Building a sparse patch-based co-visibility factor graph.
- Performing sliding-window event-inertial optimization using GTSAM.



Experiments

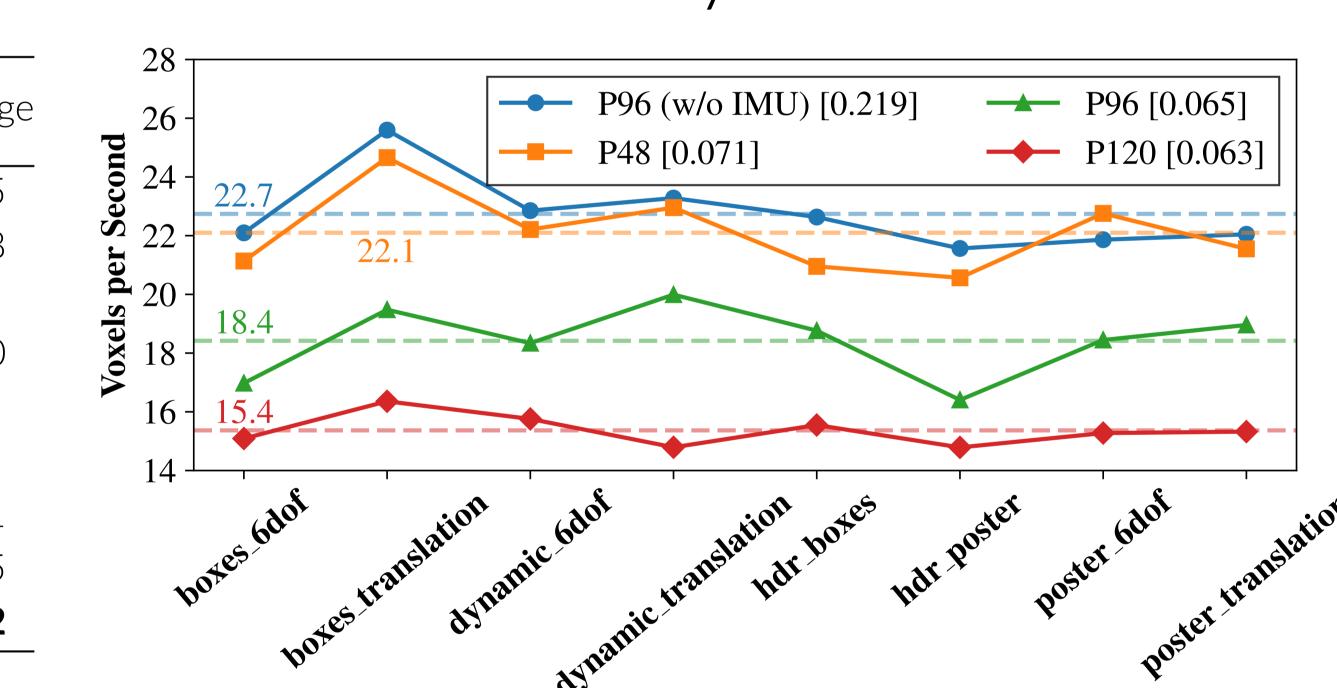
Evaluation on Stereo-HKU

Methods	agg_translation	agg_rotation	agg_flip	agg_walk	hdr_circle	hdr_slow	hdr_tran_rota	hdr_agg	dark_normal	Average
ORB-SLAM3	0.15	0.35	0.36	failed	0.17	0.16	0.30	0.29	failed	0.25
VINS-Fusion	0.11	1.34	1.16	failed	5.03	0.13	0.11	1.21	0.86	1.24
DPVO	0.07	0.04	0.99	1.17	0.31	0.23	0.67	0.29	failed	0.47
DBA-Fusion	0.13	0.16	0.83	0.37	0.18	failed	failed	0.10	0.27	0.29
Kai et al.	0.21	0.28	0.81	0.35	0.71	0.43	0.50	0.27	0.52	0.45
PL-EVIO	0.07	0.23	0.39	0.42	0.14	0.13	0.10	0.14	1.35	0.33
EVI-SAM	0.17	0.24	0.32	0.26	0.13	0.11	0.11	0.10	0.85	0.25
ESIO	0.55	0.78	3.17	1.30	0.46	0.31	0.91	1.41	0.35	1.03
ESVIO	0.10	0.17	0.36	0.31	0.16	0.11	0.10	0.10	0.42	0.20
DEVO	0.06	0.05	0.71	0.90	0.39	0.08	0.08	0.26	0.06	0.29
DEIO	0.06	0.09	0.20	0.48	0.14	0.07	0.09	0.06	0.11	0.14
Metric: MPE (%)									<u> </u>

Evaluation on UZH-FPV

Methods	Indoor_forward							
MEthous	3	5	6	7	9	10	Averag	
VINS-Fusion	0.84	failed	1.45	0.61	2.87	4.48	2.05	
ORB-SLAM3	0.55	1.19	failed	0.36	0.77	1.02	0.78	
DPVO	failed	failed	failed	failed	failed	failed		
VINS-MONO	0.65	1.07	0.25	0.37	0.51	0.92	0.70	
DBA-Fusion	failed	failed	failed	failed	failed	failed		
Ultimate SLAM	failed	failed	failed	failed	failed	failed		
PL-EVIO	0.38	0.90	0.30	0.55	0.44	1.06	0.61	
DEVO	0.37	0.40	0.31	0.50	0.61	0.52	0.45	
DEIO	0.39	0.36	0.33	0.32	0.59	0.55	0.42	
Metric: MPF (%)								

Ablation Study



Examples

