

TinyDEVO: Deep Event-based Visual Odometry on Ultra-low-power Multi-core Microcontrollers

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Contributions

- **TinyDEVO**: an event-based visual odometry (VO) deep learning algorithm designed for resource-constrained microcontroller units (MCUs).

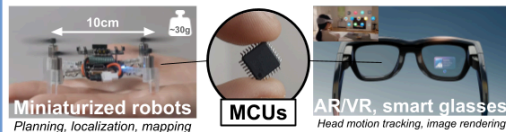
We reduce memory and operations of SoA DEVO [1] by **11.5x** and **29.7x**, respectively, **<19cm** degradation in trajectory reconstruction.

- **Average Trajectory Error (ATE)** validated on three datasets: MVSEC (27.0cm), HKU (45.3cm), RPG (4.9cm).
- **MCU Deployment**: energy-efficient execution on GAP9 System-on-Chip (SoC); throughput of **1.2 frame/second**, average power consumption of **86 mW**.

TinyDEVO is the first full-fledged VO algorithm completely running on a sub-100mW MCU.

Visual Odometry & event-based cameras

Applications on power constrained systems



Event-based cameras



ADVANTAGES

High dynamic range Robustness to motion-blur Low power (<10mW)

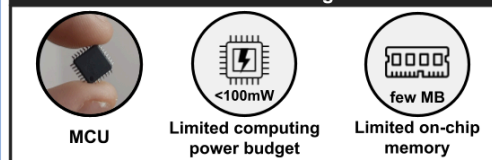
Challenges

Requirements DEVO

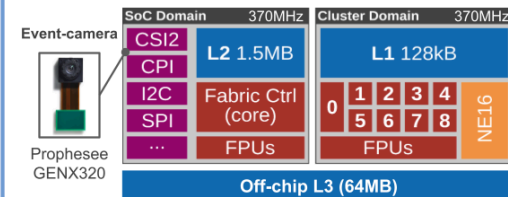


vs.

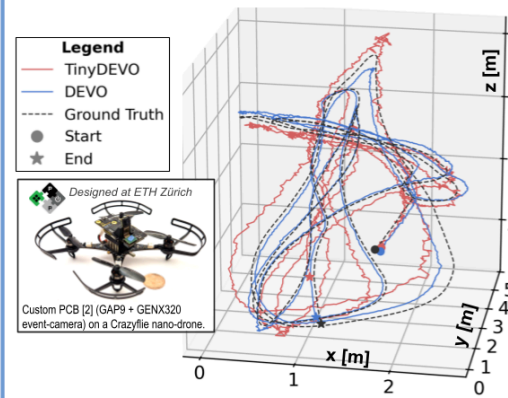
Constraints extreme edge devices



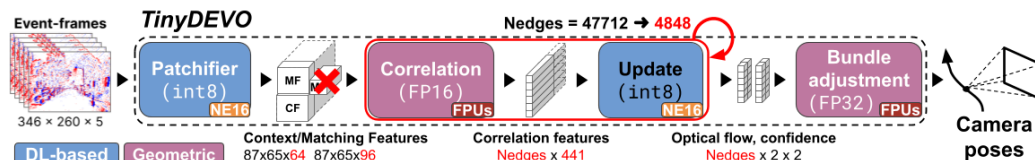
The GAP9 SoC



Conclusions



Results: TinyDEVO



Model	ATE* (cm) ↓			Peak Memory (MB)	Compute cost (Ops/frame)	Device	Power
	MVSEC	HKU	RPG				
DEVO (SoA)	8.25	25,86	0,93	732	155G	GPU	~250W
TinyDEVO (ours)	27	45,30	4,91	64	5.2G	MCU	<100mW

*Absolute Trajectory Error (ATE)

TinyDEVO

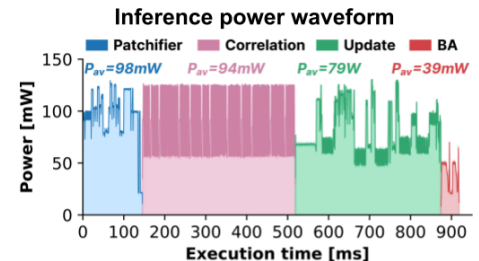
Memory: **11.5x** Less than DEVO
 Operations: **29x** Less than DEVO
 ATE: **<19cm** Higher than DEVO

Average trajectory length		
MVSEC	HKU	RPG
31m	68m	10m

TinyDEVO on GAP9

Model	Latency [s]	FPS	Power [mW]
DEVO	45,00*	0.02*	Not deployable
TinyDEVO	0.85	1.2	86

*estimated



[1] S. Klenk et al., "Deep Event Visual Odometry," International Conference on 3D Vision (3DV), 2024.
 [2] P. Bartoli et al., "LynX: An Event-Based Gesture Dataset for Egocentric Interaction in Extended Reality," IWASI, 2025.

