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Efficient Hardware Acceleration of Event-Based Vision with Reconfigurable Architectures

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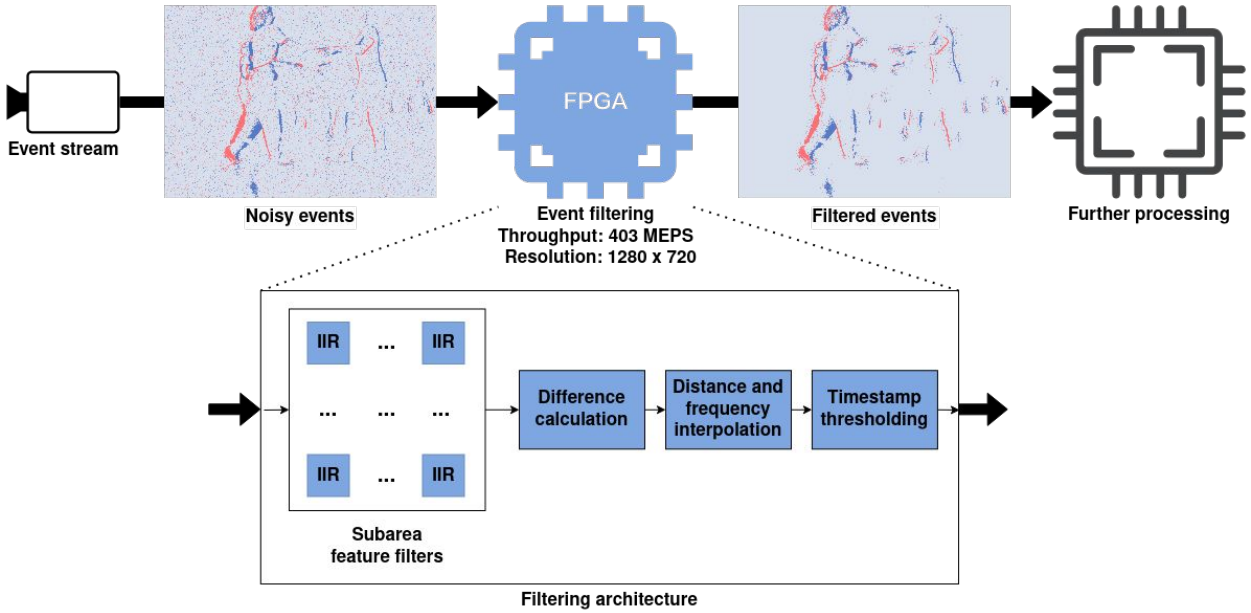
Event Stream Filtering Architecture

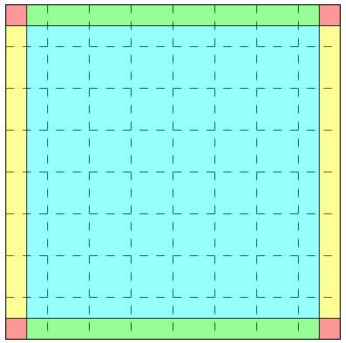
- Events unrelated to objects, camera movements, or lighting changes
- Negatively impact the performance of algorithms
- Noise intensity depends on the illumination and sensor temperature

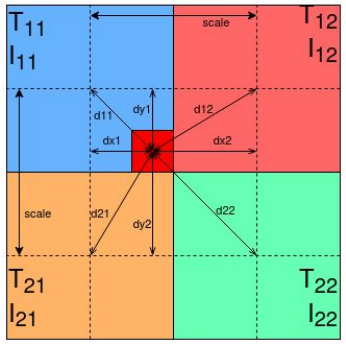


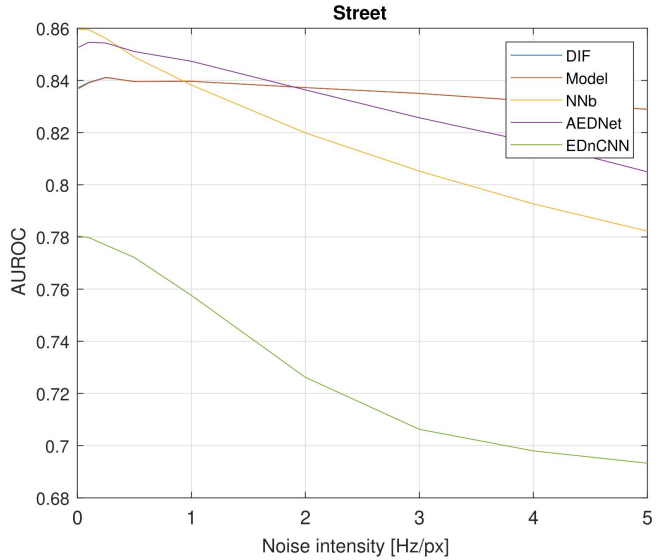
Source: Kowalczyk, Marcin, and Tomasz Kryjak. "High throughput event filtering: The interpolation-based DIF algorithm hardware architecture." Microprocessors and Microsystems (2025): 105171.

Event Stream Filtering Architecture

- Grid of IIR filters for timestamps and intervals
- Interpolation of features
- 30 KB @ 1280×720 px
- 403.39 MEPS @ 1280×720 px



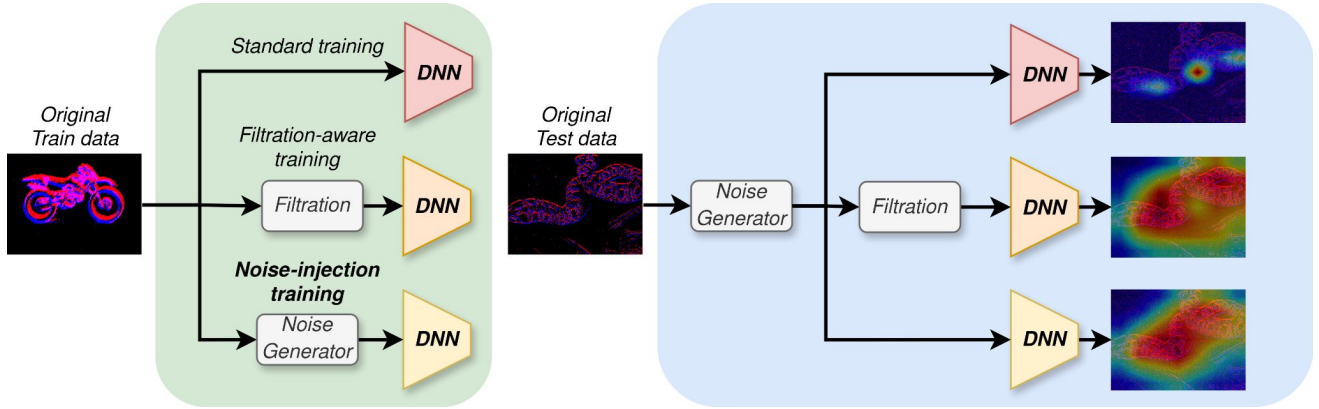




Source: Kowalczyk, Marcin, and Tomasz Kryjak. "High throughput event filtering: The interpolation-based DIF algorithm hardware architecture." Microprocessors and Microsystems (2025): 105171.

Noise injection training

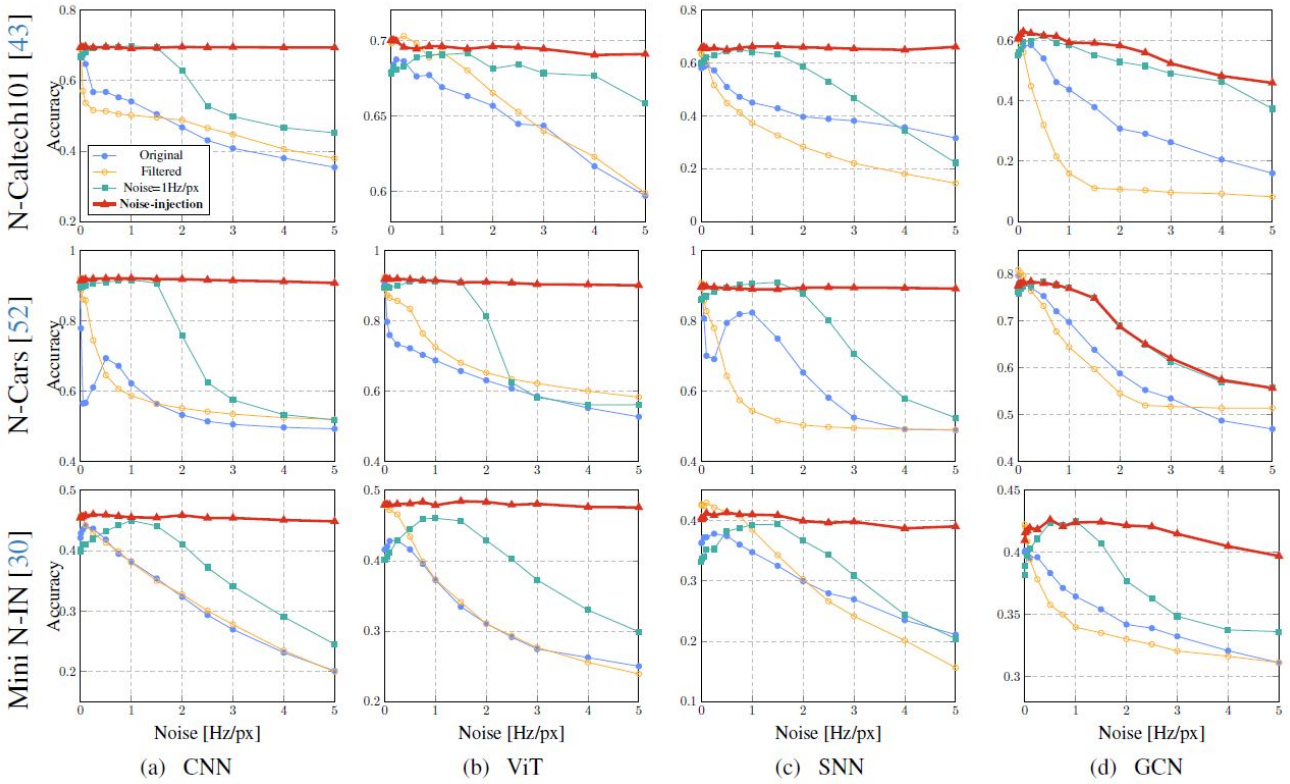
- Noise impact on classification and detection results
- Comparison of different NN architectures
- Filtering vs Noise-injection training
- 0.01 - 5 Hz/px noise level



Source: Kowalczyk, Marcin, Kamil Jeziorek, and Tomasz Kryjak. "Learning from Noise: Enhancing DNNs for Event-Based Vision through Controlled Noise Injection." Proceedings of the Computer Vision and Pattern Recognition Conference. 2025.

Noise injection training

- Robust to different noise level
- No parameters tuning
- Slight reduction in classification accuracy
- Similar results for detection task



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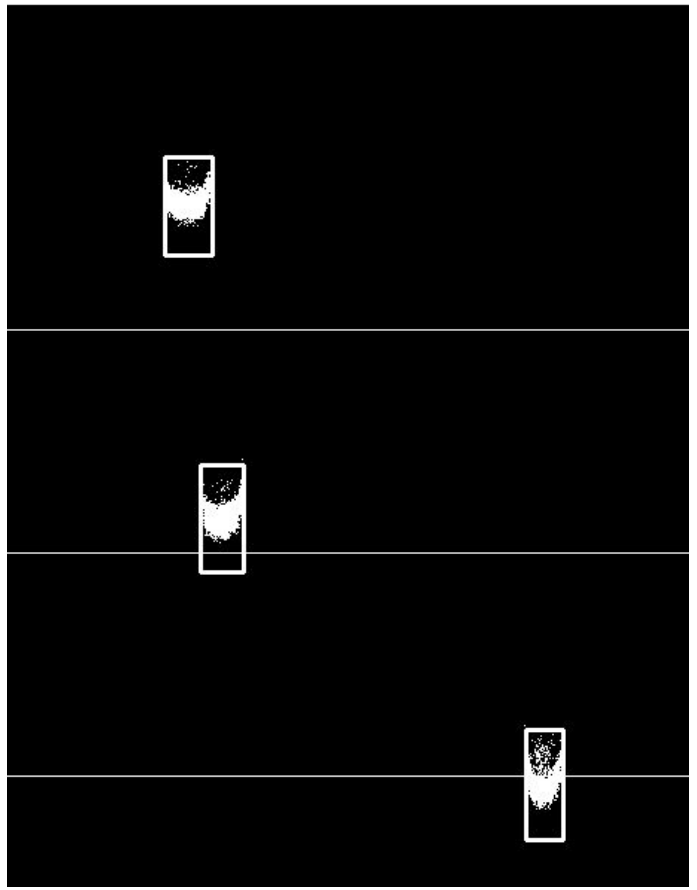
Tracking and counting objects

- Control of grain grains falling rate
- Jaccard index based tracking
- Counting objects that passed the lines
- Over 97% counting accuracy



Source: Bialik, Kamil, et al. "Fast-moving object counting with an event camera." arXiv preprint arXiv:2212.08384 (2022).

Driver monitoring system

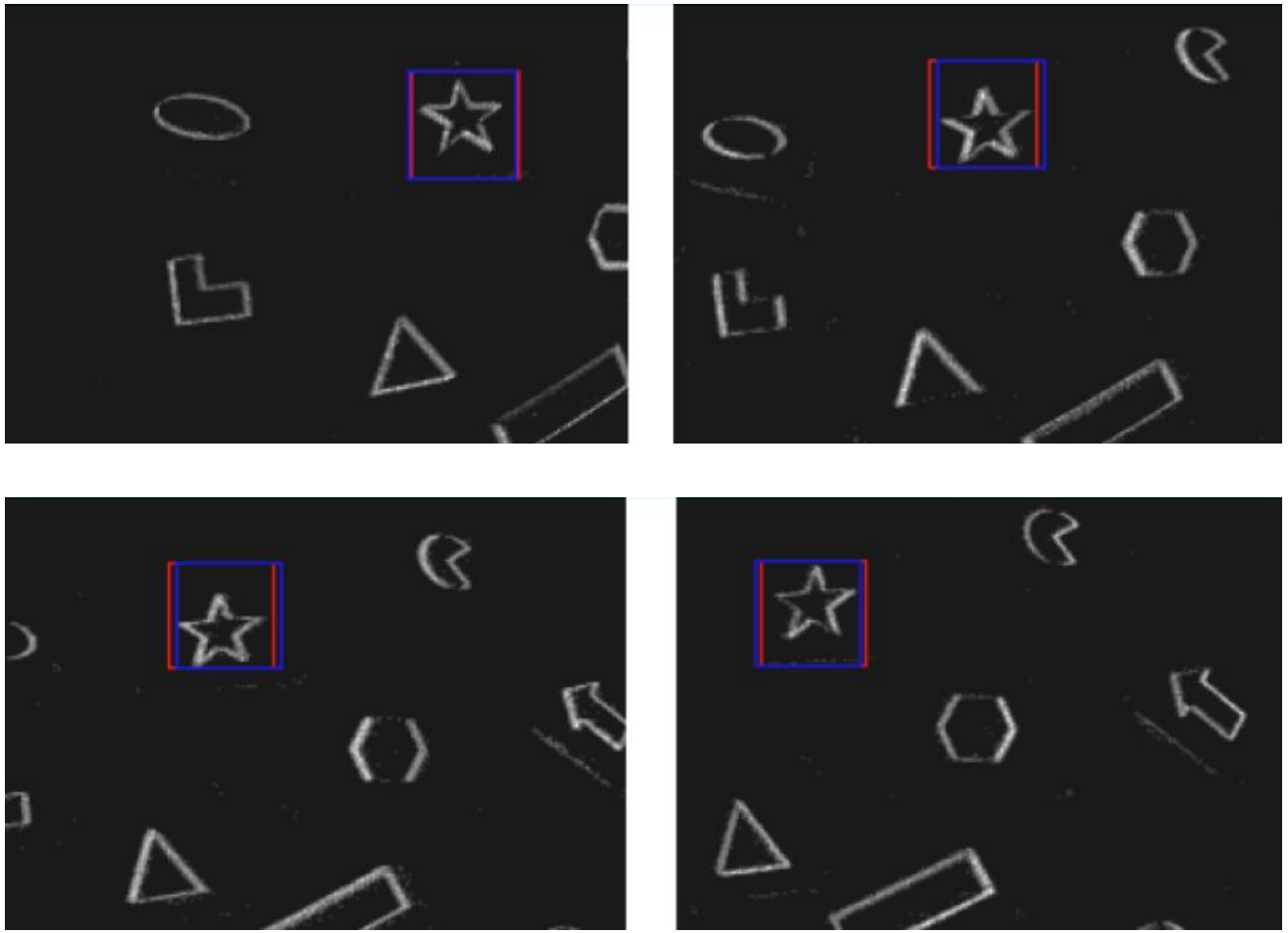
- High dynamic range
- Detecting of fatigue, distraction, falling asleep
- Datasets recorded with DVS and frame cameras
- Dataset collection and labelling phase



Source: Bialik, Kamil, et al. "Fast-moving object counting with an event camera." arXiv preprint arXiv:2212.08384 (2022).

Contrast Maximization algorithm

- Event histogram generation
- Bilinear voting
- Gradient descent optimization algorithm
- 64×64 window size
- ~1.2 MEPS



Thank you for your attention

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