



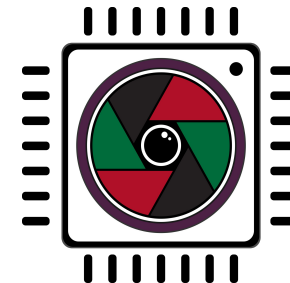
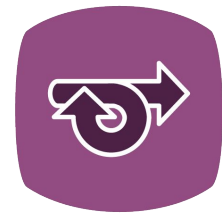
AKADEMIA GÓRNICZO-HUTNICZA  
IM. STANISŁAWA STASZICA W KRAKOWIE  
AGH UNIVERSITY OF KRAKOW

# Towards Event-Based In-Cabin Sensing: A Synchronized Dual-Camera Dataset Pipeline

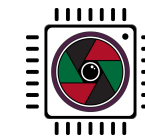
Konferencja Użytkowników Komputerów Dużej Mocy 2026

**Marcin Kowalczyk**, Marek Długosz, Kamil Jeziorek,  
Mateusz Komorkiewicz, Tomasz Kryjak, Dariusz Marchewka,  
Marcin Szelest, Piotr Wzorek, Paweł Skruch

Department of Automatic Control and Robotics  
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# Introduction to Dynamic Vision Sensors



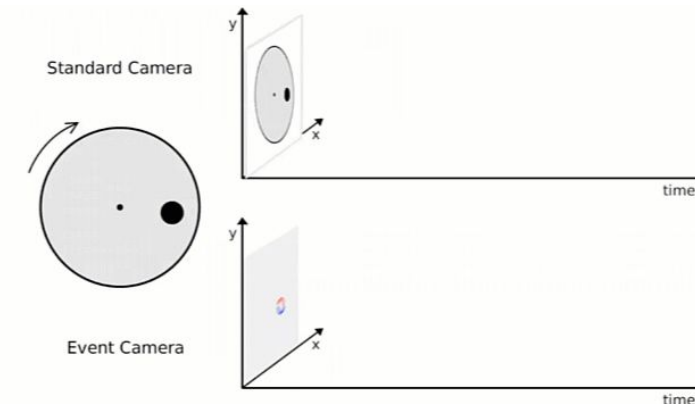
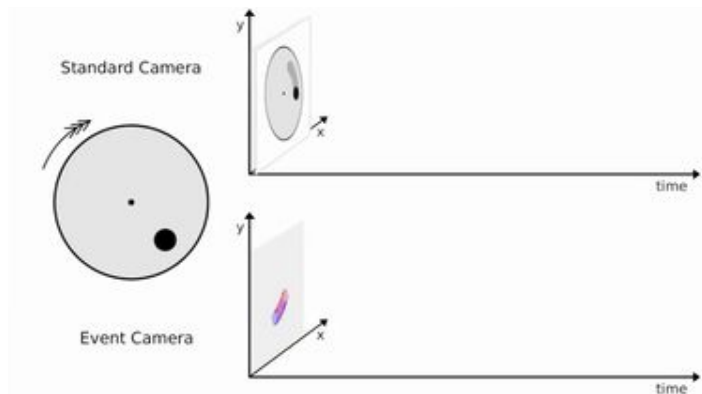
- What are **event cameras**?

- Event generation:

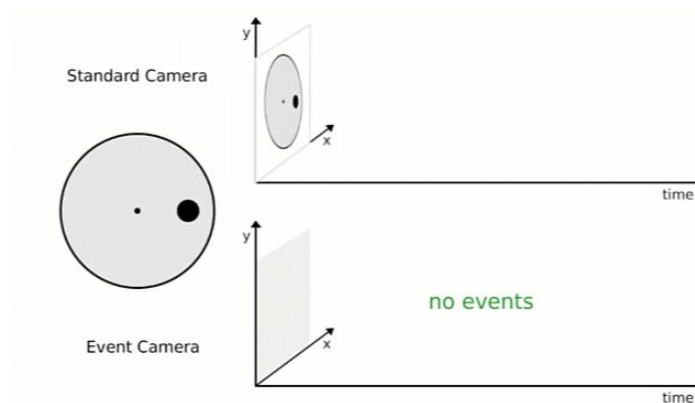
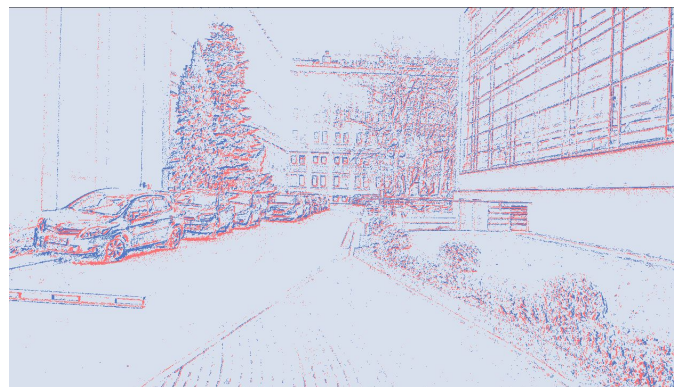
$$|\log I(t) - \log I(t - \Delta t)| > C$$

- Event:

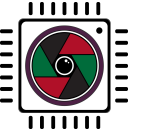
$$E = \left\{ t, (x, y), \text{sign}\left(\frac{dI(x,y)}{dt}\right) \right\}$$



Kim, H., Leutenegger, S., & Davison, A. J. (2016). Real-time 3D reconstruction and 6-DoF tracking with an event camera.



# Introduction to Dynamic Vision Sensors

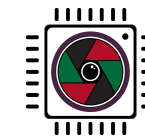


## Advantages:

- High temporal resolution
- Low latency
- High dynamic range (120 dB)
- Reduction of redundant data
- Low power (50–70 mW)

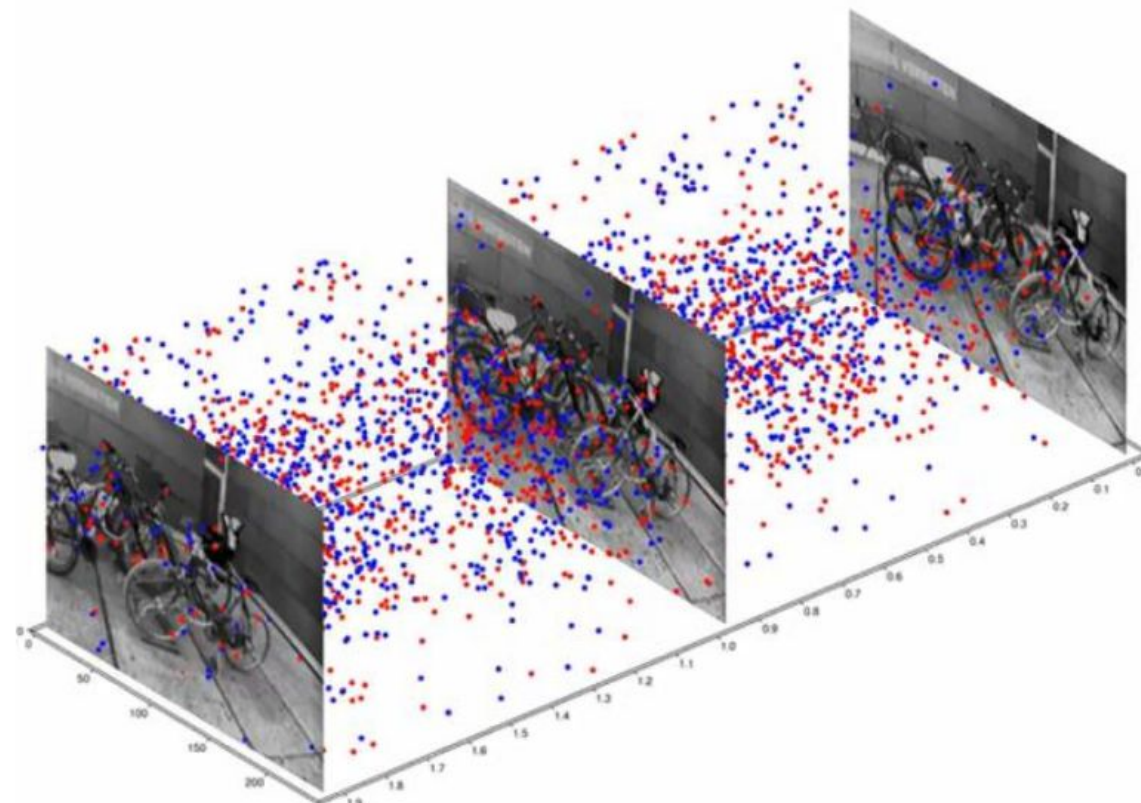


Source: M. Gehrig, D. Scaramuzza "Recurrent Vision Transformers for Object Detection with Event Cameras" IEEE Conference on Computer Vision and Pattern Recognition (CVPR), Vancouver, 2023



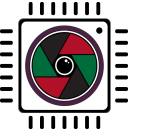
## Challenges:

- Sparse space-time point cloud
- No “absolute” brightness
- Susceptible to noise
- Low resolution
- High cost and limited availability



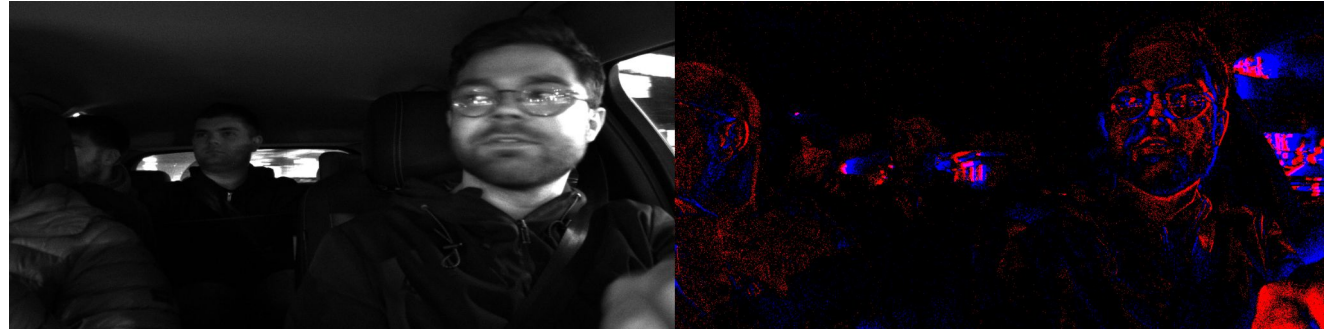
Source: D. Scaramuzza "Tutorial on Event-based Cameras", ETH Zurich, University of Zurich

# Description of the problem

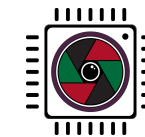


## Driver monitoring system:

- Various lighting conditions
- IR illumination
- Motion blur
- Micro-Expressions (e.g. eye blinking)

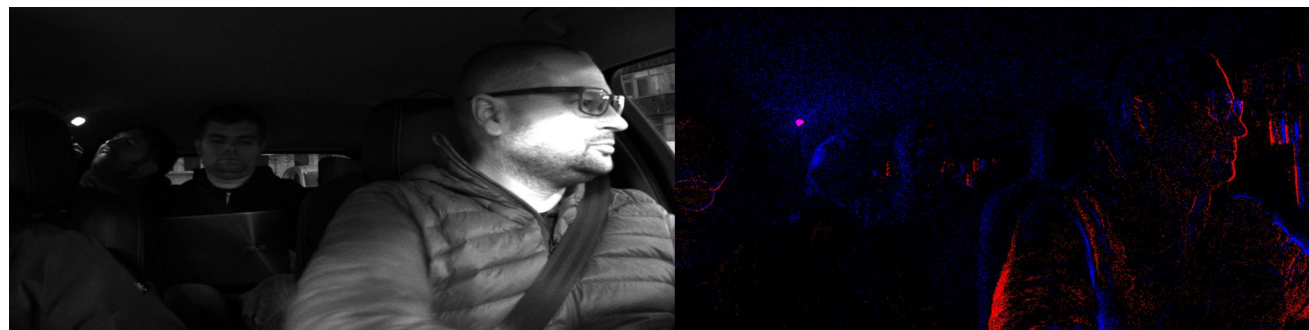
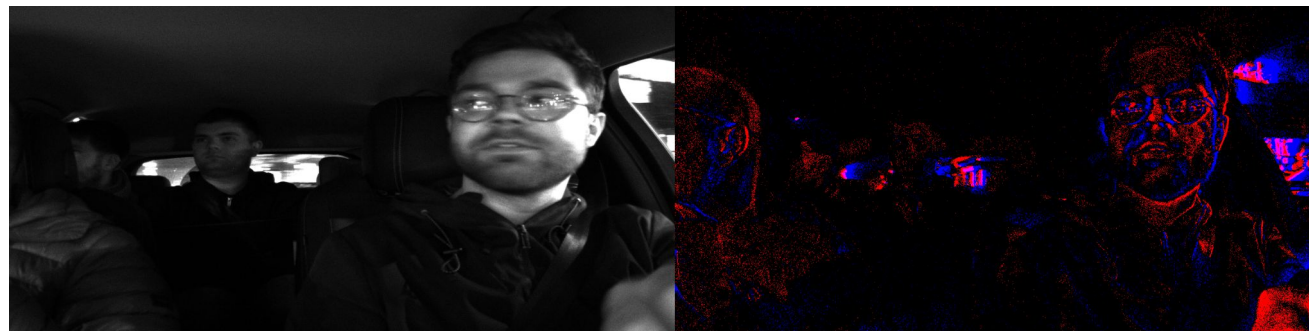


# Description of the problem

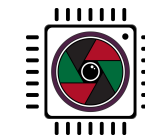


## Driver monitoring system:

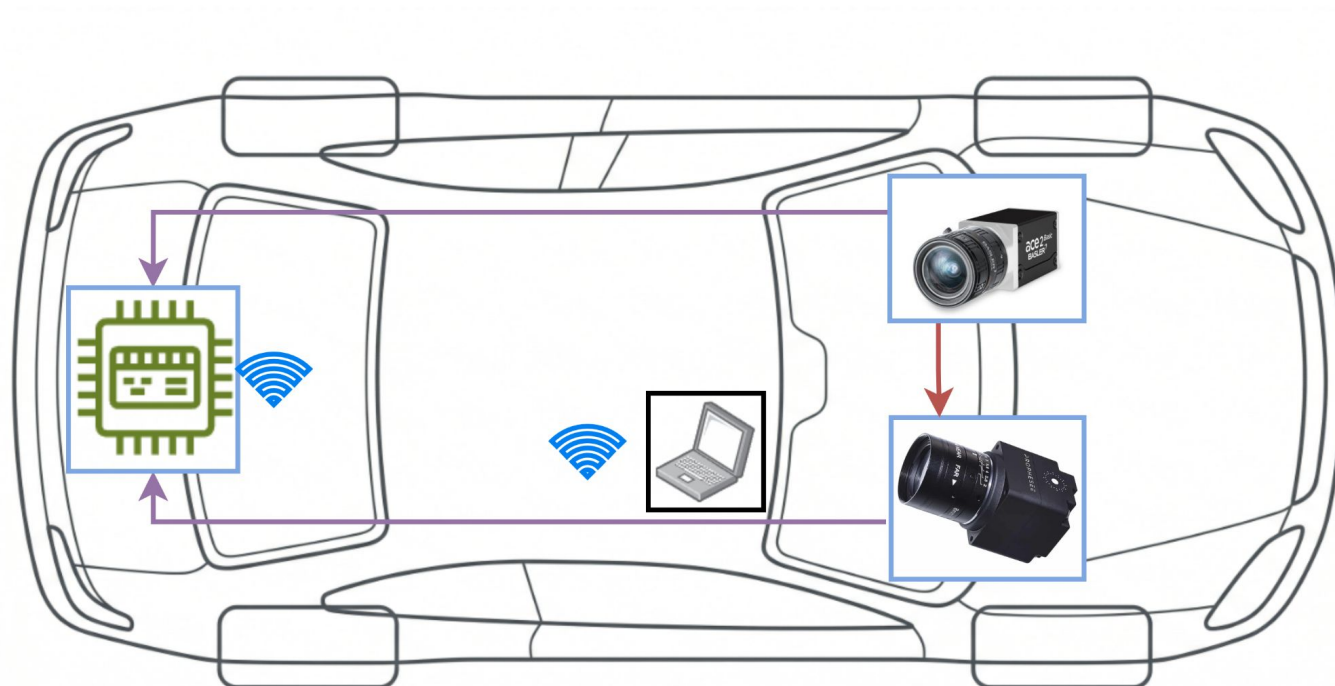
- Neural networks
- No public datasets
- Need for direct comparison
- Data labelling
- Sensors synchronisation



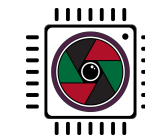
# Hardware scheme



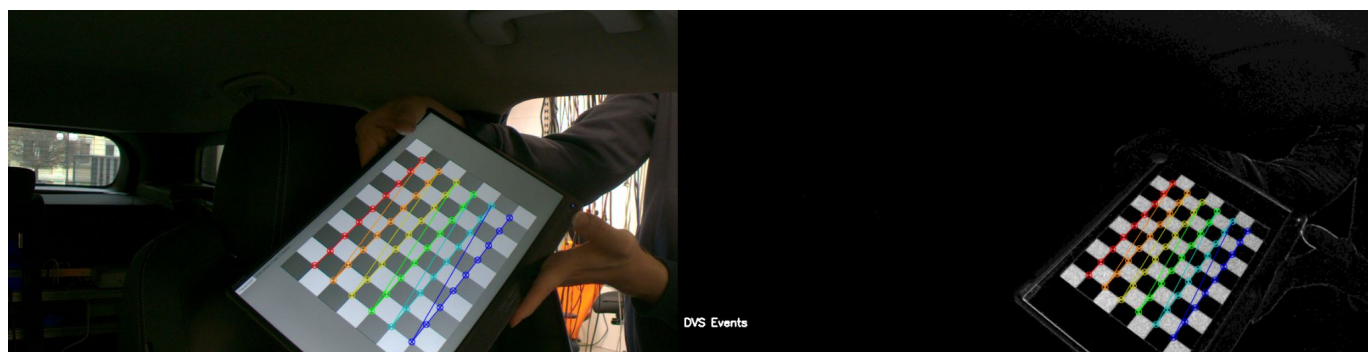
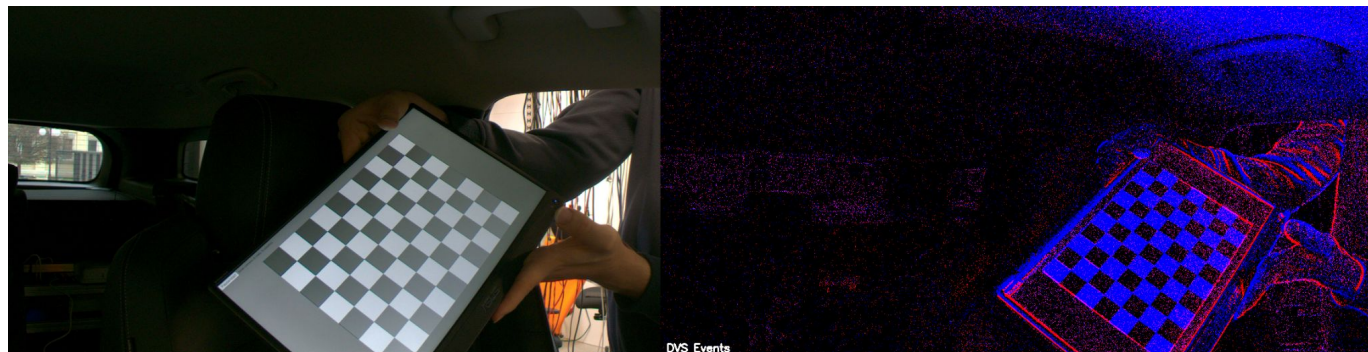
- Trigger generation
- Correctness verification
- Saving the data



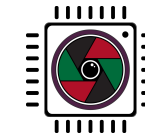
# Calibration process



- **Blinking chessboard**
- **Data amount**
- **Fraction correct**
- **Events representations**
- **Preprocessing**
- **Depth estimation**



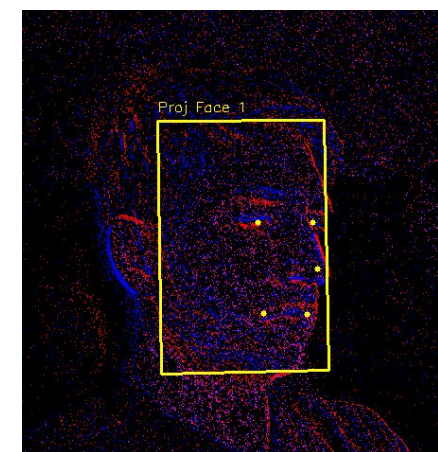
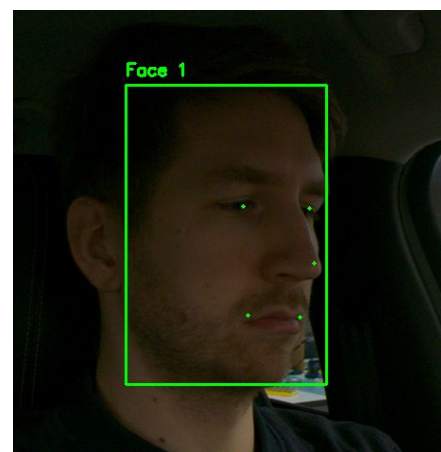
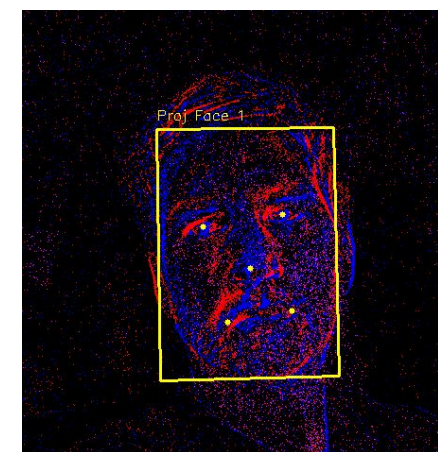
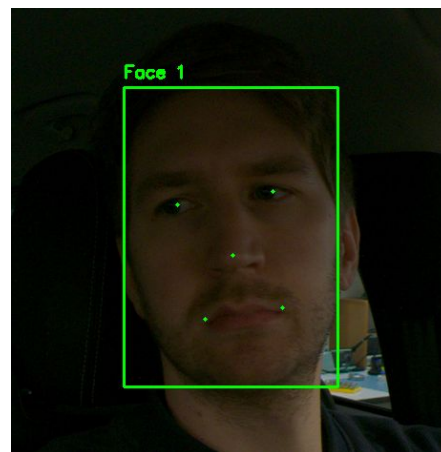
# Detection and Annotations



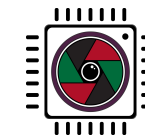
- Face detection on the frames
- Transfer to event camera
- Application of the estimated depth

## Future work:

- Data collection campaign
- Detection models training



# Tools used

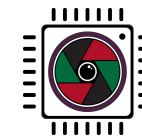


- **Apptainer & Metavision, C++**  
(Ares)
- **Python & PyTorch** (Athena)
- **InsightFace** (Athena)
- **OpenCV** (Ares)

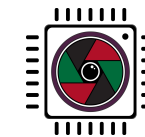




# Acknowledgements



We gratefully acknowledge Polish high-performance computing infrastructure PLGrid (HPC Center: ACK Cyfronet AGH) for providing computer facilities and support within computational grant no. PLG/2026/019101.



# Thank you for your attention !!!

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