



# Event-based Robot Vision for Autonomous Systems and Animal Observation

Prof. Dr. Guillermo Gallego

[guillermo.gallego@tu-berlin.de](mailto:guillermo.gallego@tu-berlin.de)

<http://www.guillermogallego.es>

# Motion Estimation

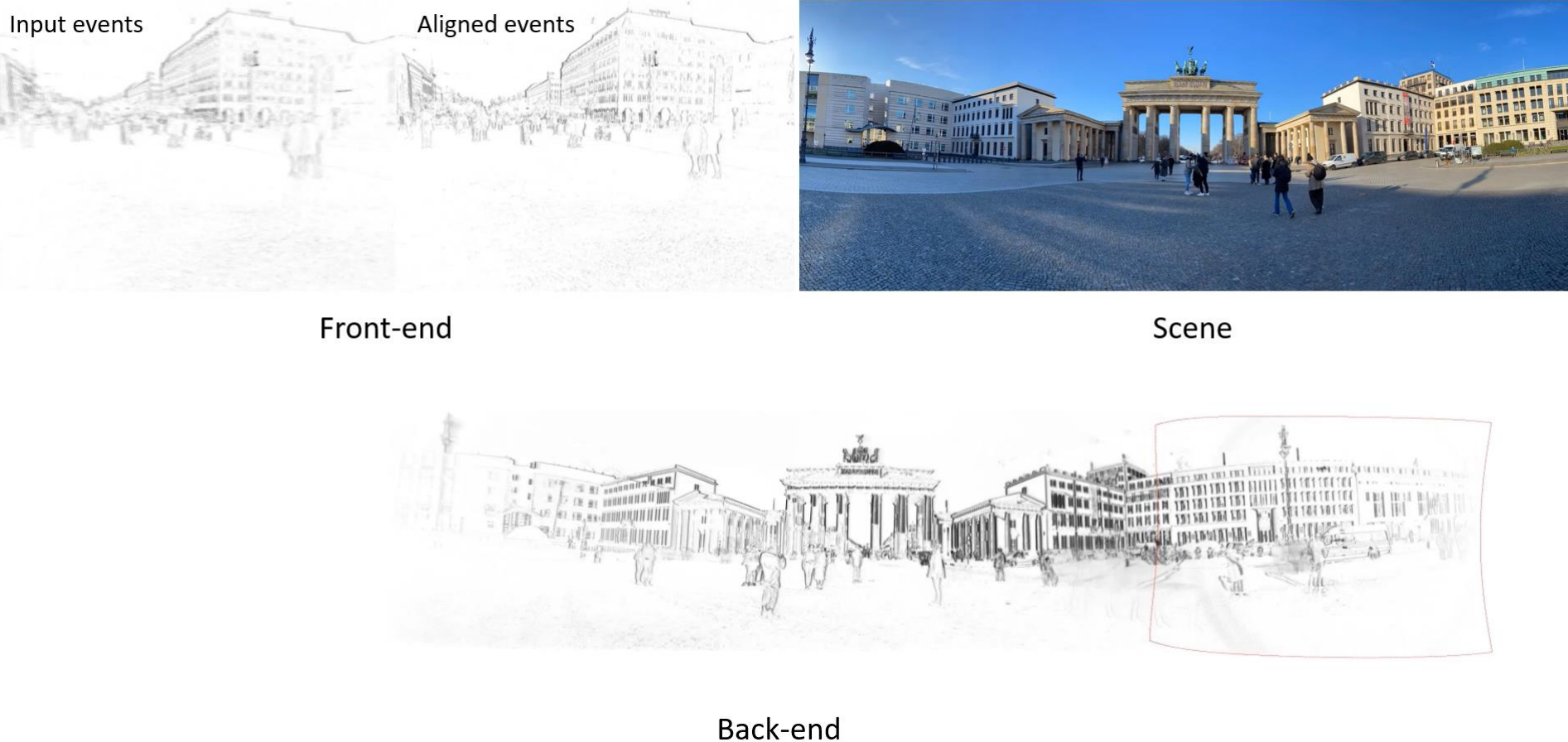
Contrast Maximization for...  
Optical Flow, SLAM and Image Reconstruction

# Extending CMax to SLAM



Shuang Guo

## Rotational Motion CMax-SLAM, with front-end and back-end



# CMax Stereo 3D Reconstruction

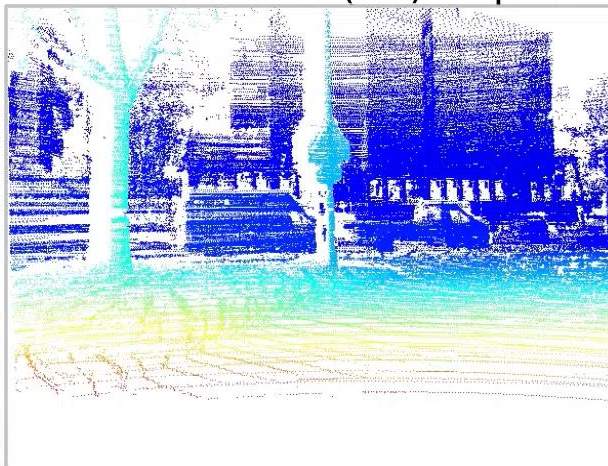


S. Ghosh

Left events



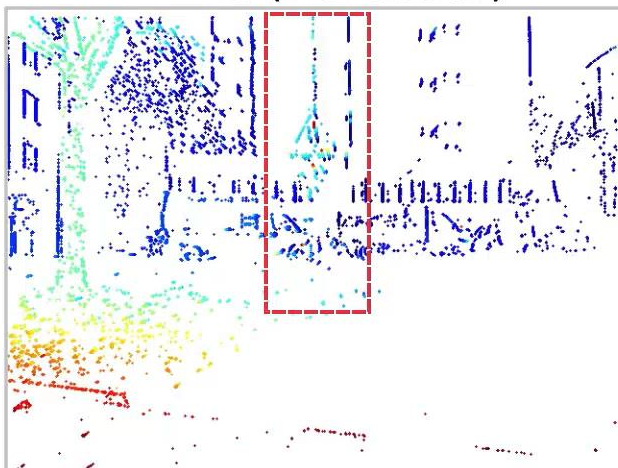
Ground-truth (GT) Depth



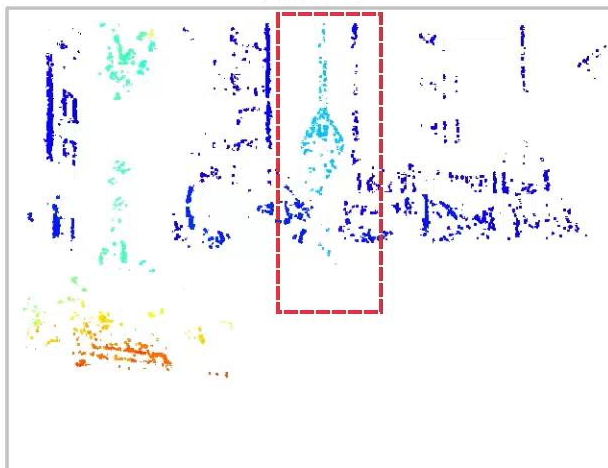
Confidence map (ours)



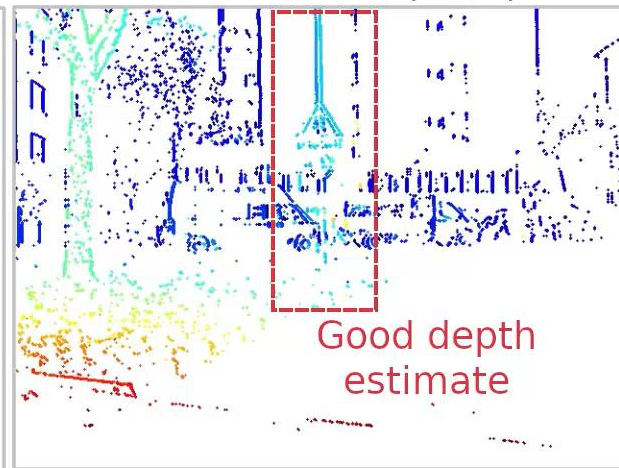
EMVS (Monocular)



ESVO



Stereo fusion (ours)



**Code** is available: [https://github.com/tub-rip/dvs\\_mcemvs](https://github.com/tub-rip/dvs_mcemvs)



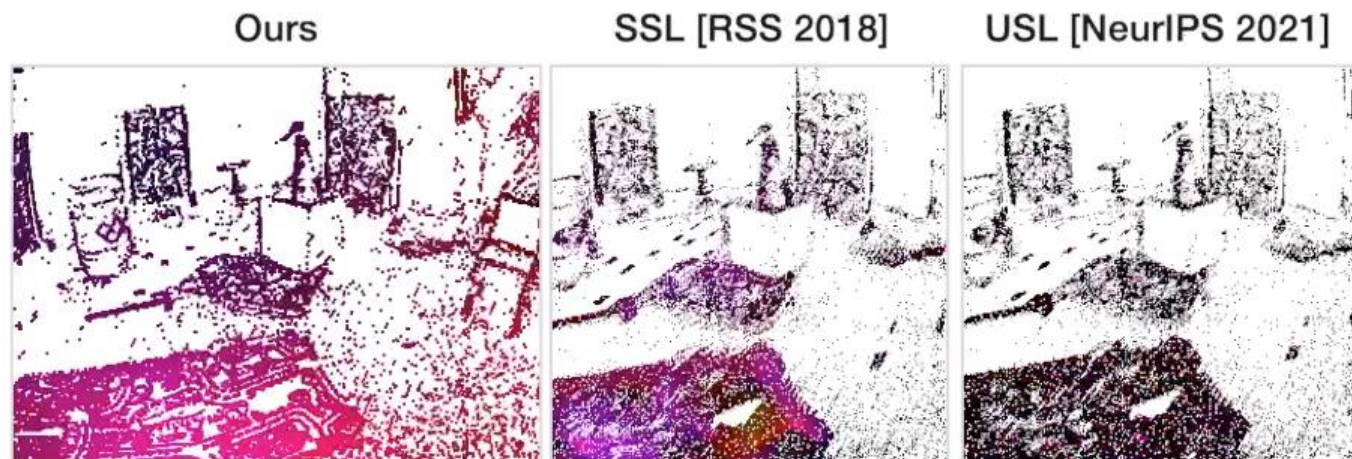
# CMax Dense Optical Flow



S. Shiba

## Results

MVSEC Indoor  
346 x 260 px



Estimated flow



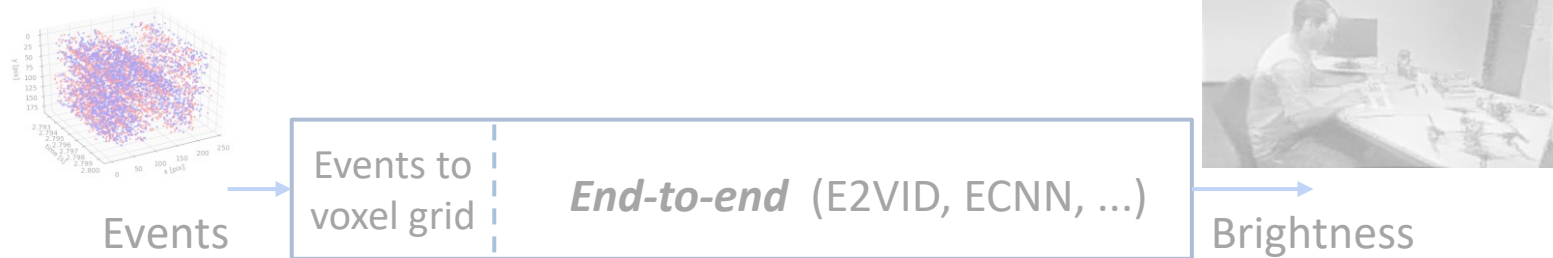
Input events

Warped events

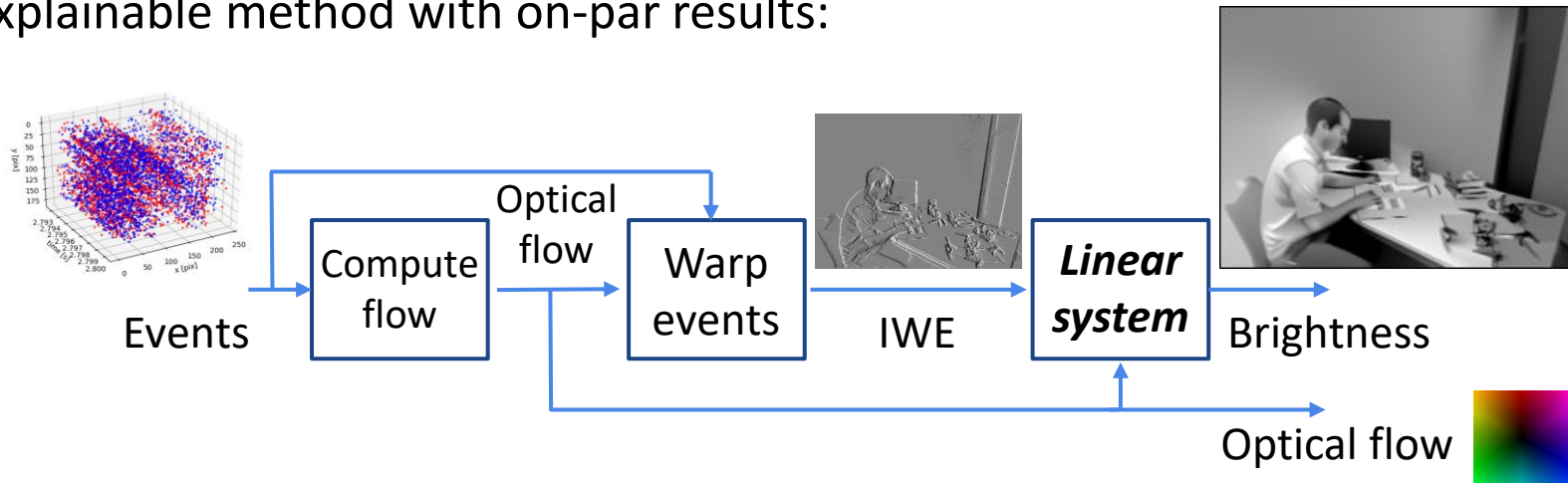
**Code:** [https://github.com/tub-rip/event\\_based\\_optical\\_flow](https://github.com/tub-rip/event_based_optical_flow)

# CMax facilitates Image Reconstruction

State of the art: Recurrent Neural Network (black-box)



An explainable method with on-par results:

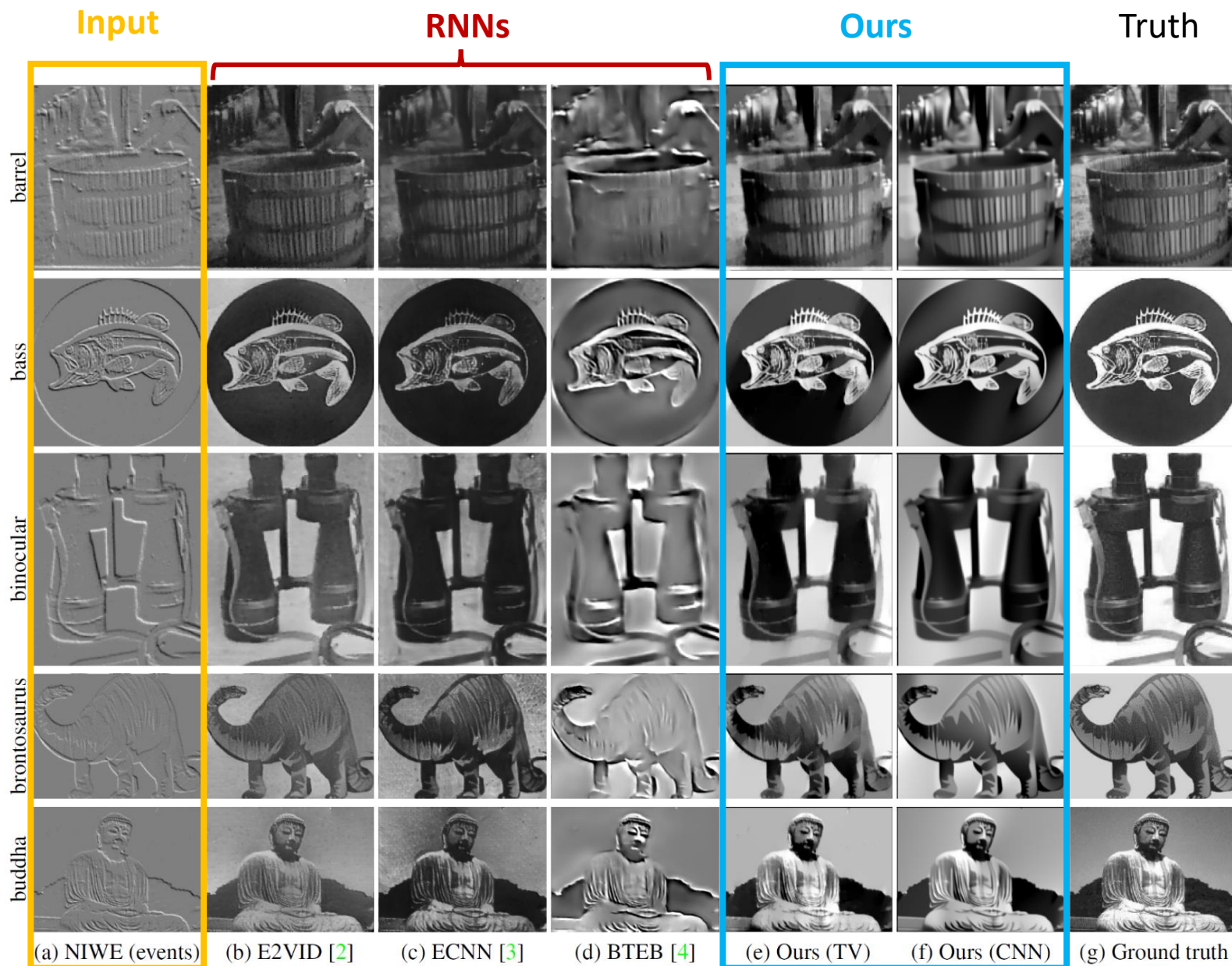


**Code:** [https://github.com/tub-rip/event\\_based\\_image\\_rec\\_inverse\\_problem](https://github.com/tub-rip/event_based_image_rec_inverse_problem)

# Image Reconstruction (TPAMI 2022)



Z. Zhang

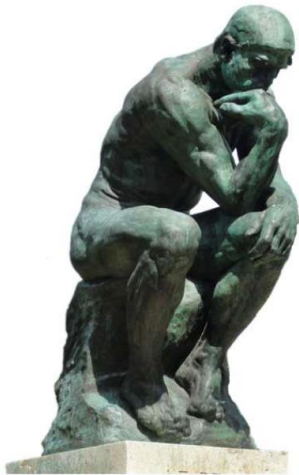


# Animal Observation

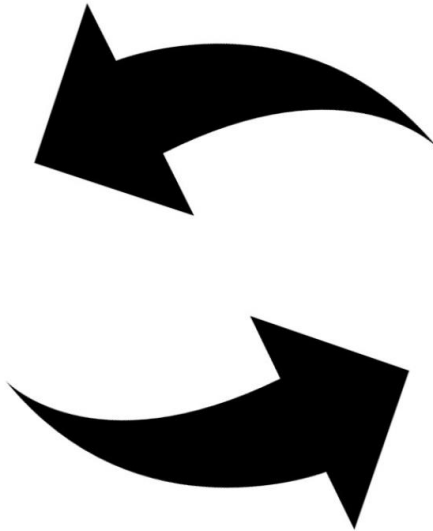




Analysis of  
natural intelligence



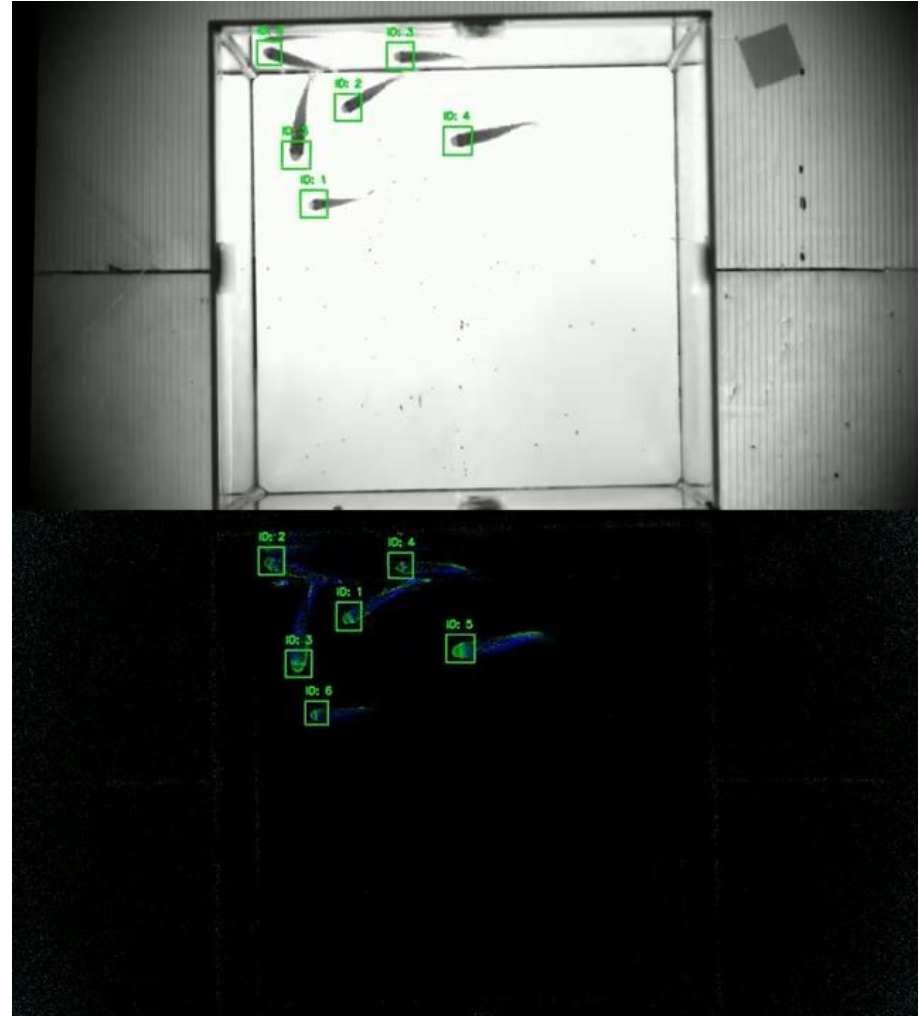
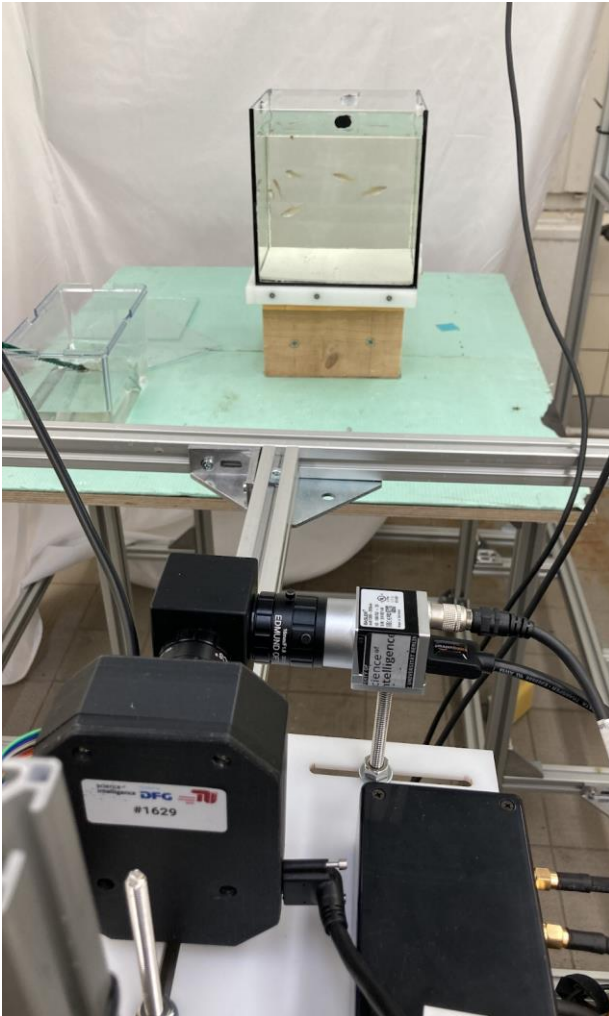
Synthesis of  
artificial intelligence



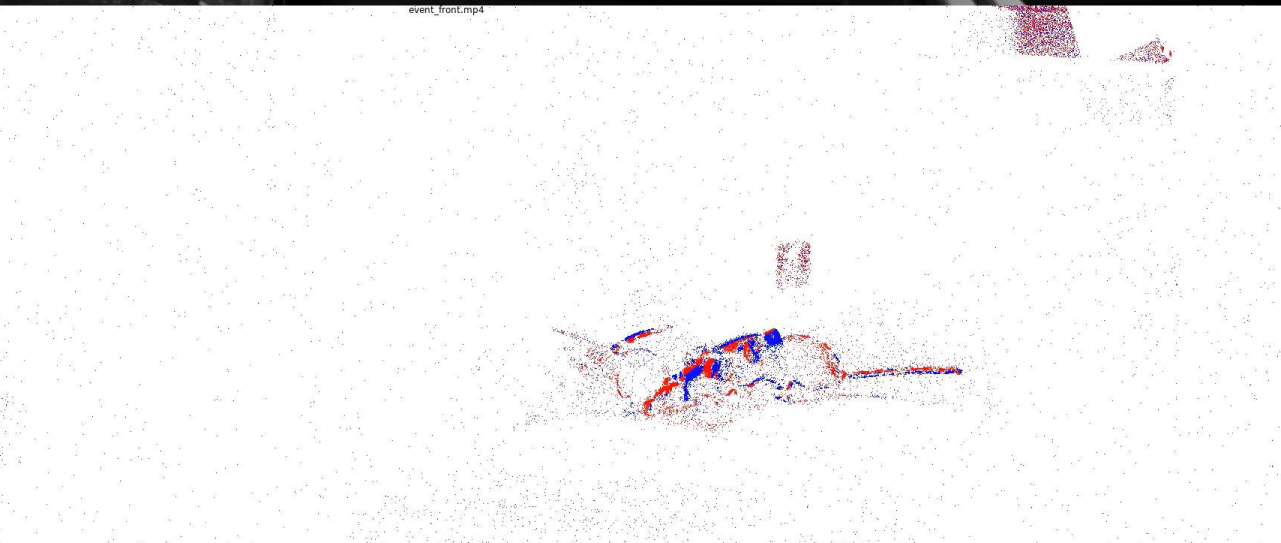
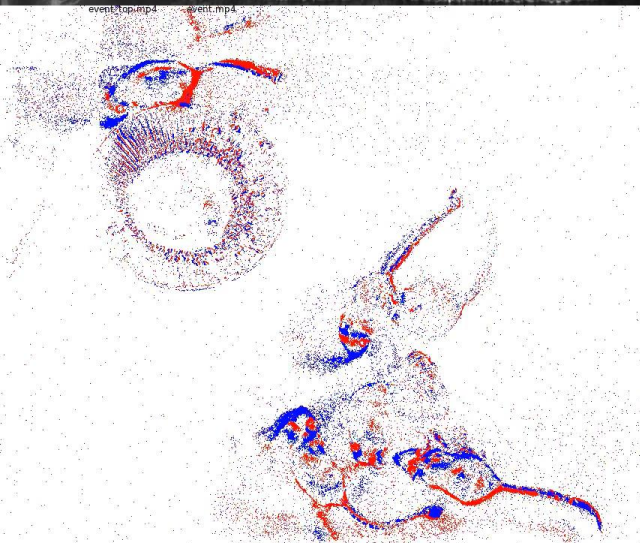
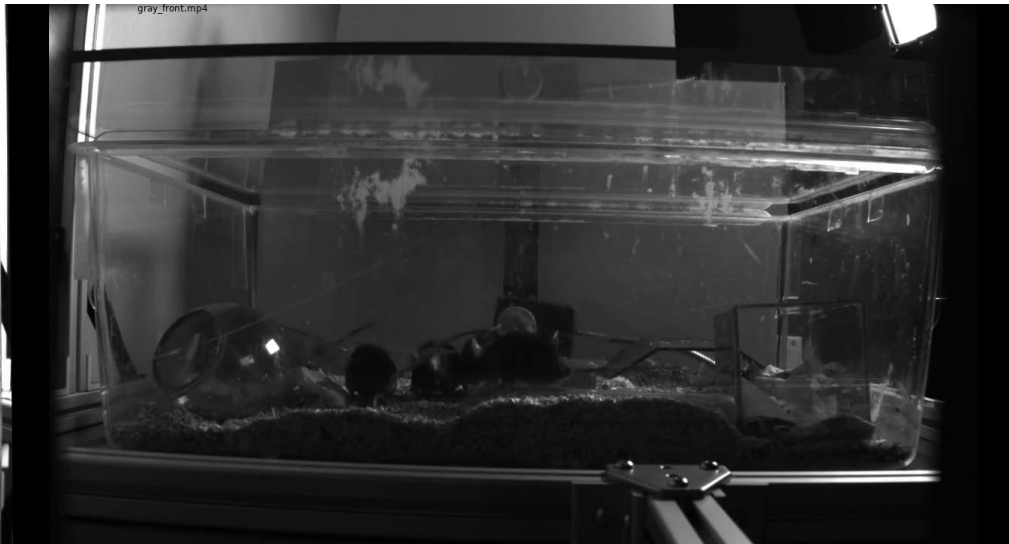
# Animal behavior observation and analysis



## Fish tracking. In collaboration with HU University



# Animal behavior quantification



# TU Berlin Lab working on event cameras



Suman Ghosh



Friedhelm Hamann



Shintaro Shiba  
(from Aoki Lab)



Shuang Guo

<https://github.com/tub-rip>