

# Team Project: Tracking with Event Stream

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**Christian Cierpka**<sup>3</sup>, Steffen Jung<sup>1</sup>, Margret Keuper<sup>1,2</sup>

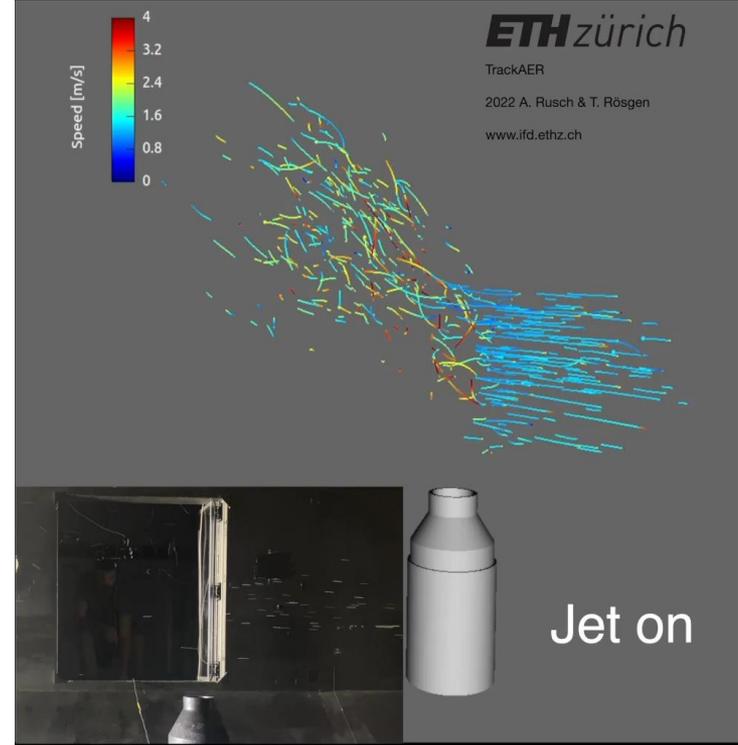
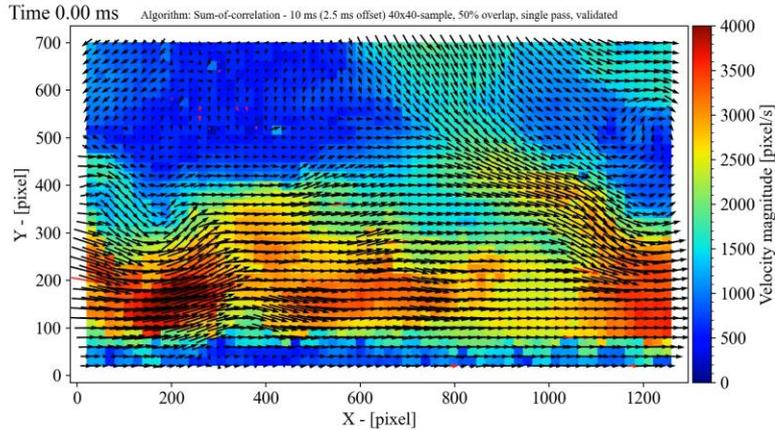
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# Event-based vision

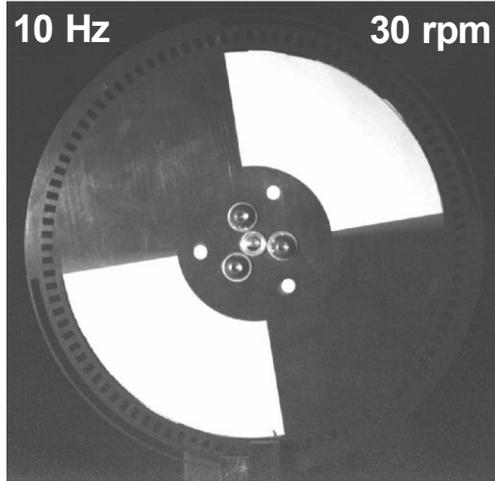
[3] Willert et al. (2022), Exp. Fluids 63 (6)



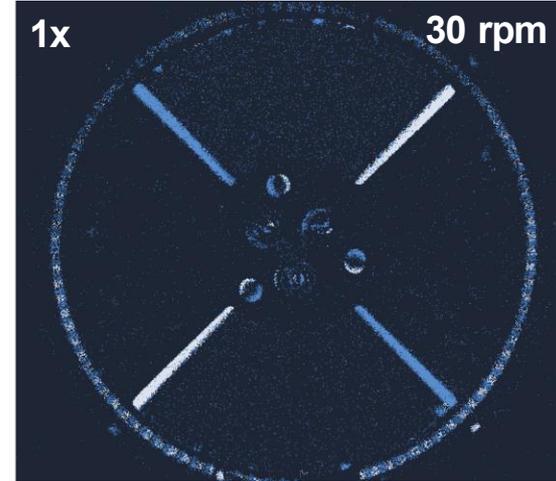
[4] Rusch et al. (2023), Exp. Fluids 64 (8)

# Event-based vision

frame-based

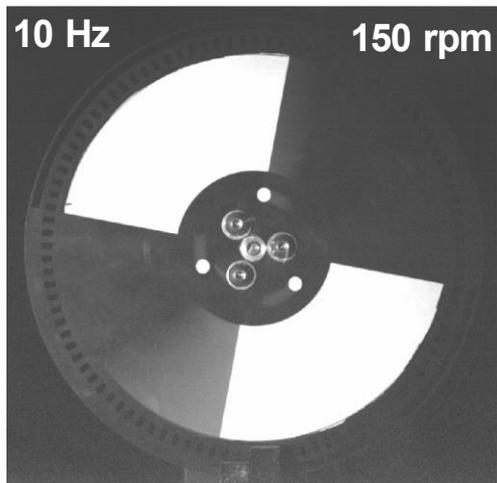


event-based

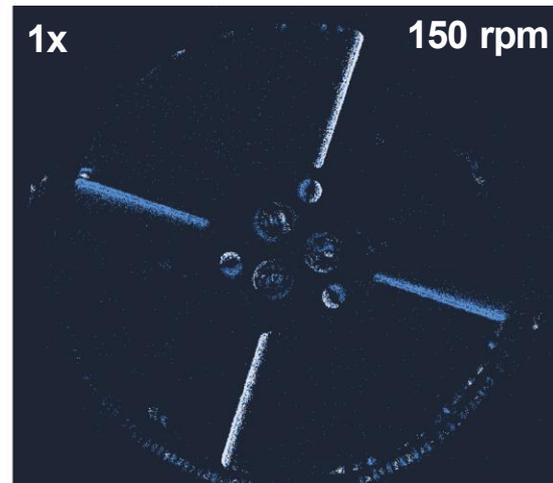


# Event-based vision

frame-based

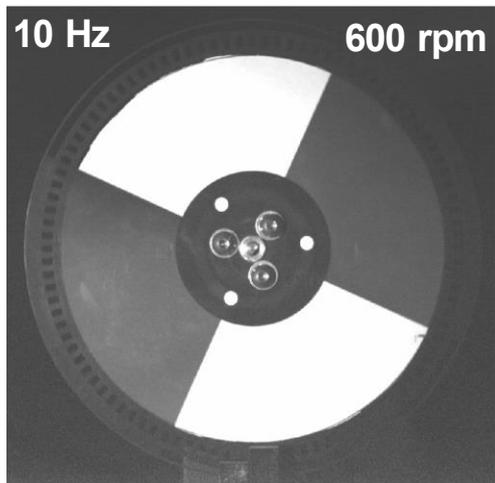


event-based

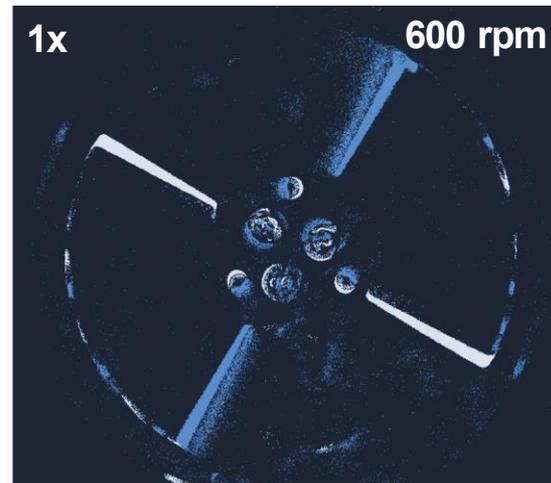


# Event-based vision

frame-based

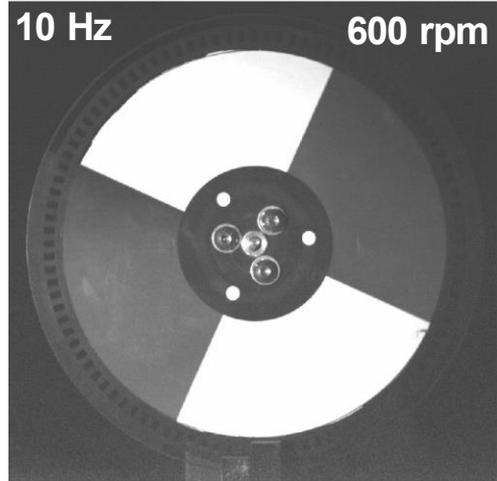


event-based

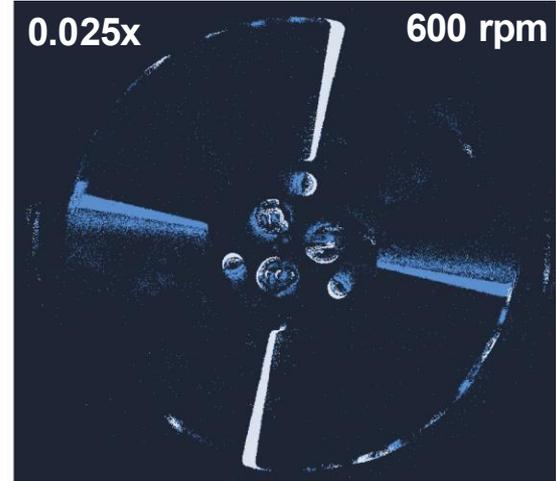


# Event-based vision

frame-based

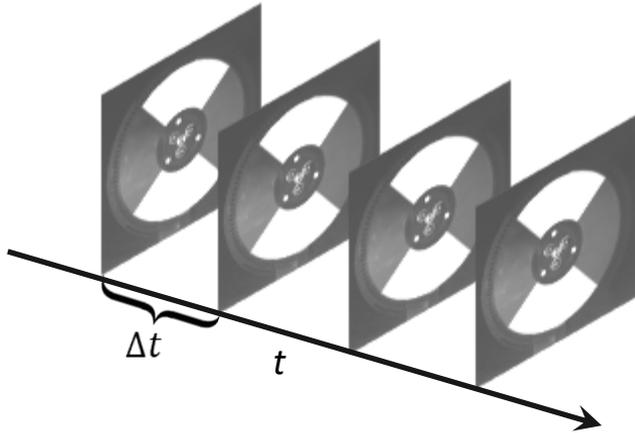


event-based



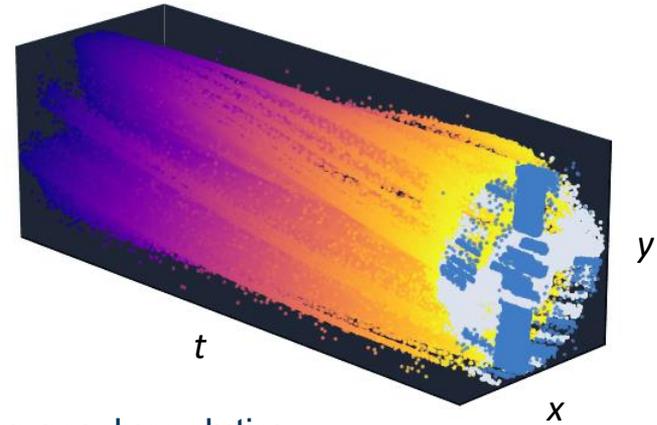
# Event-based vision

frame-based



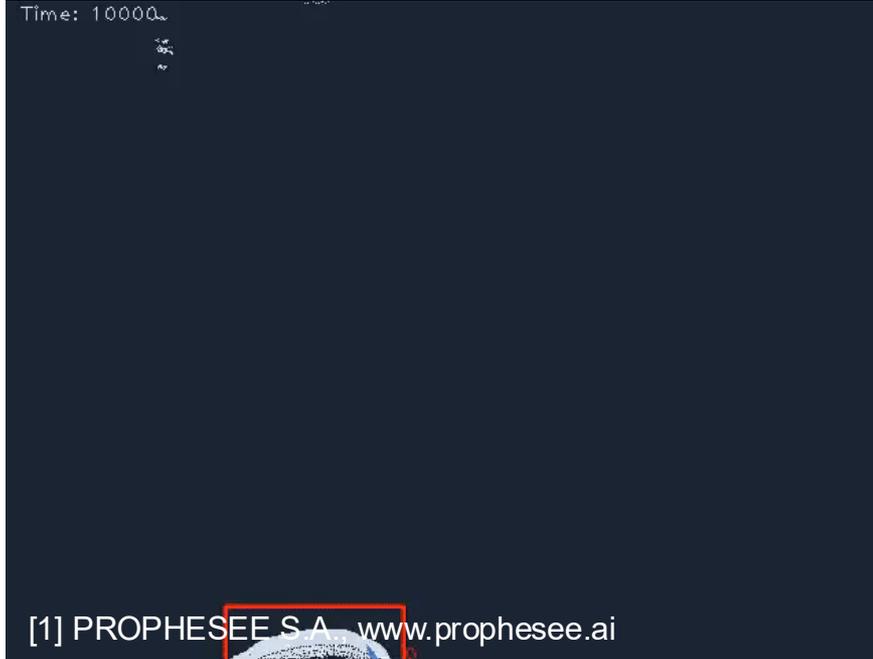
- fixed frame rate
- dense data
- rather expensive

event-based



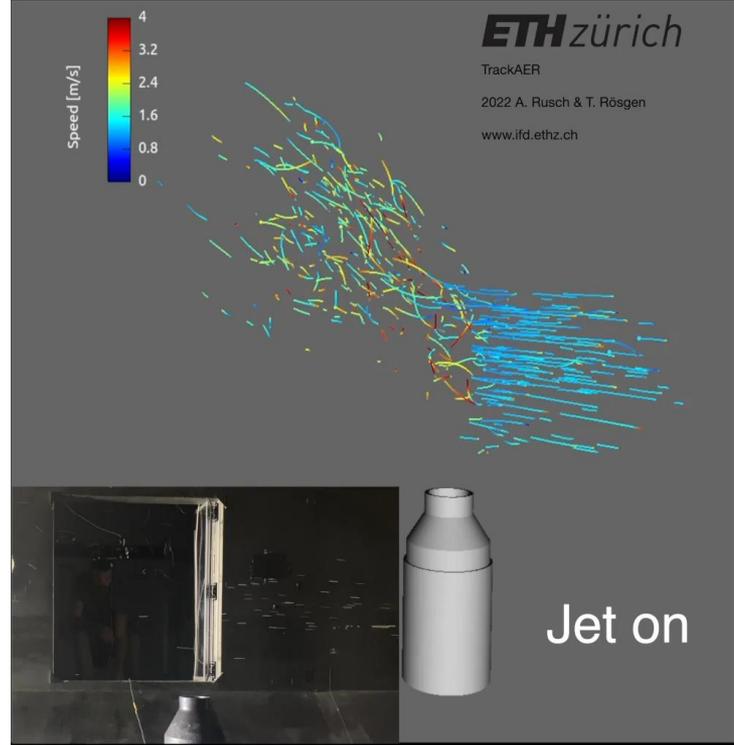
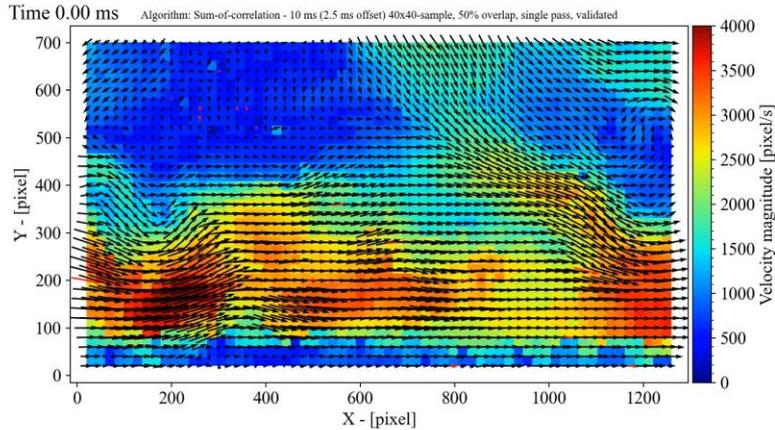
- high temporal resolution
- asynchronous, spatiotemporally sparse event-stream
- high dynamic range
- cost- and energy efficient

# Event-based vision - examples



# Event-based vision

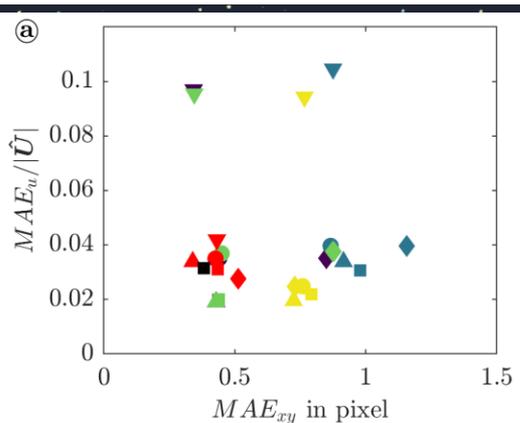
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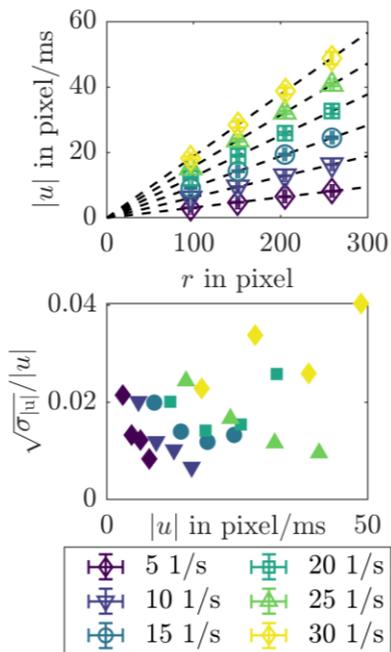
# Datasets

## synthetic



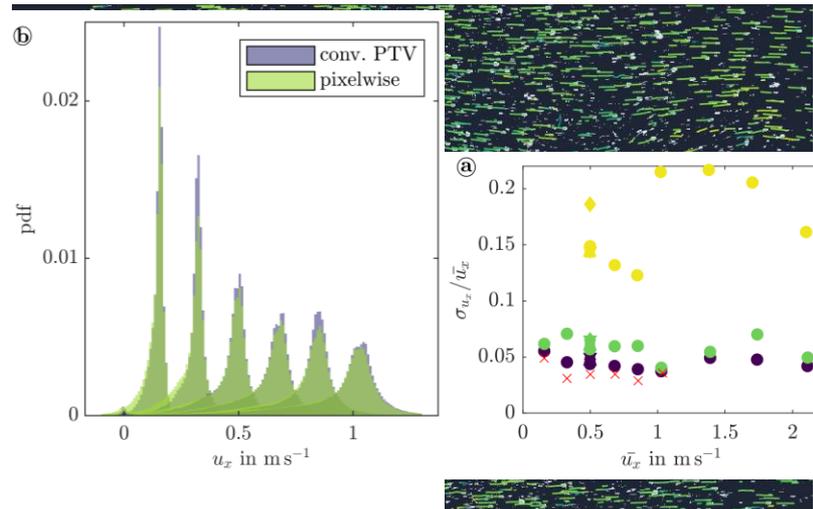
- pixelwise    ■ DBSCAN    ■ RVT
- kd - tree    ■ pseudo    ◇ spline
- ▽ Kalman    □  $X^K, u^{KS}$
- $X^K, u^S$     △  $X^{KS}, u^{KS}$

## experimental (I)



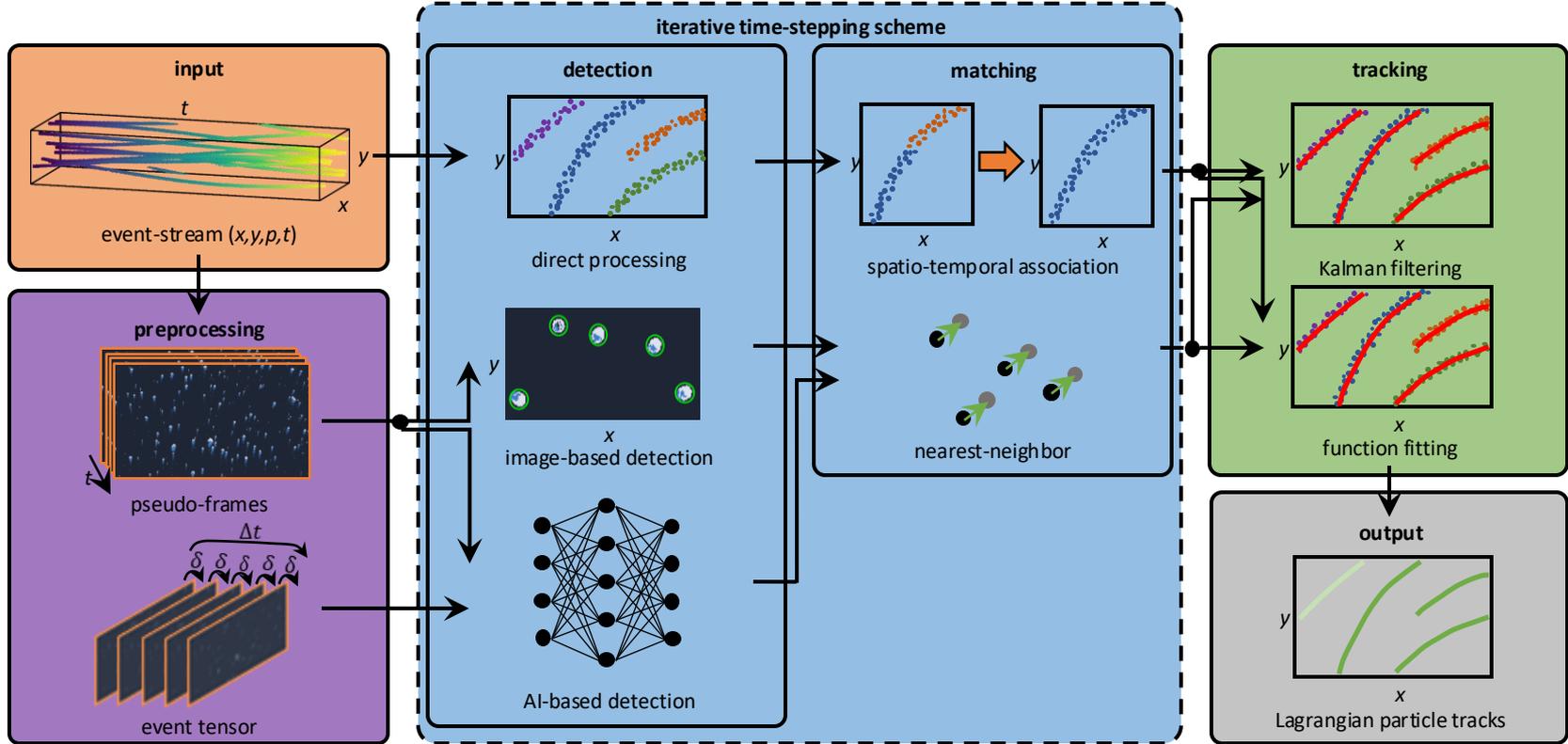
- 5 1/s    ■ 20 1/s
- 10 1/s    ■ 25 1/s
- 15 1/s    ■ 30 1/s

## experimental (II)



- pixelwise    ■ DBSCAN    ■ RVT    ▽ Kalman    □  $X^K, u^{KS}$
- kd - tree    ■ pseudo    ◇ spline    ○  $X^K, u^S$     △  $X^{KS}, u^{KS}$

# Framework STELLA



# Tasks: Benchmarking

Large Vision  
Language  
Models

- In-context Learning (ICL)
- Zero shot

Large  
Language  
Models

- ICL
- Zero-shot

DNNs

- Convolution networks
- Vision transformers

State-of-the-art  
methods

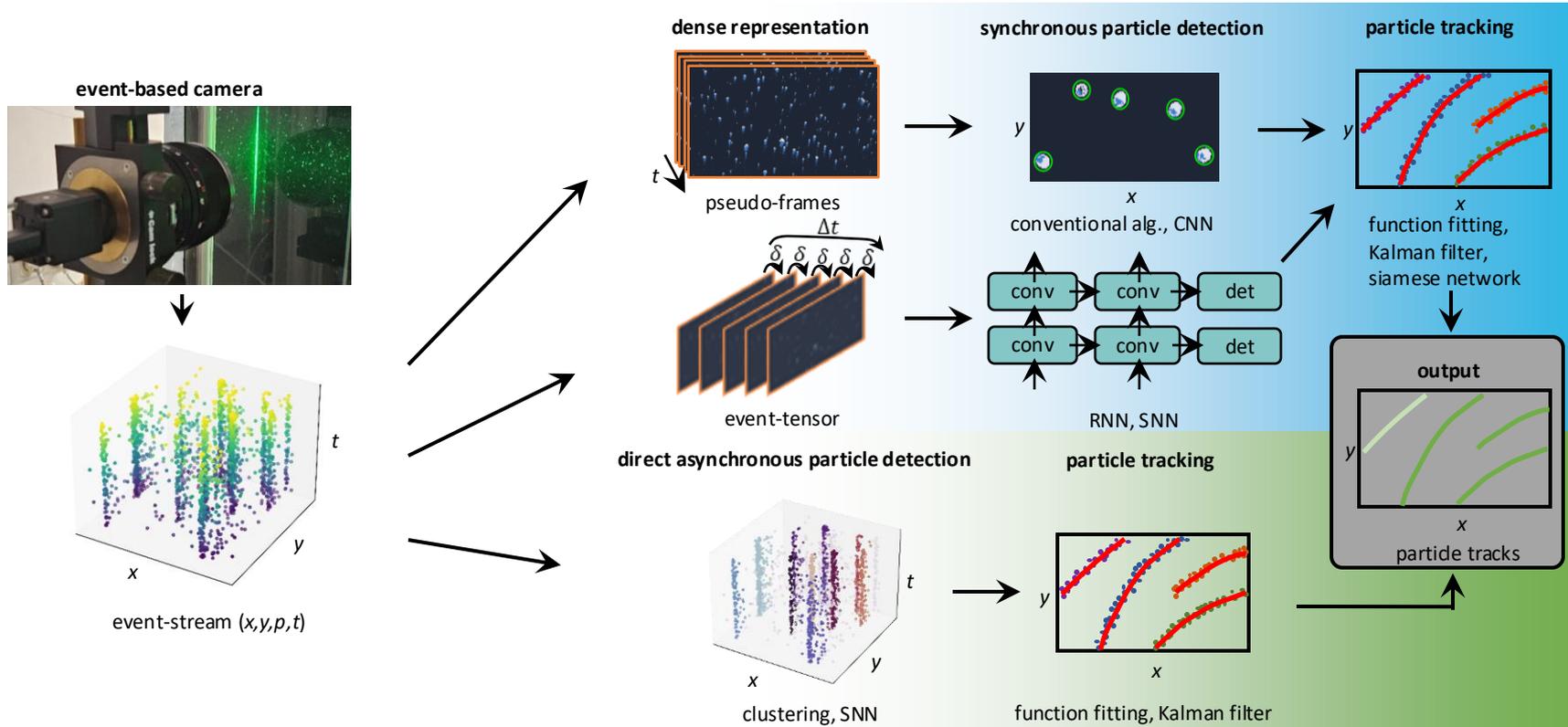
- Kalman Filter-Based
- SMILEtrack

# Useful Information

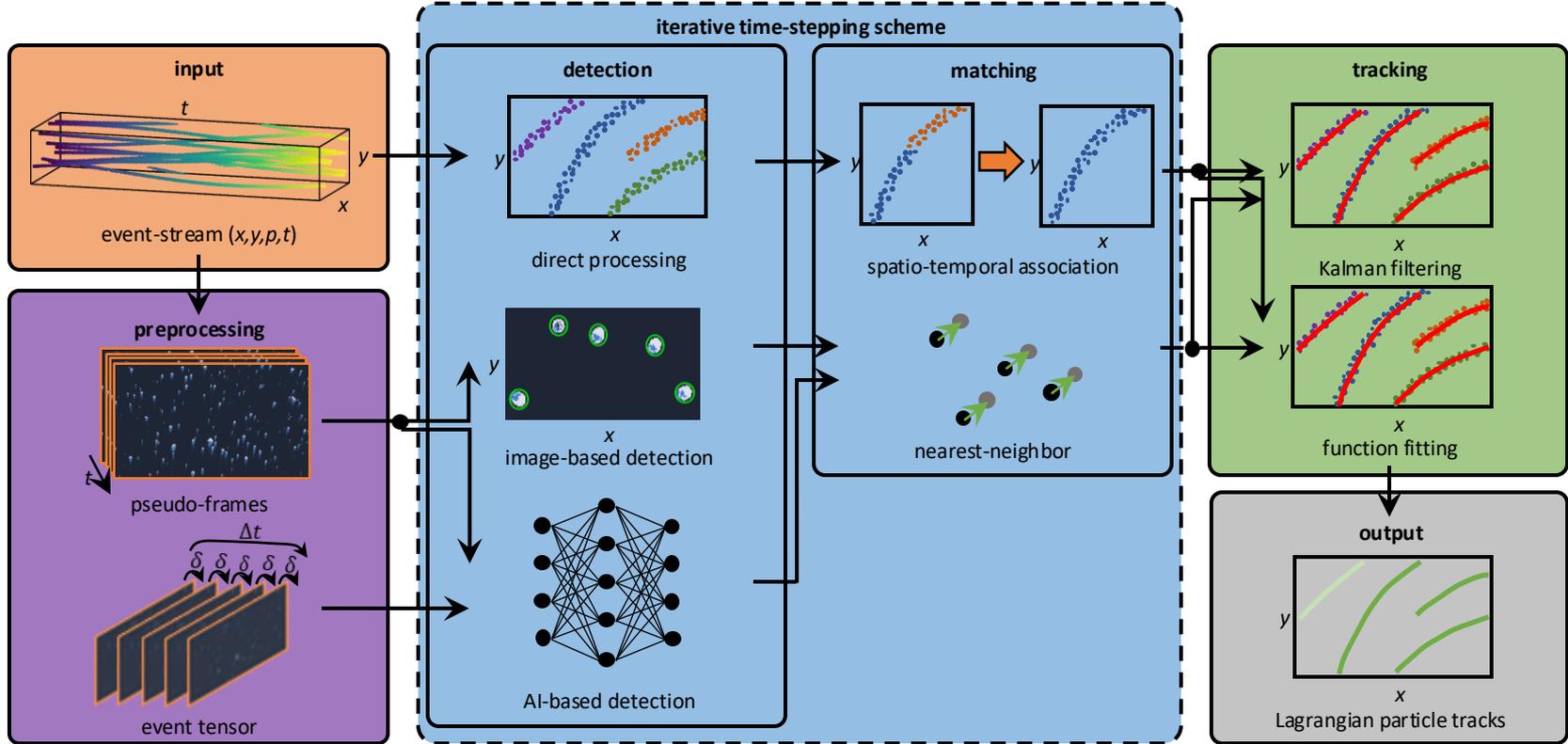
- Duration: 5-6 months
- Number of members: 2-6 (more the merrier, larger the benchmarking)
- Online: Possible
- Structure: Bi-Weekly meetings
- Requirements: **Python, pytorch**, Deep Learning and Computer Vision
- Open for: EVERYONE
- Goal: Publish the Benchmarking
- Contact: [shashank.agnihotri@uni-mannheim.de](mailto:shashank.agnihotri@uni-mannheim.de)

# APPENDIX

# Data processing



# Framework STELLA



# Conclusion

- collected synthetic and experimental **datasets**
- developed modular **framework** for particle tracking using event-based cameras
- presented at „ISPIV2025“ and „Fachtagung Experimentelle Strömungsmechanik“
- currently compiling journal publication

## **Outlook:**

- tailored neural network architecture in strong collaboration with Prof. Margret Keuper