

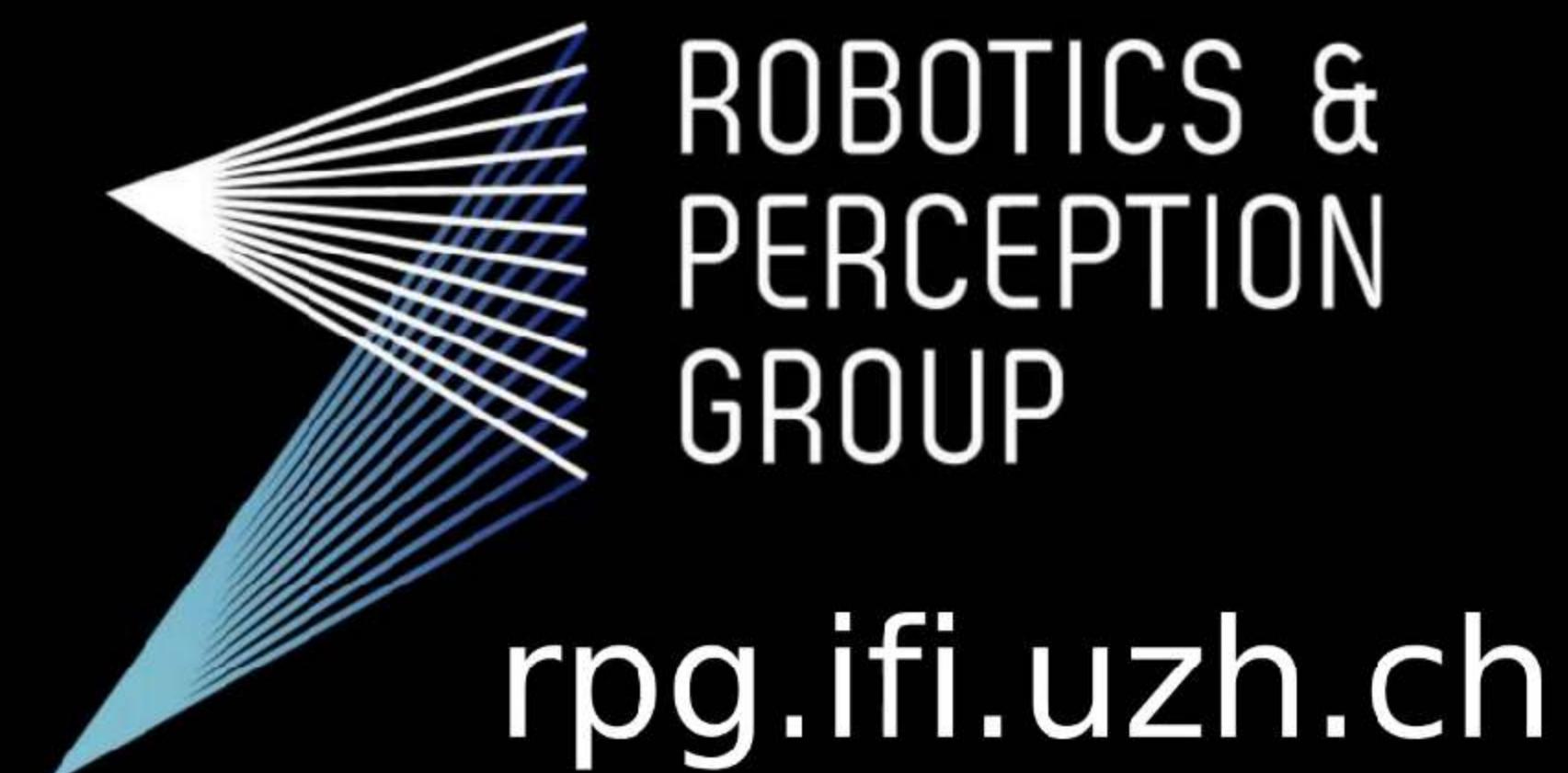
TimeLens: Event-based Video Frame Interpolation

Stepan Tulyakov*, Daniel Gehrig*, Stamatios Geourgoulis,
Julius Erbach, Mathias Gehrig, Yuanyou Li, Davide Scaramuzza

Code & Dataset: <http://rpg.ifi.uzh.ch/timelens>



**University of
Zurich^{UZH}**



* these authors contributed equally

Time Lens: Event-based Video Frame Interpolation

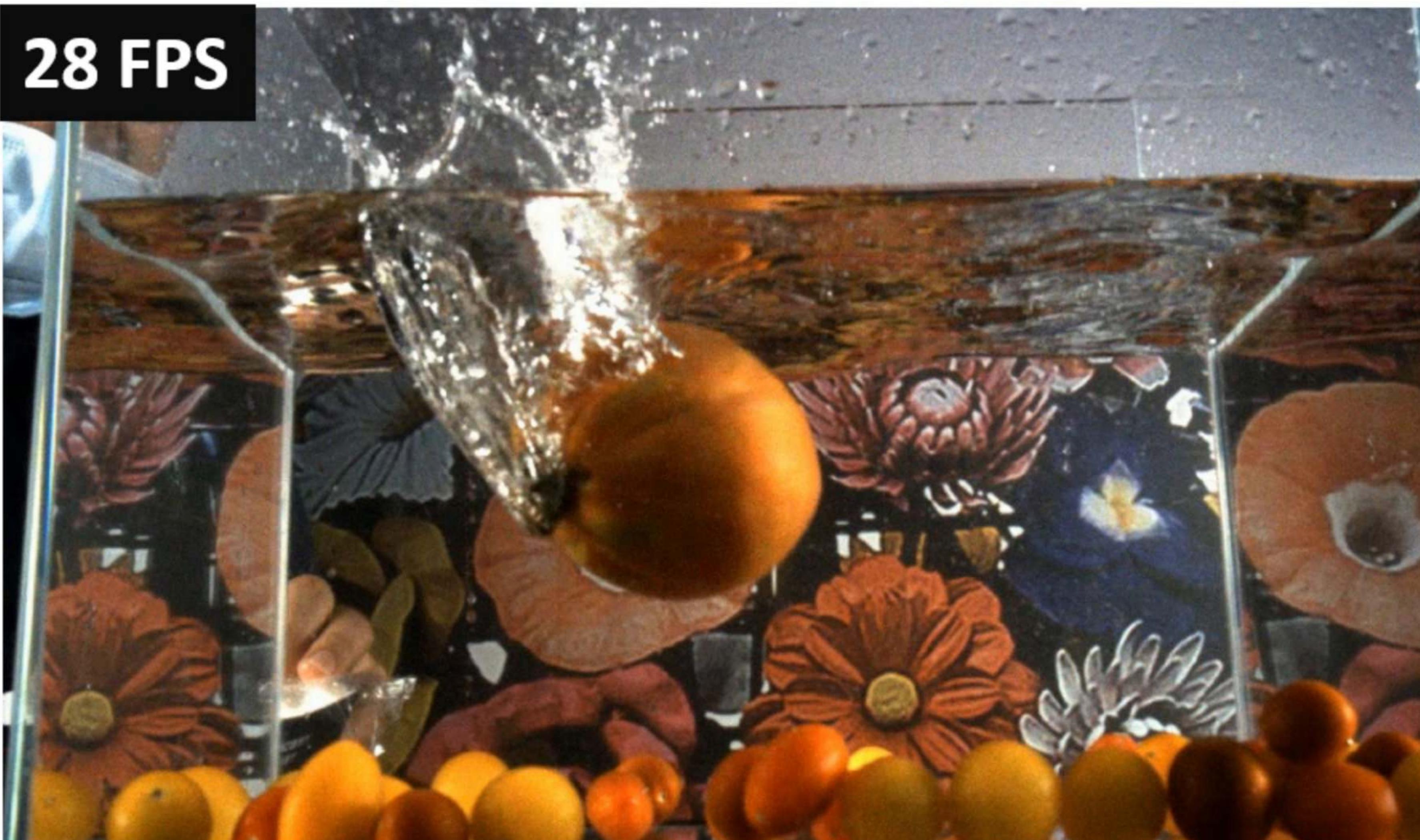


low framerate video input

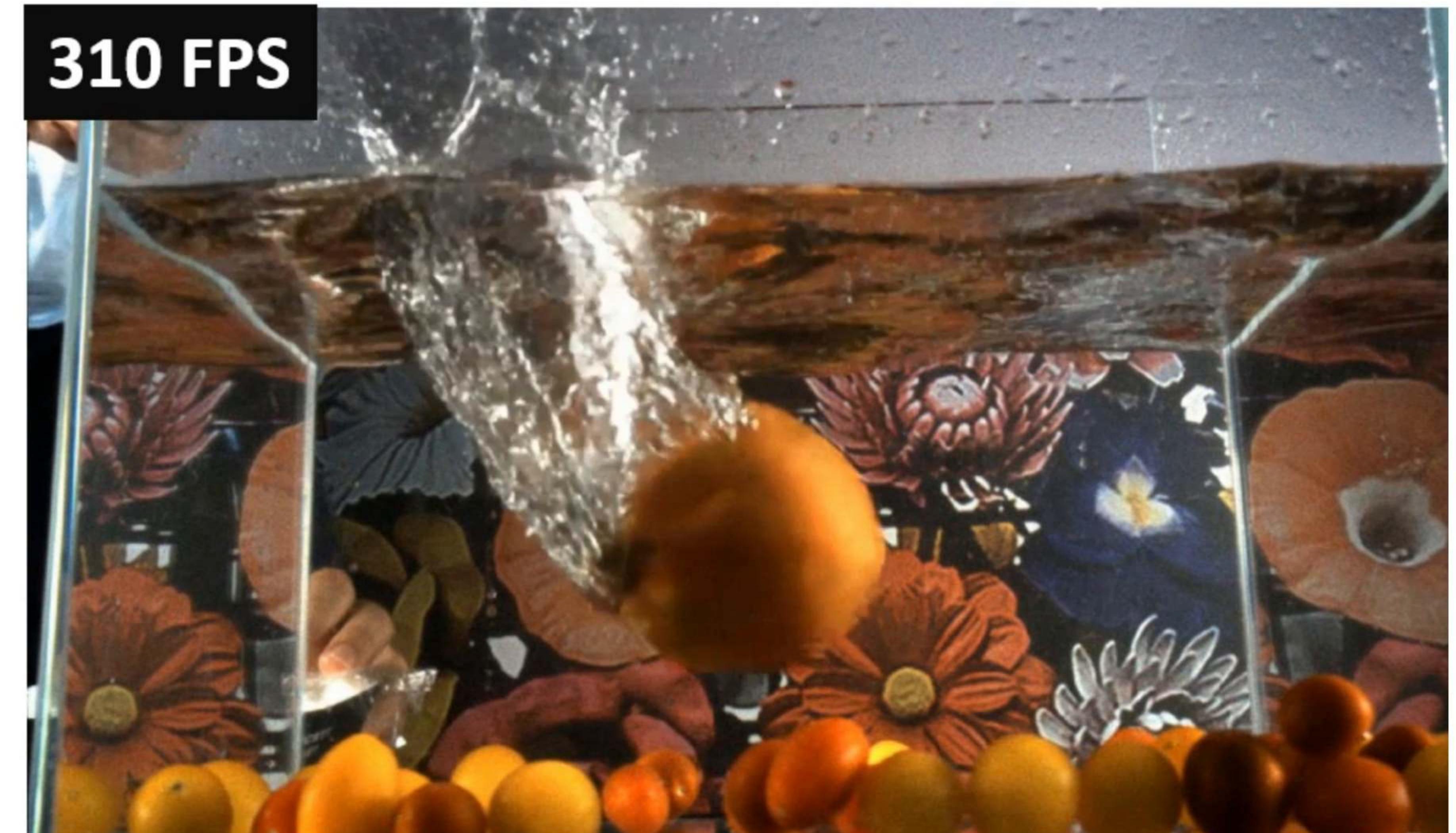


Time Lens (this work)

Time Lens: Event-based Video Frame Interpolation

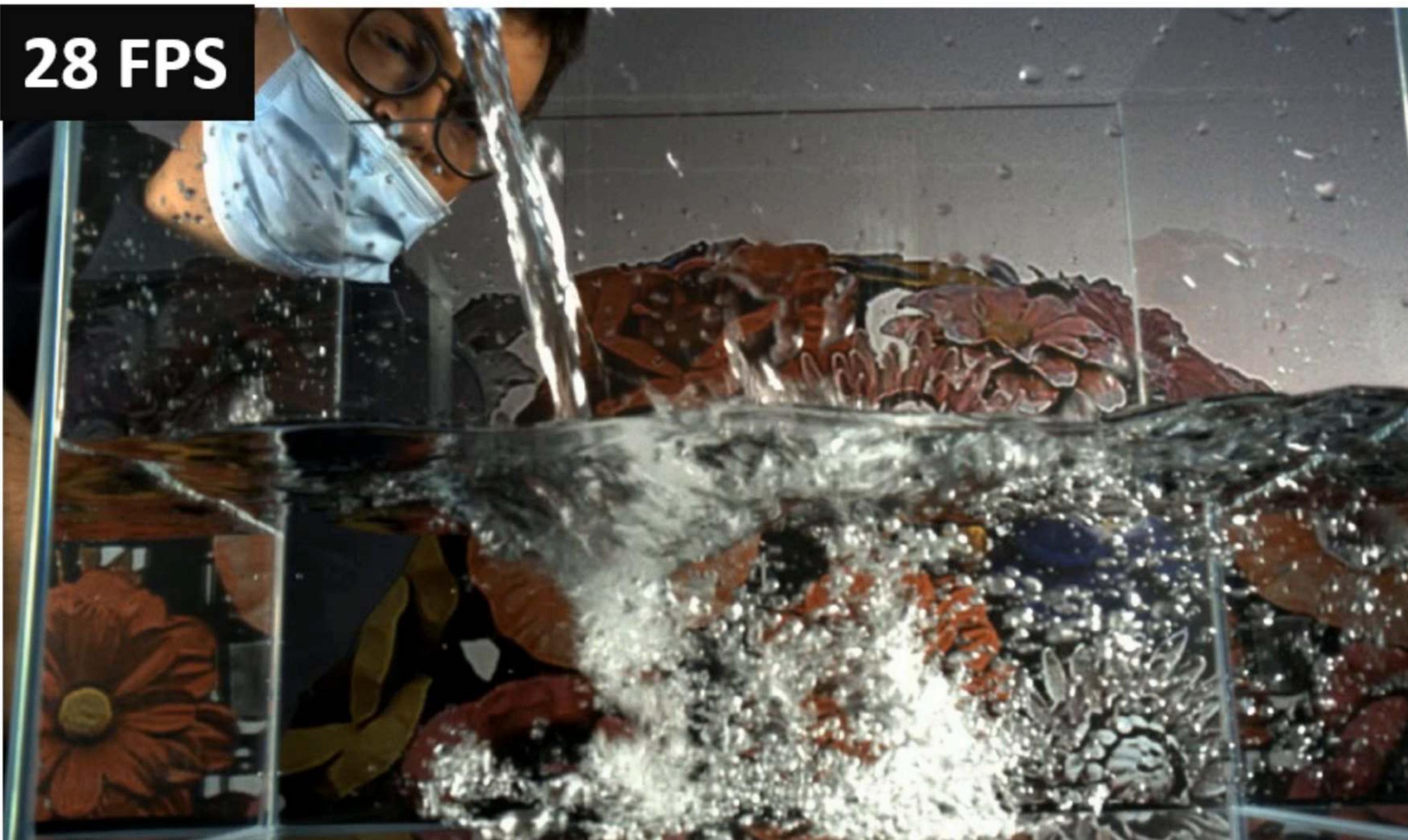


low framerate video input



Time Lens (this work)

Time Lens: Event-based Video Frame Interpolation



low framerate video input



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low framerate video input



Time Lens (this work)

Time Lens: Event-based Video Frame Interpolation



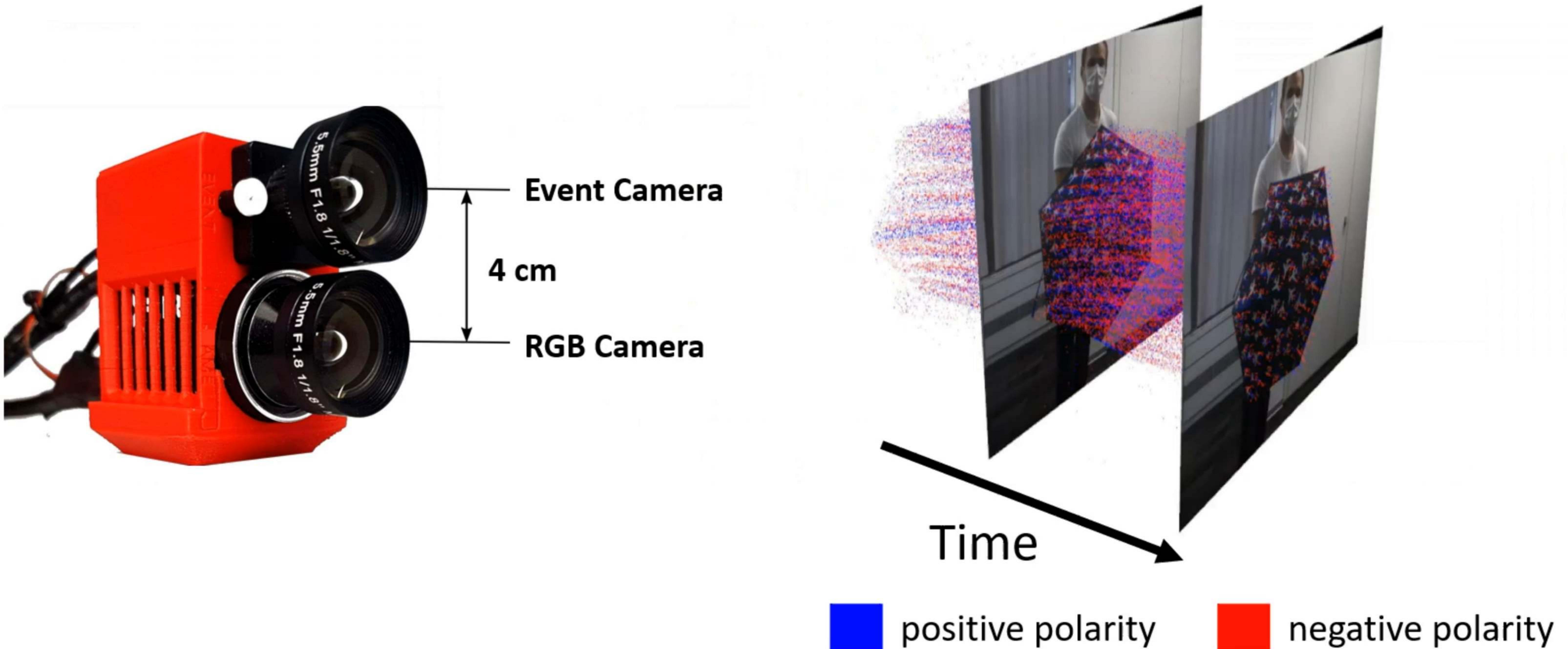
low framerate video input



Time Lens (this work)

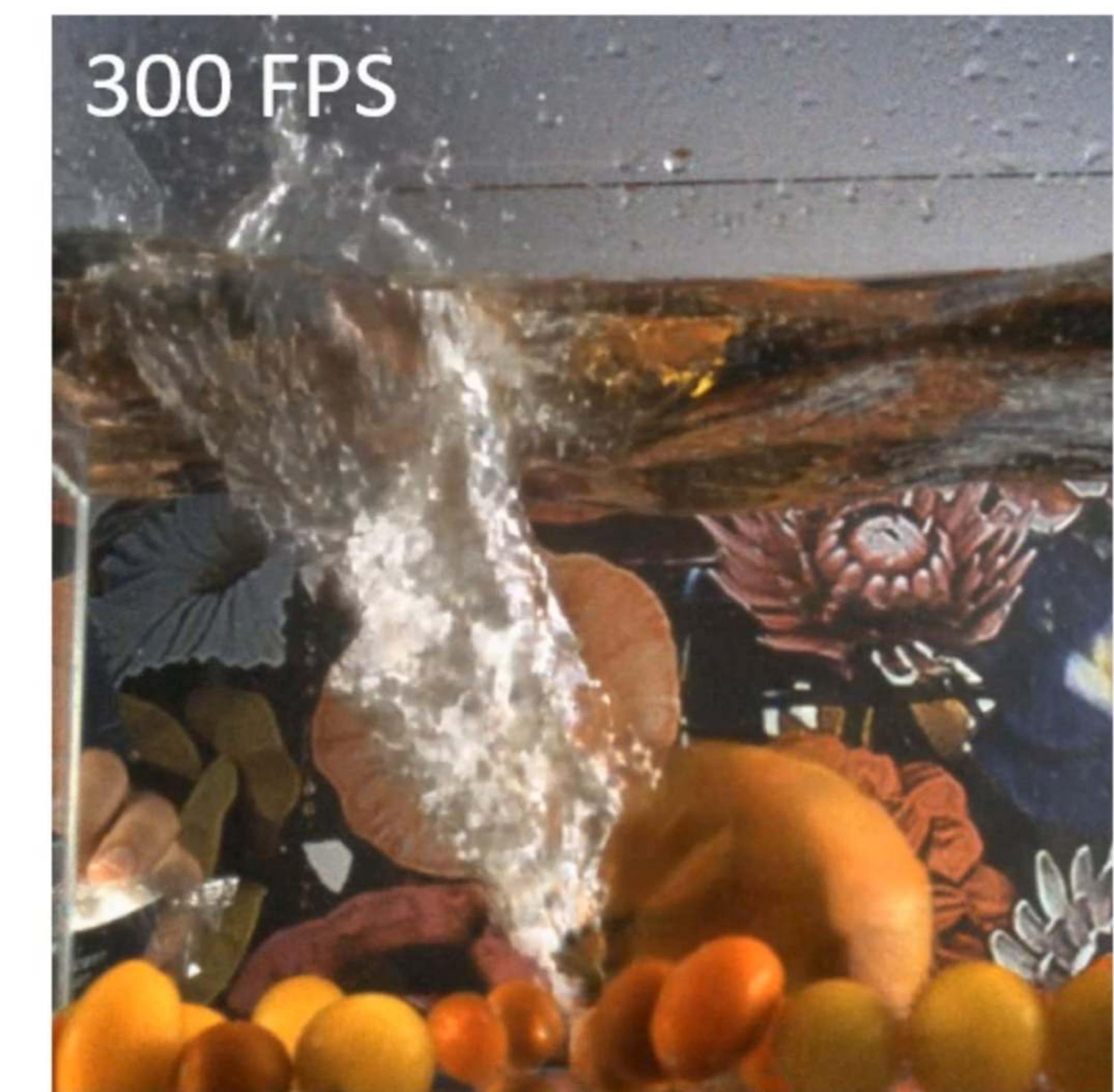
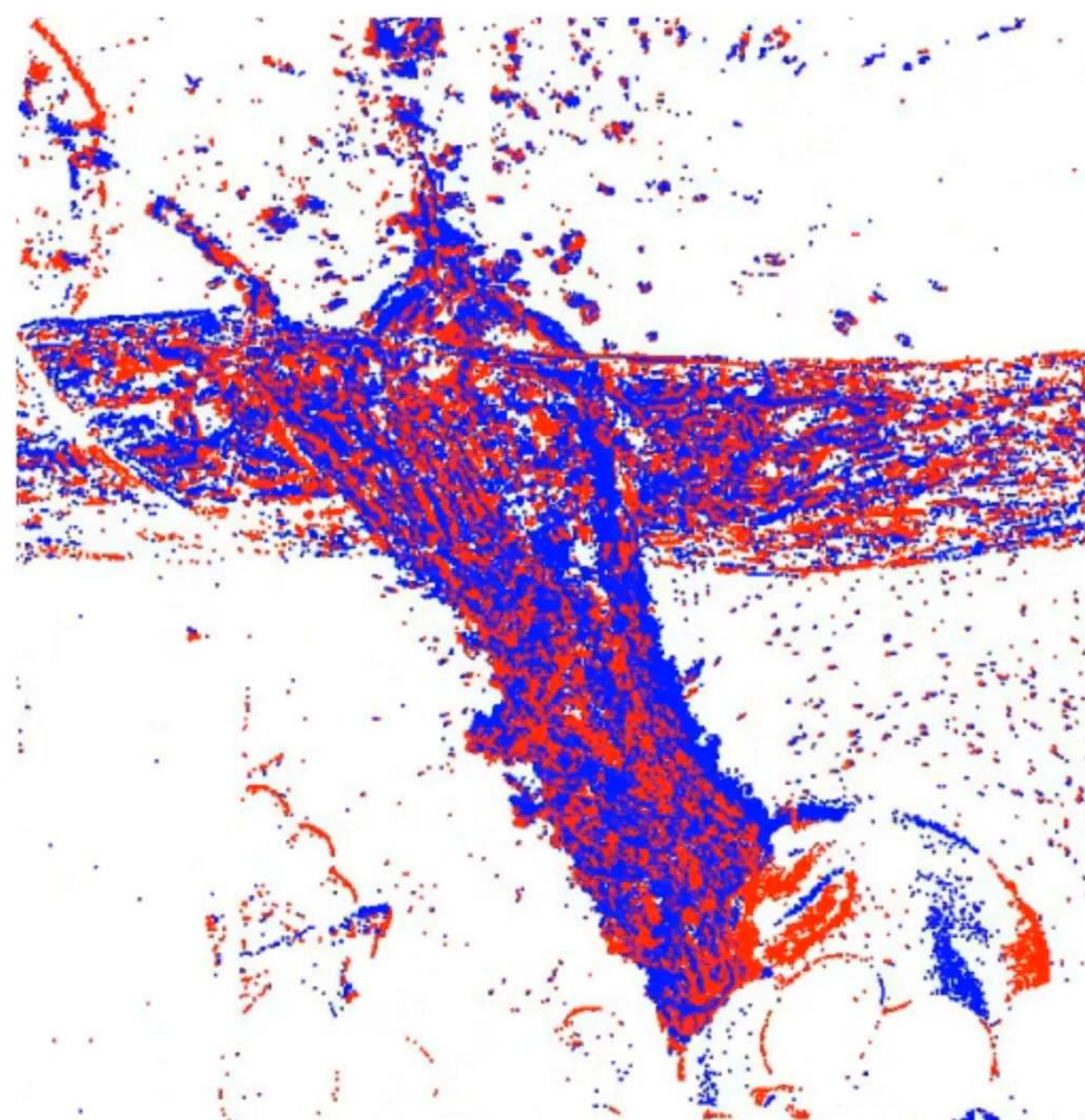
Time Lens: Event-based Video Frame Interpolation

It does this by leveraging event cameras which provide a compressed stream of visual information in the blind-time between frames.

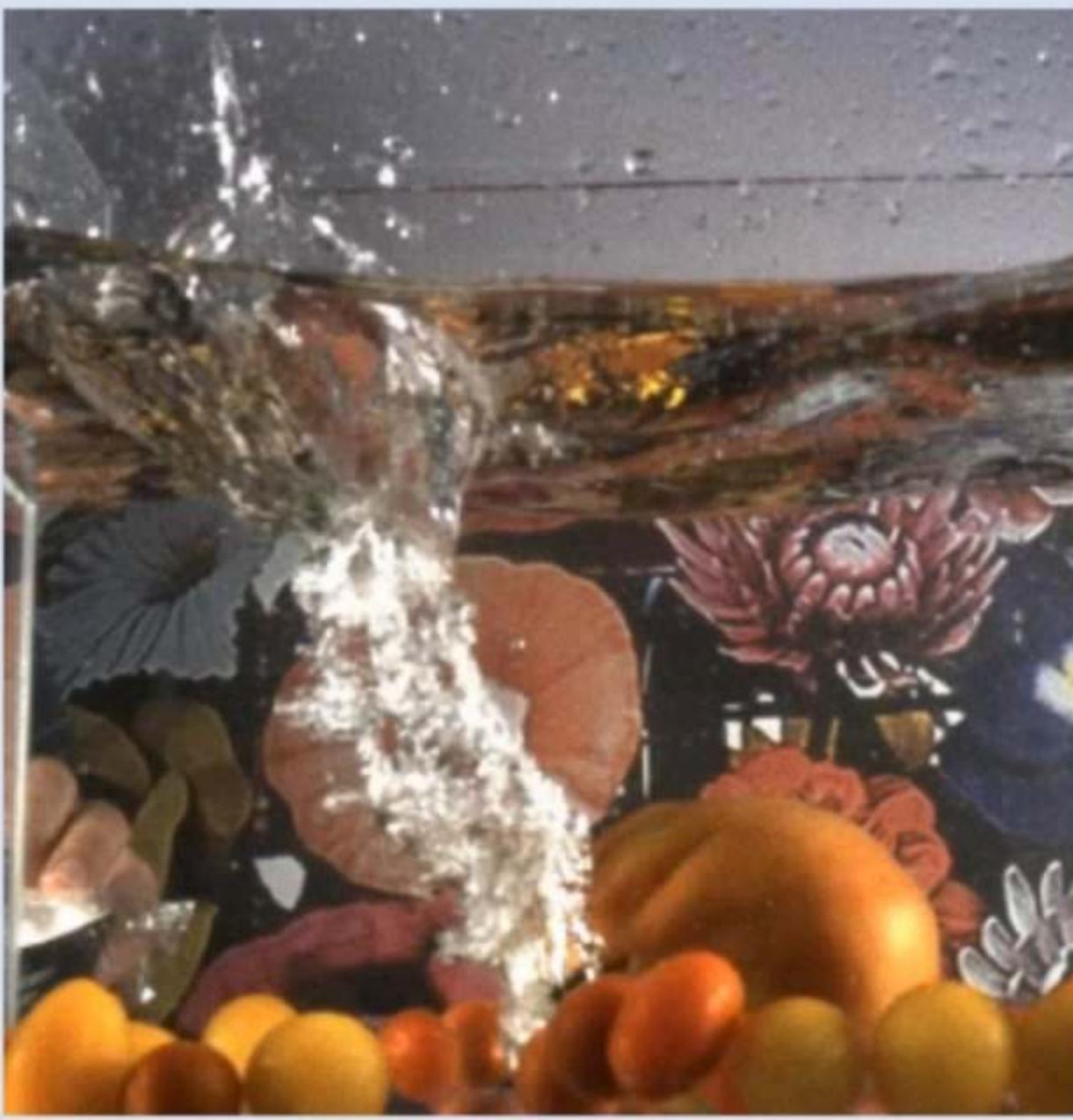


Time Lens: Event-based Video Frame Interpolation

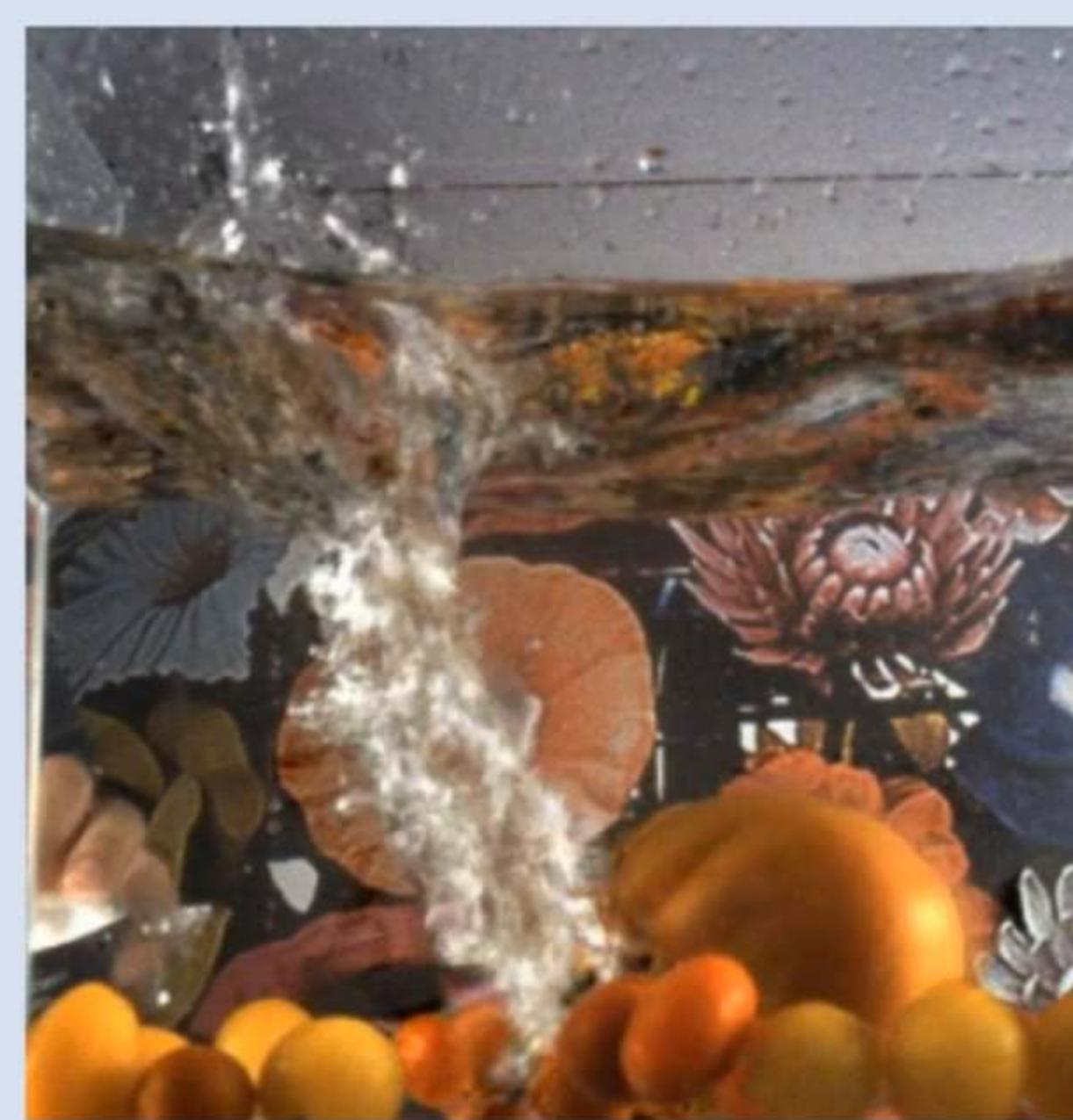
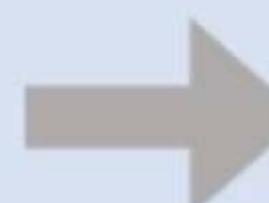
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Time Lens: Event-based Video Frame Interpolation

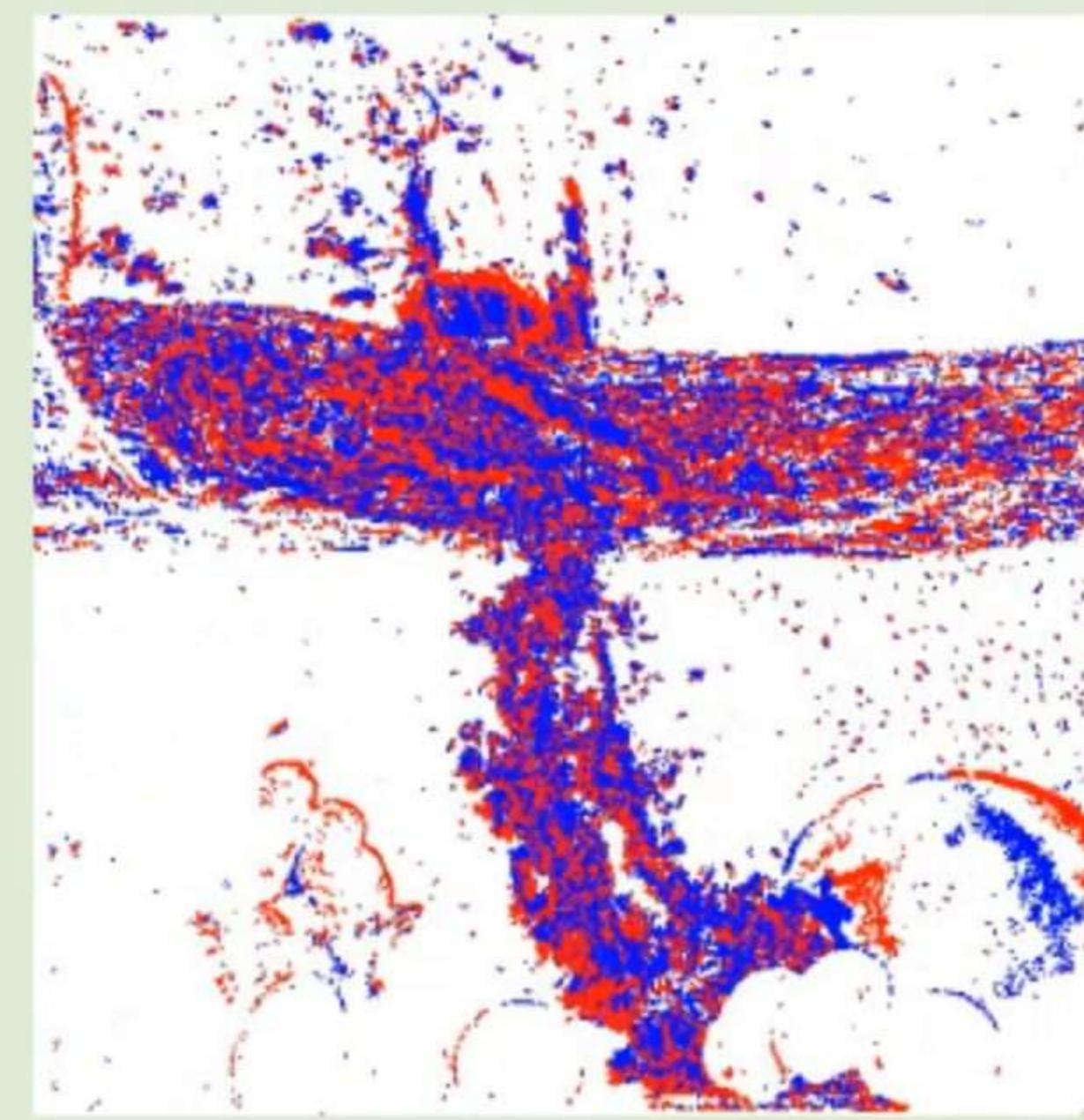


low framerate video input

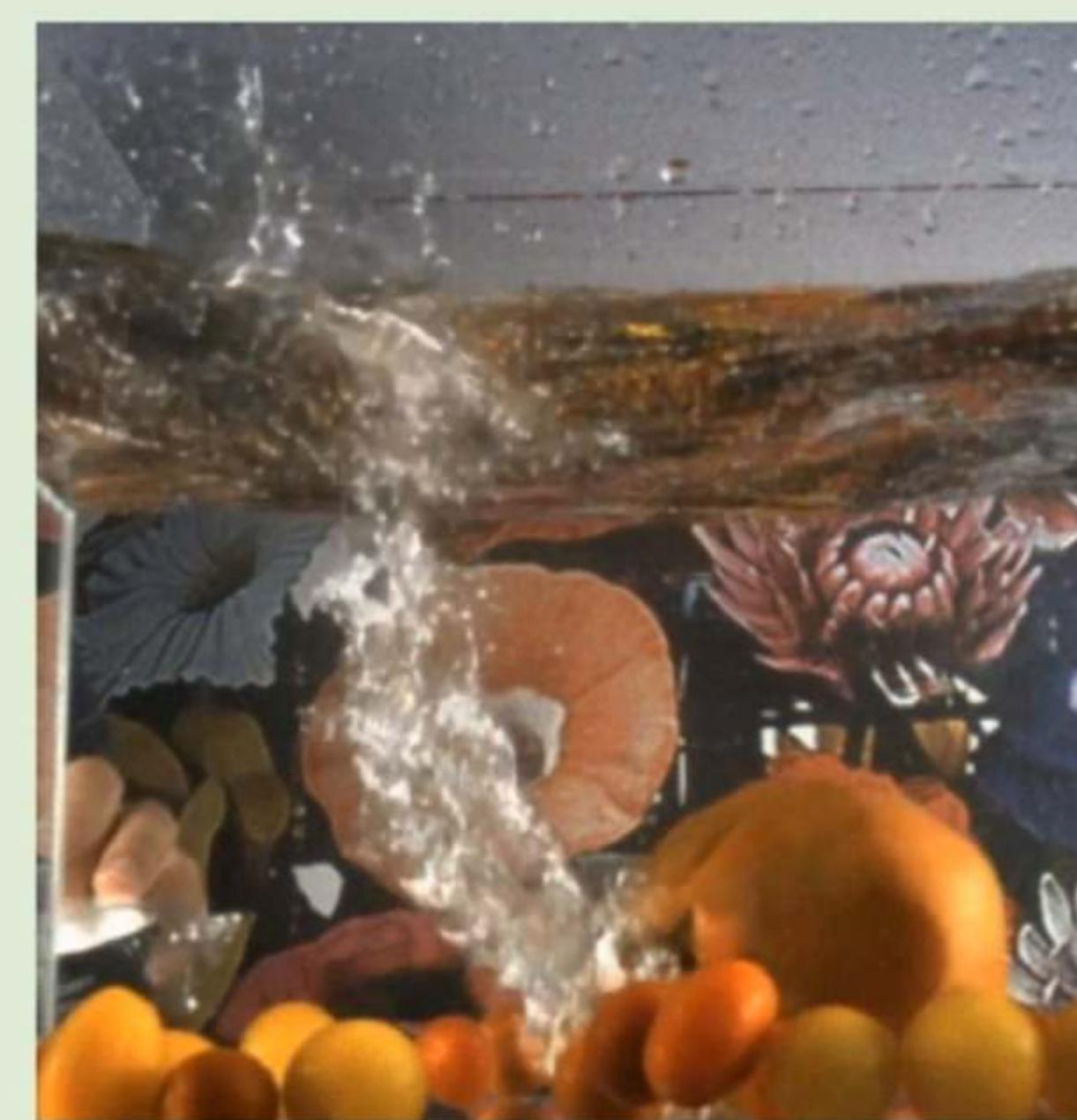
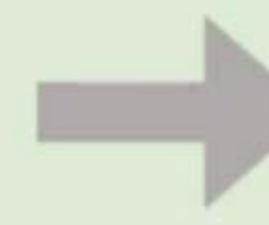


high framerate video

**frame-based
methods (DAIN)
[Bao CVPR'19]**



low framerate video input

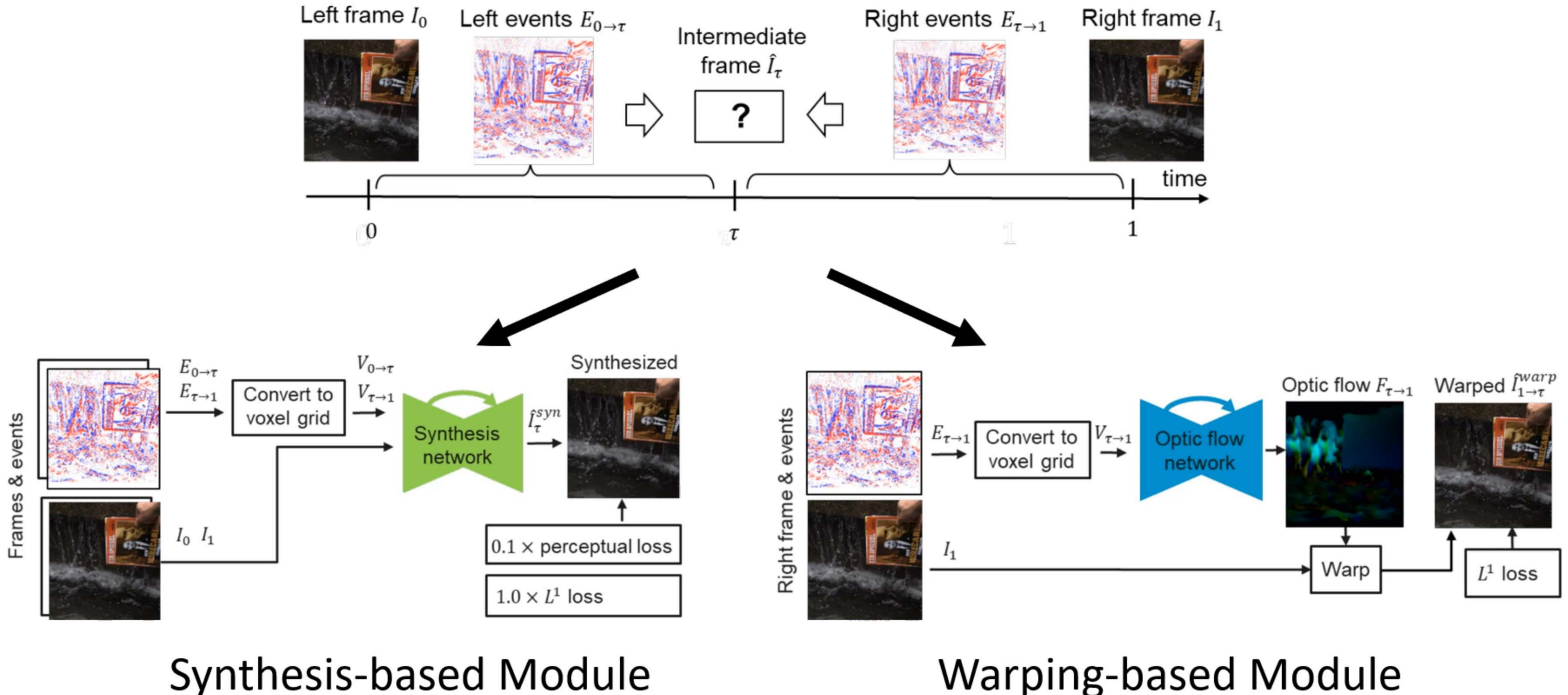


events

high framerate video

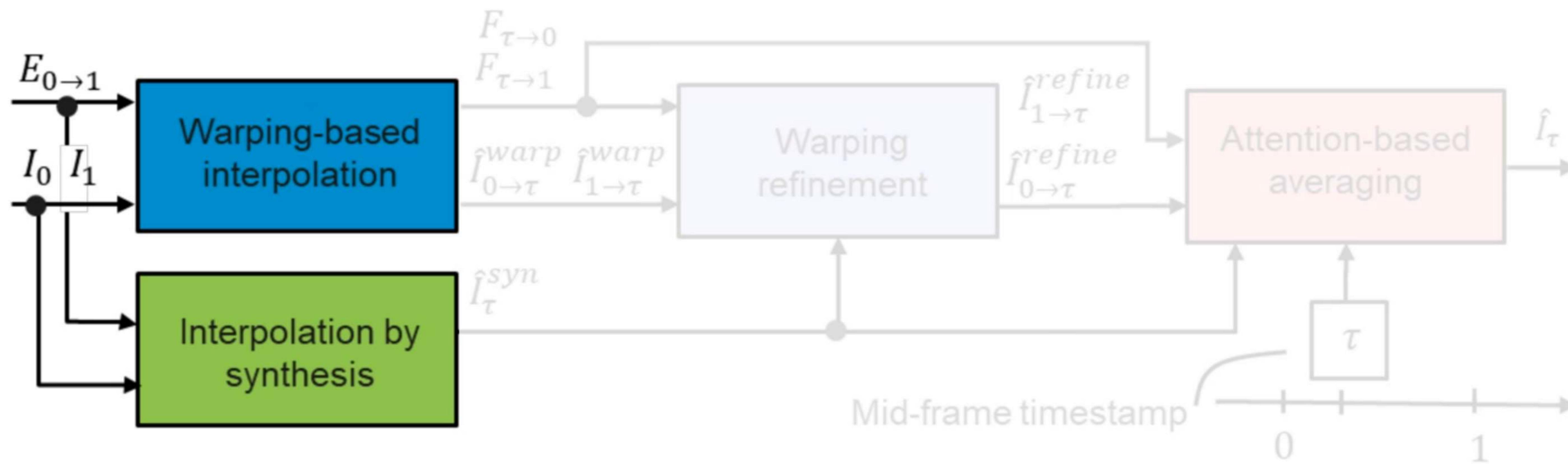
**Time Lens
(this work)**

Methodology



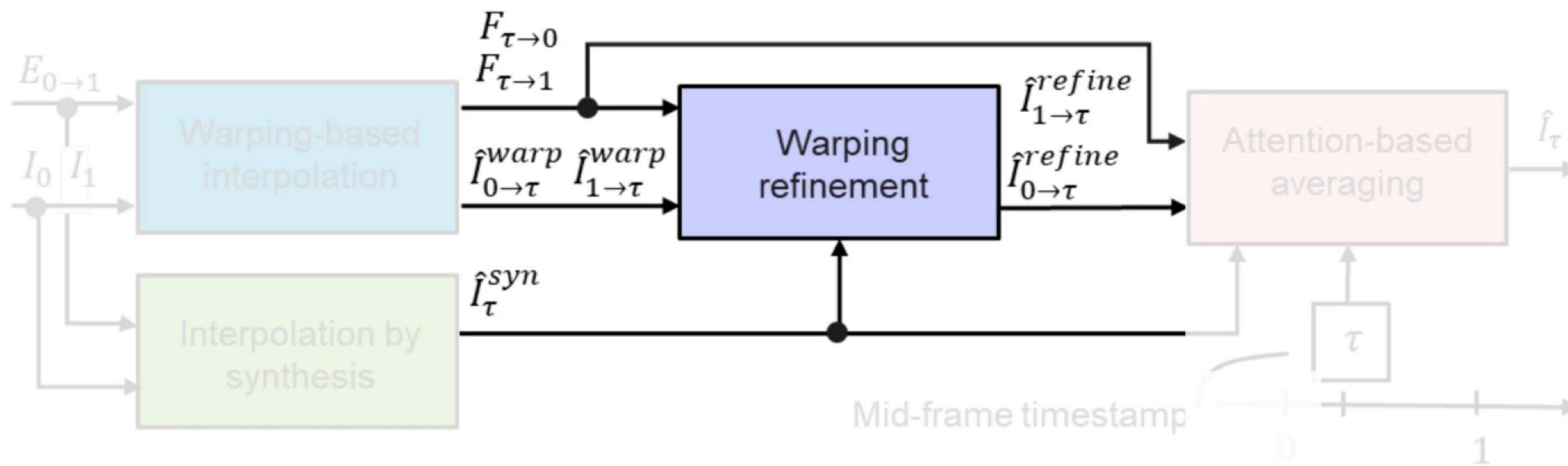
Methodology - Overview

Separate **synthesis-** and **warping-based** modules with warping refinement



Methodology - Overview

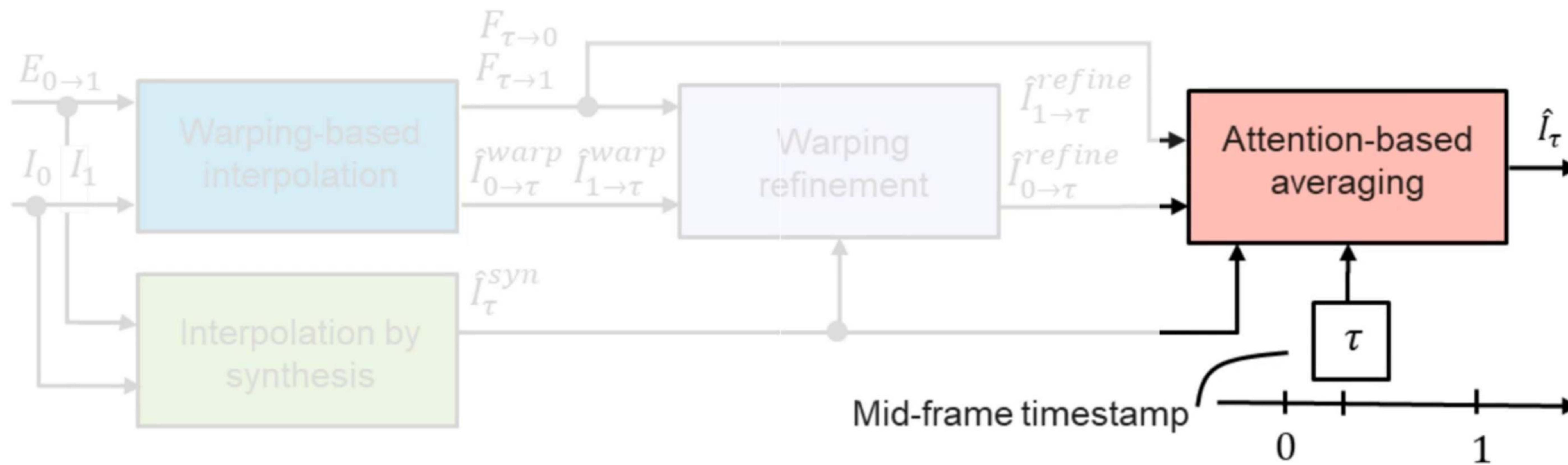
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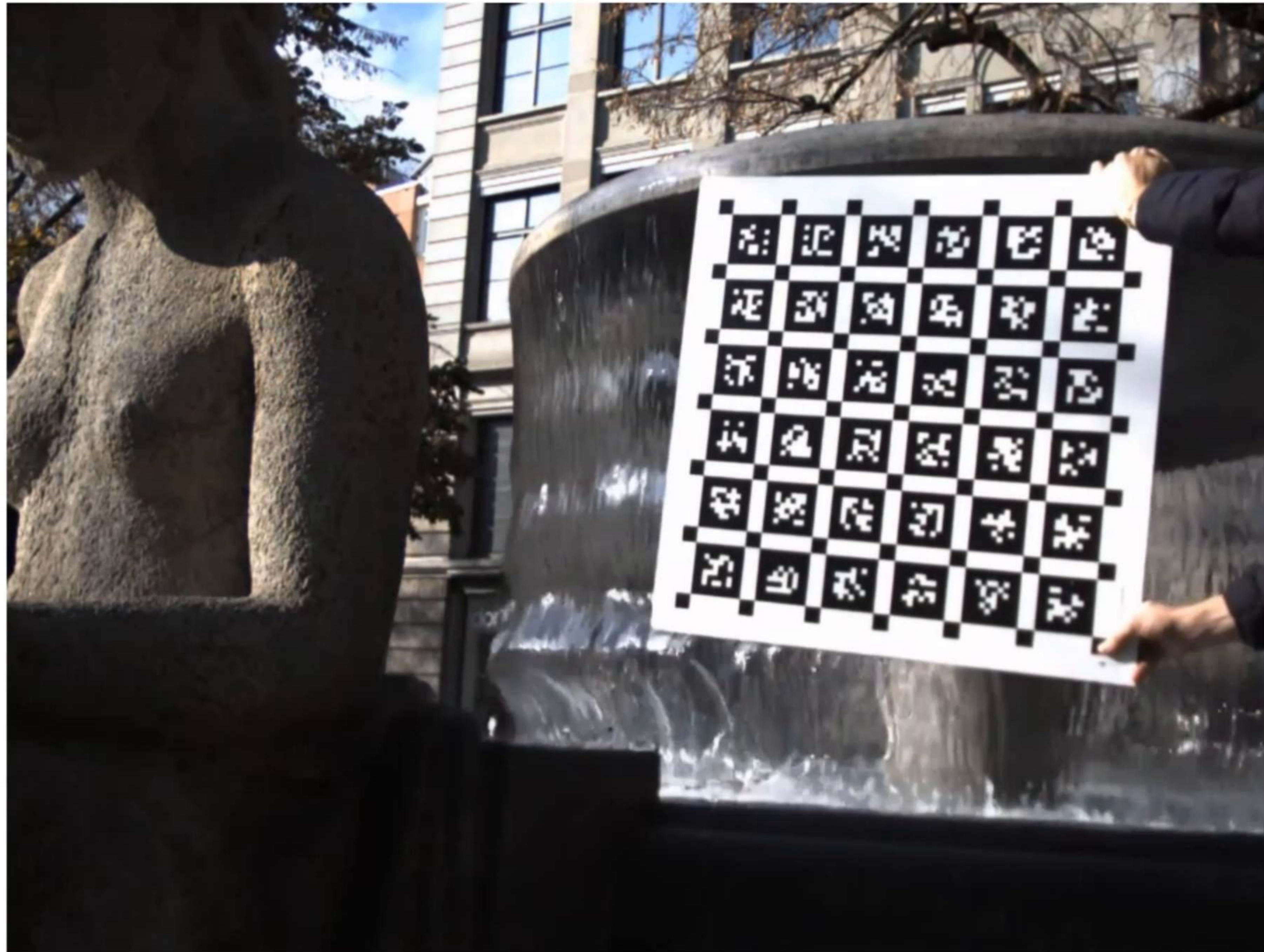
Methodology - Overview

Separate **synthesis-** and **warping-based** modules with warping refinement

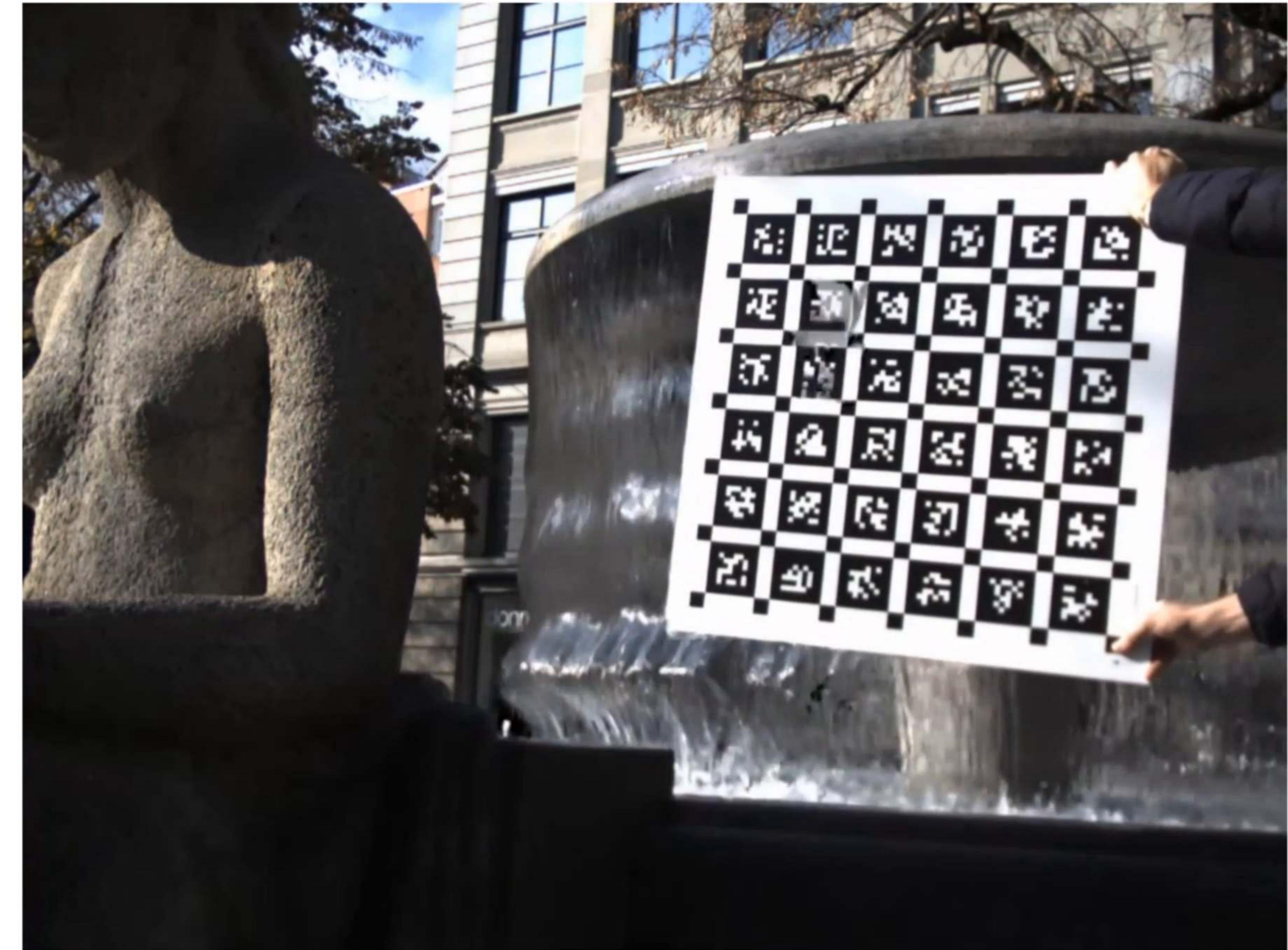
Fusion of separate candidates with **attention**.



Challenging Scenarios: Highly Dynamic Scenes



Time Lens (ours)



DAIN [Bao CVPR'19]

Challenging Scenarios: Highly Dynamic Scenes



Time Lens (ours)



DAIN [Bao CVPR'19]

Challenging Scenarios: Highly Dynamic Scenes



Time Lens (ours)



DAIN [Bao CVPR'19]

Comparison with Event-based Methods



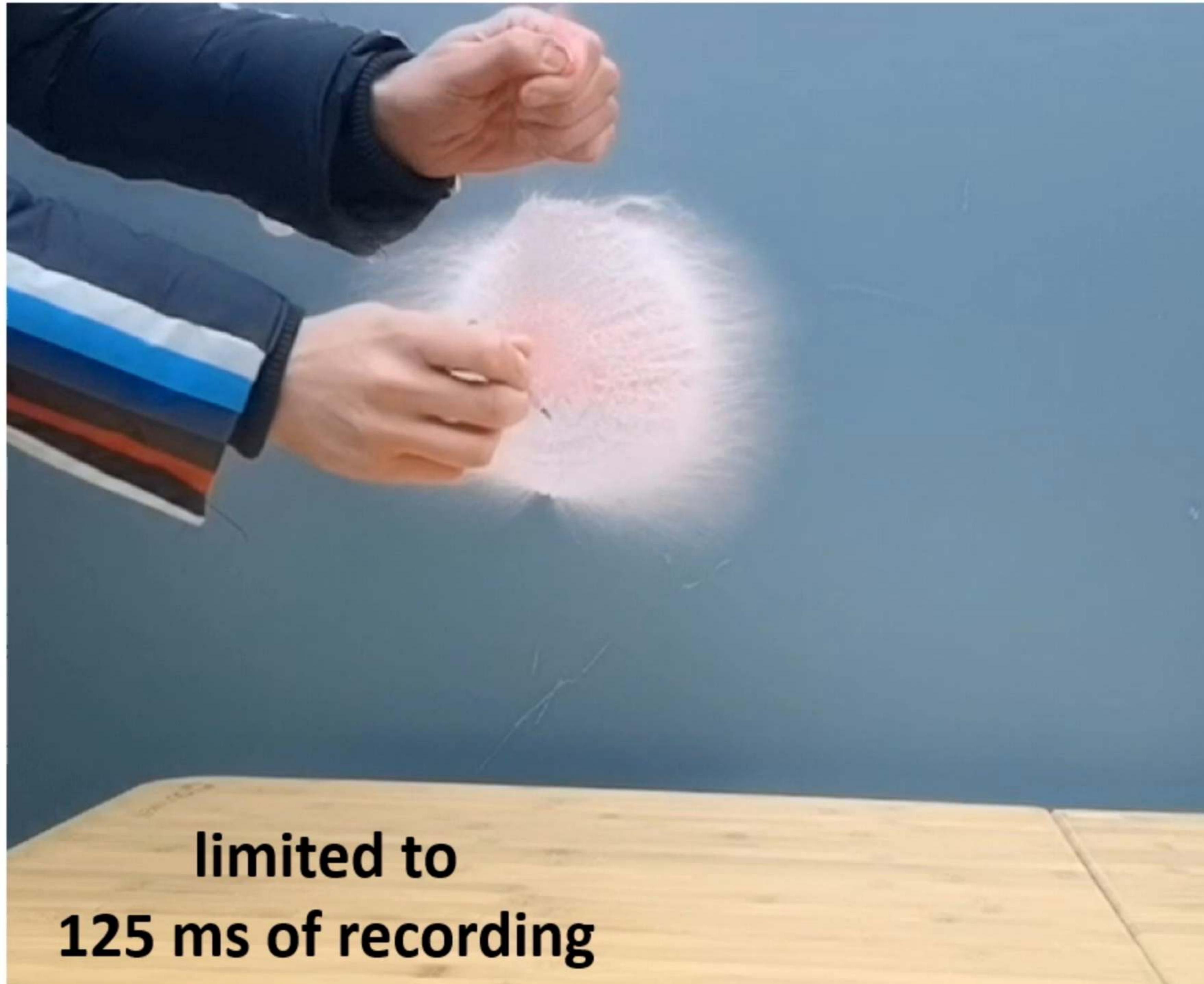
Time Lens (ours)



LEDVDI [Lin ECCV'20]

Applications: Slow Motion Video at 7680 FPS

Upsampled from 1920 FPS to 7680 FPS



**limited to
125 ms of recording**

Huawei P40 Pro

Upsampled from 160 FPS to 7680 FPS



Time Lens (ours)

Applications: Slow Motion Video at 7680 FPS

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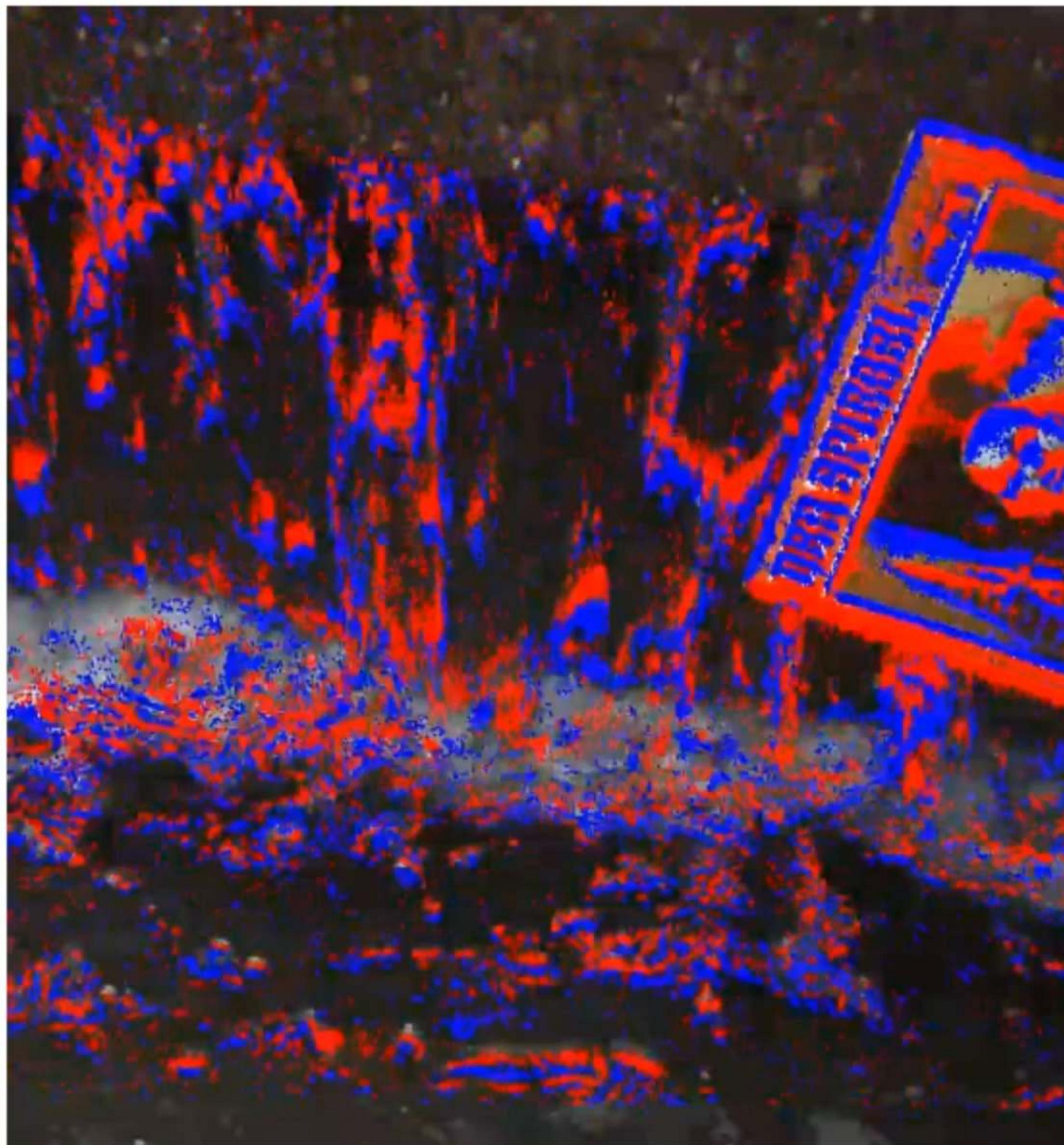
Upsampled from 160 FPS to 7680 FPS



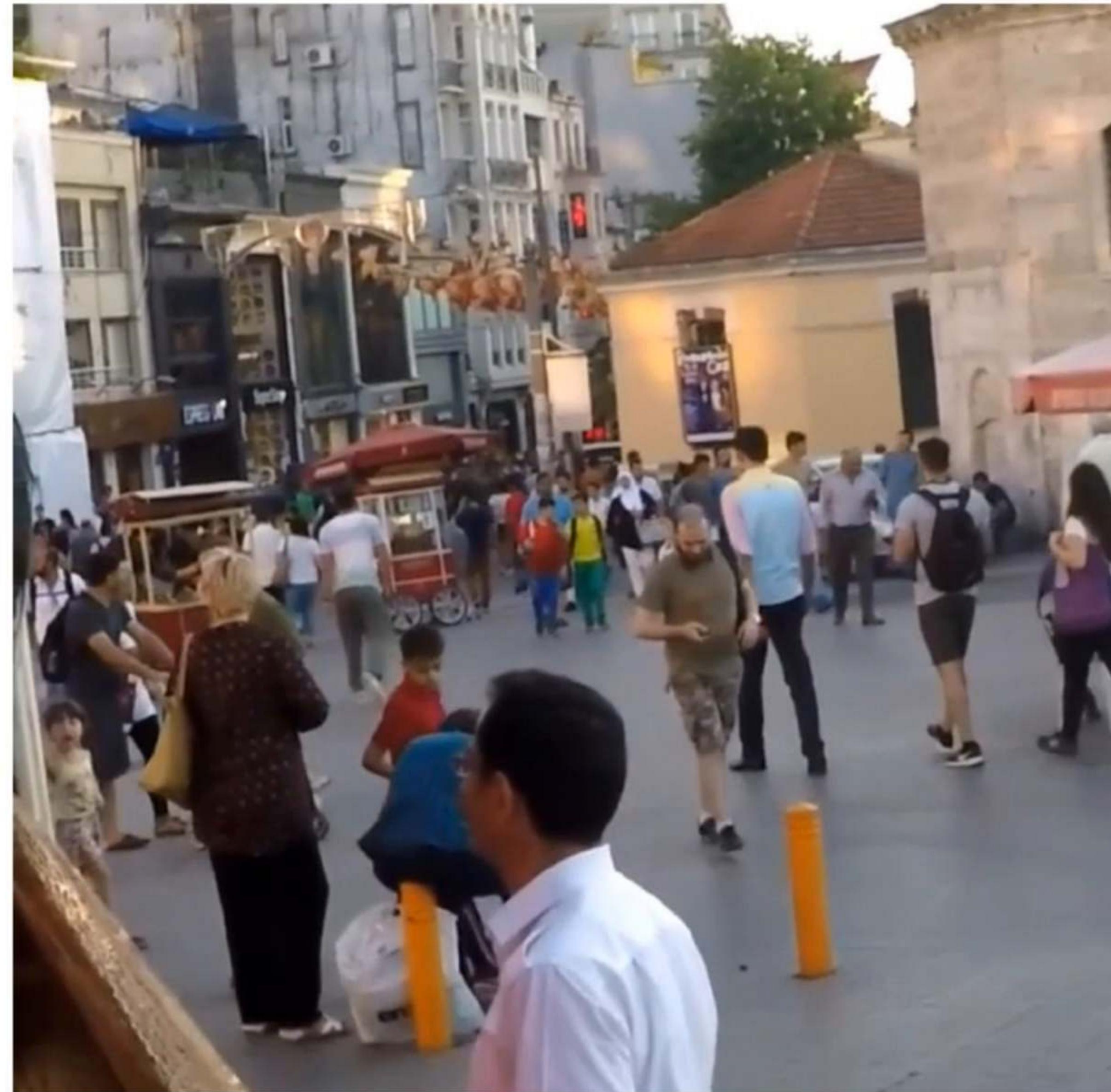
Time Lens (ours)

Experimental Results on Public Datasets

Extensive evaluation on both synthetic and real datasets shows an **up to 5.4 dB improvement in PSNR** compared to both event- and frame-based methods.



**High Speed Event and
RGB Dataset (HS-ERGB)**



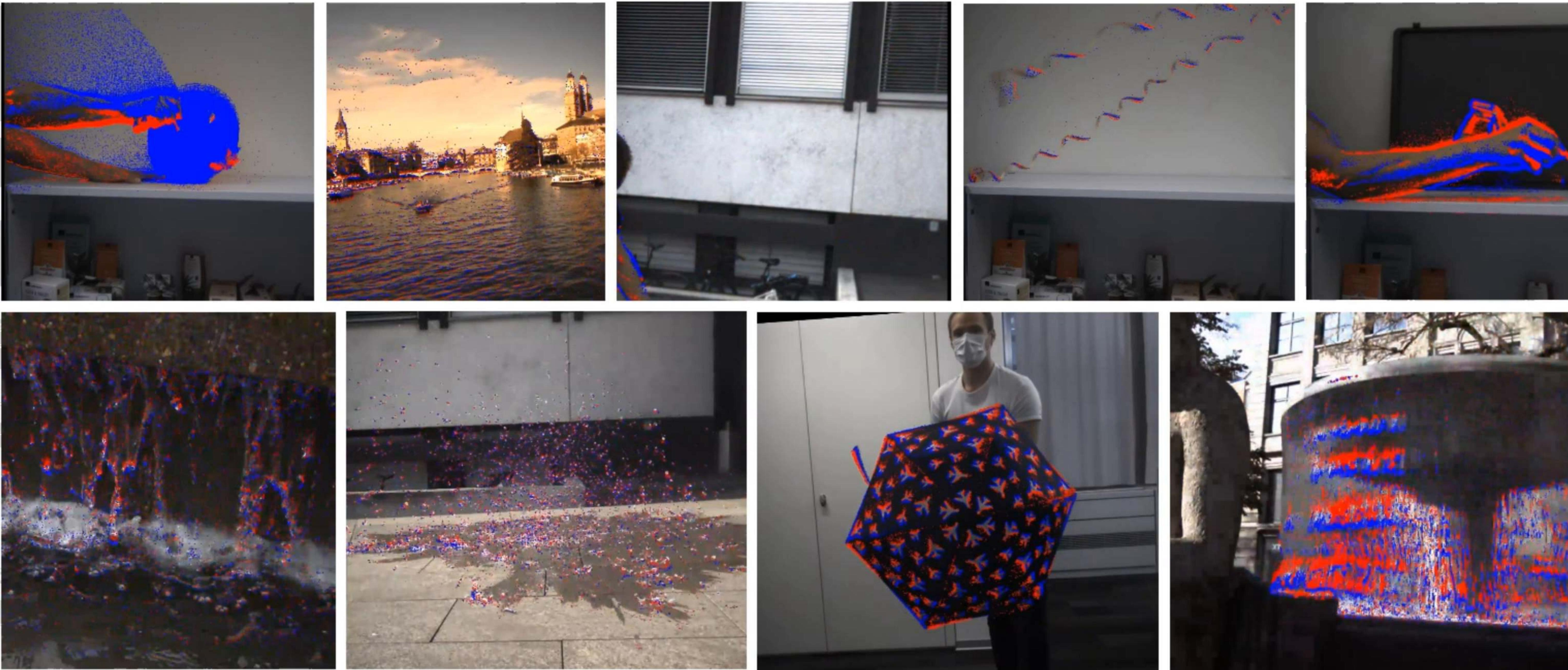
GoPro [Nah CVPR'17]



**HQF Dataset
[Stoffregen ECCV'2020]**

High-Speed Event and Color Camera Dataset

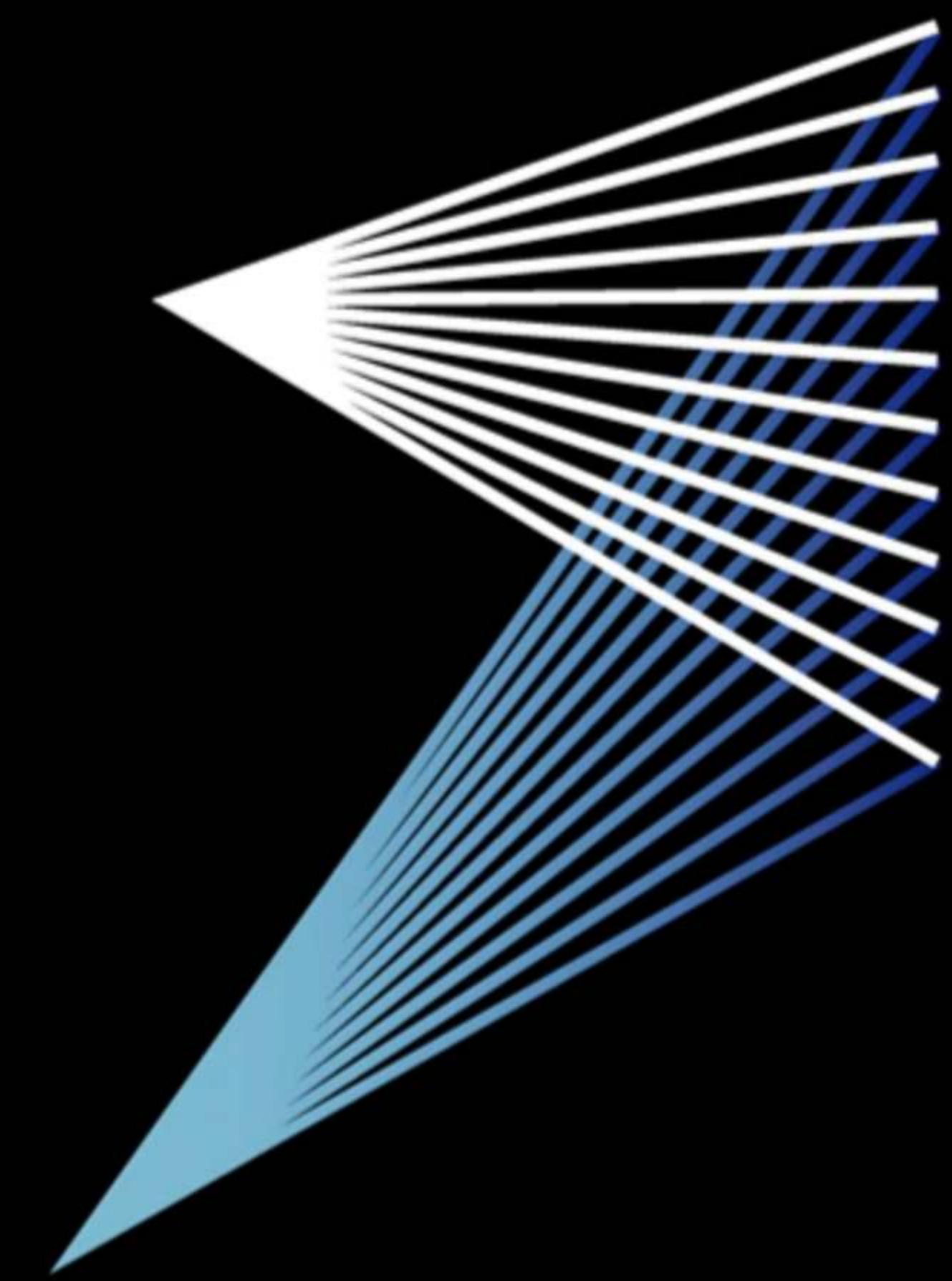
We release the first high resolution and high speed (160 FPS) event and frame dataset to push the limits of existing frame interpolation approaches.



Conclusion

- We present a method which combines frames and asynchronous events for video frame interpolation
- We address many frame-interpolation challenges, such as **visual aliasing, highly dynamic motions and illumination changes.**
- We show **up to 5.4 dB improvements in terms of PSNR** over both frame- and event-based methods
- We achieve similar results to a high-speed camera with a significant reduction in data, greatly extending the recording time.

Code and Dataset: <http://rpg.ifi.uzh.ch/timelens>



ROBOTICS &
PERCEPTION
GROUP

rpg.ifi.uzh.ch