

TimeLens: Event-based Video Frame Interpolation

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



**University of
Zurich**^{UZH}



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rpg.ifi.uzh.ch

* these authors contributed equally

Time Lens: Event-based Video Frame Interpolation

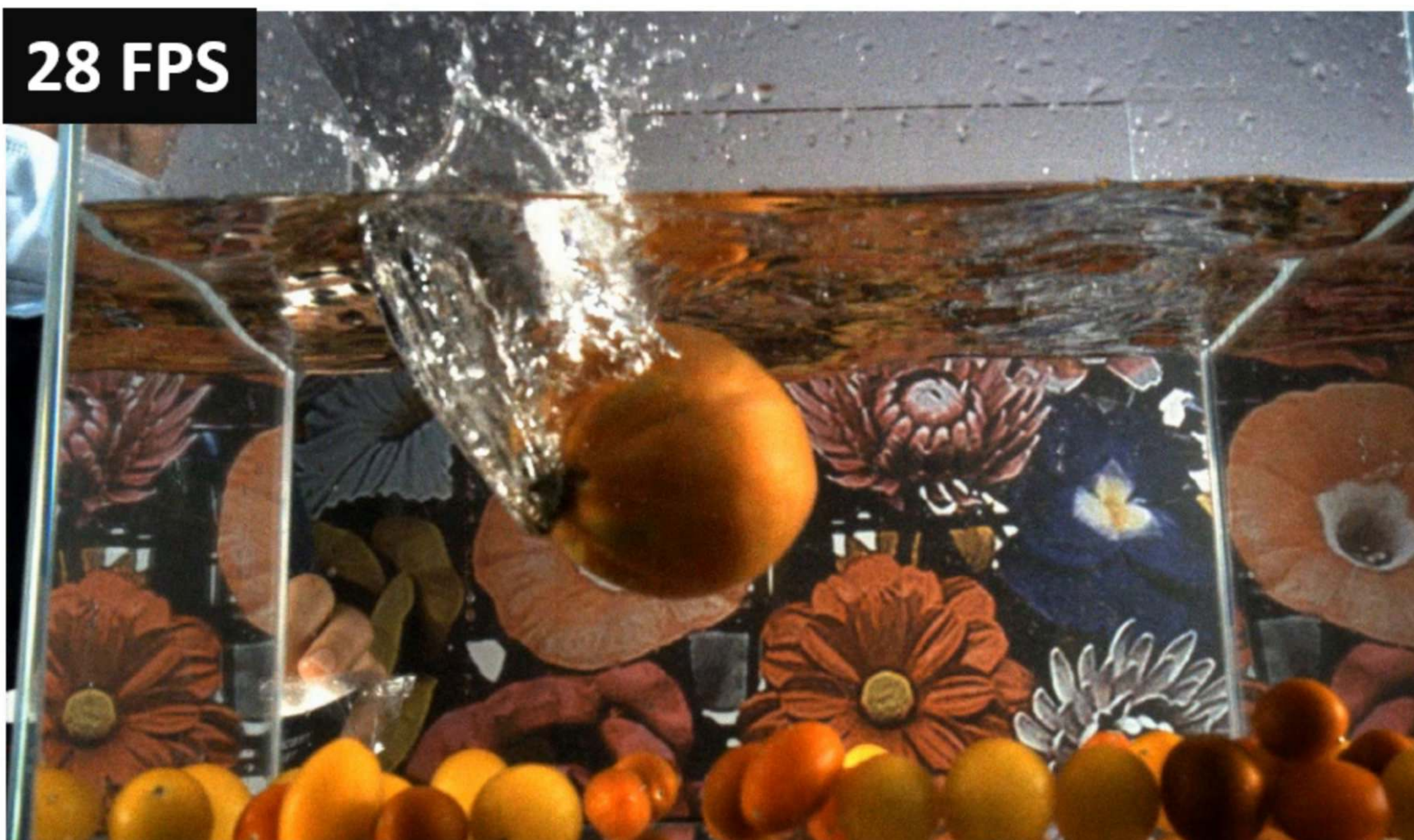


low framerate video input

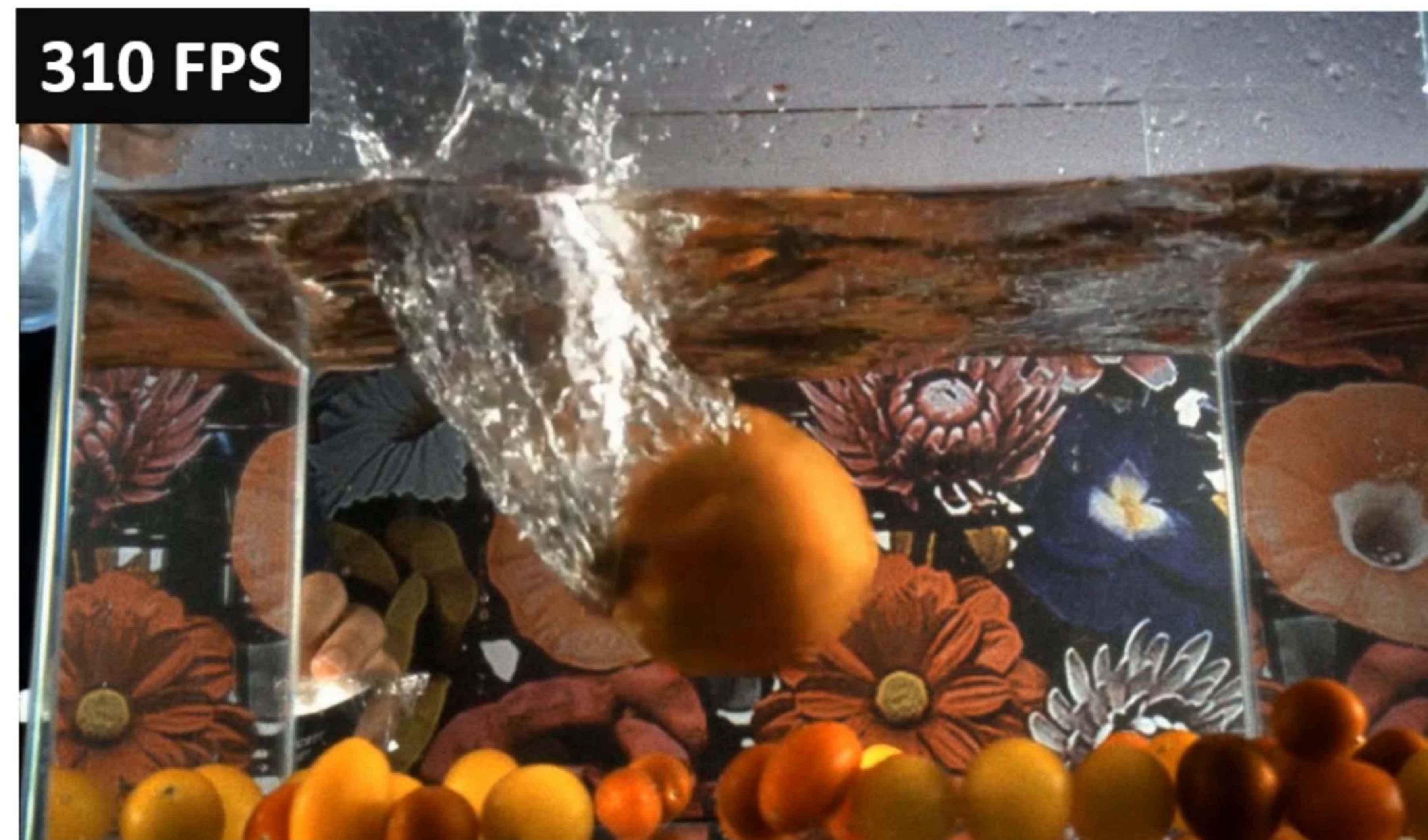


Time Lens (this work)

Time Lens: Event-based Video Frame Interpolation



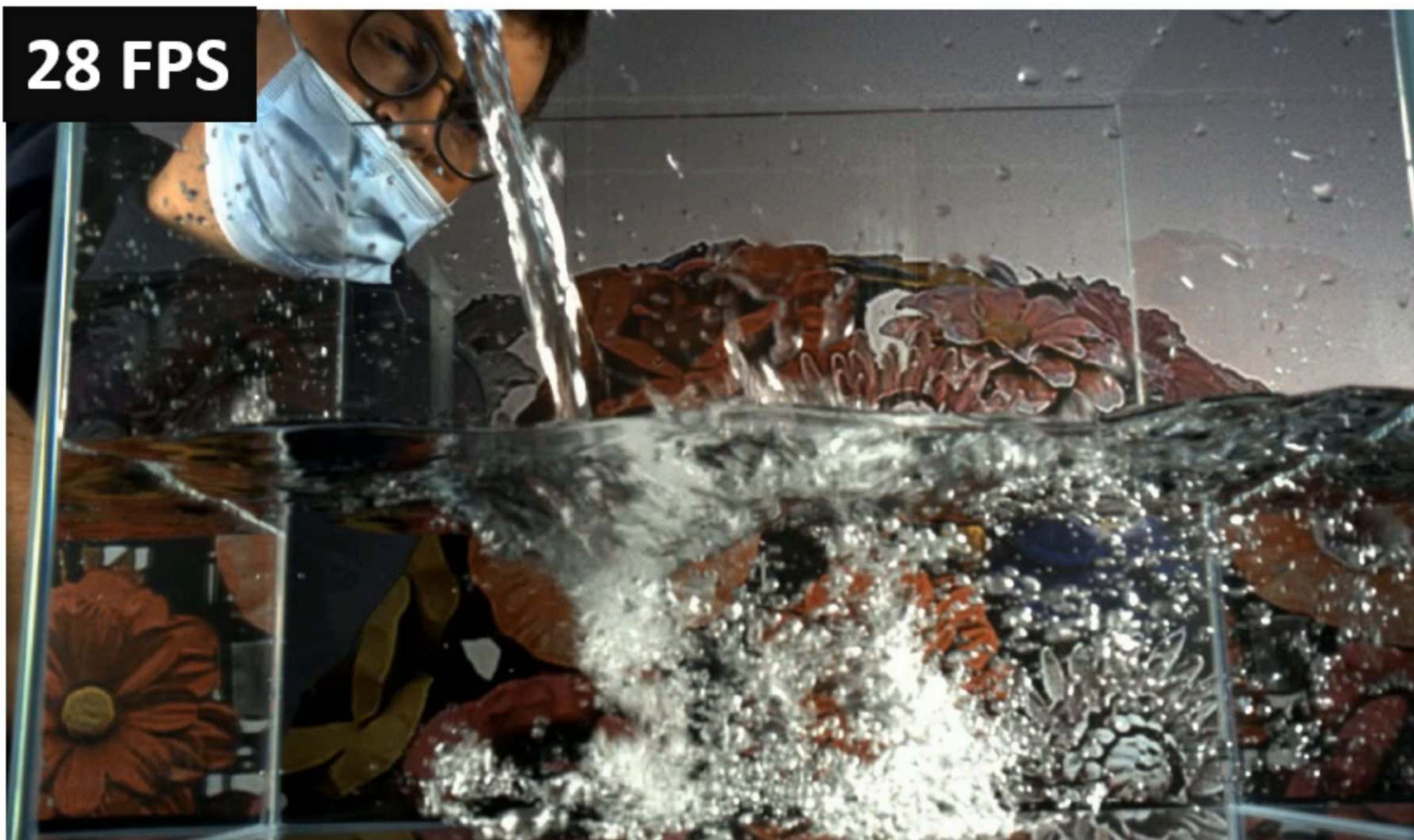
low framerate video input



Time Lens (this work)

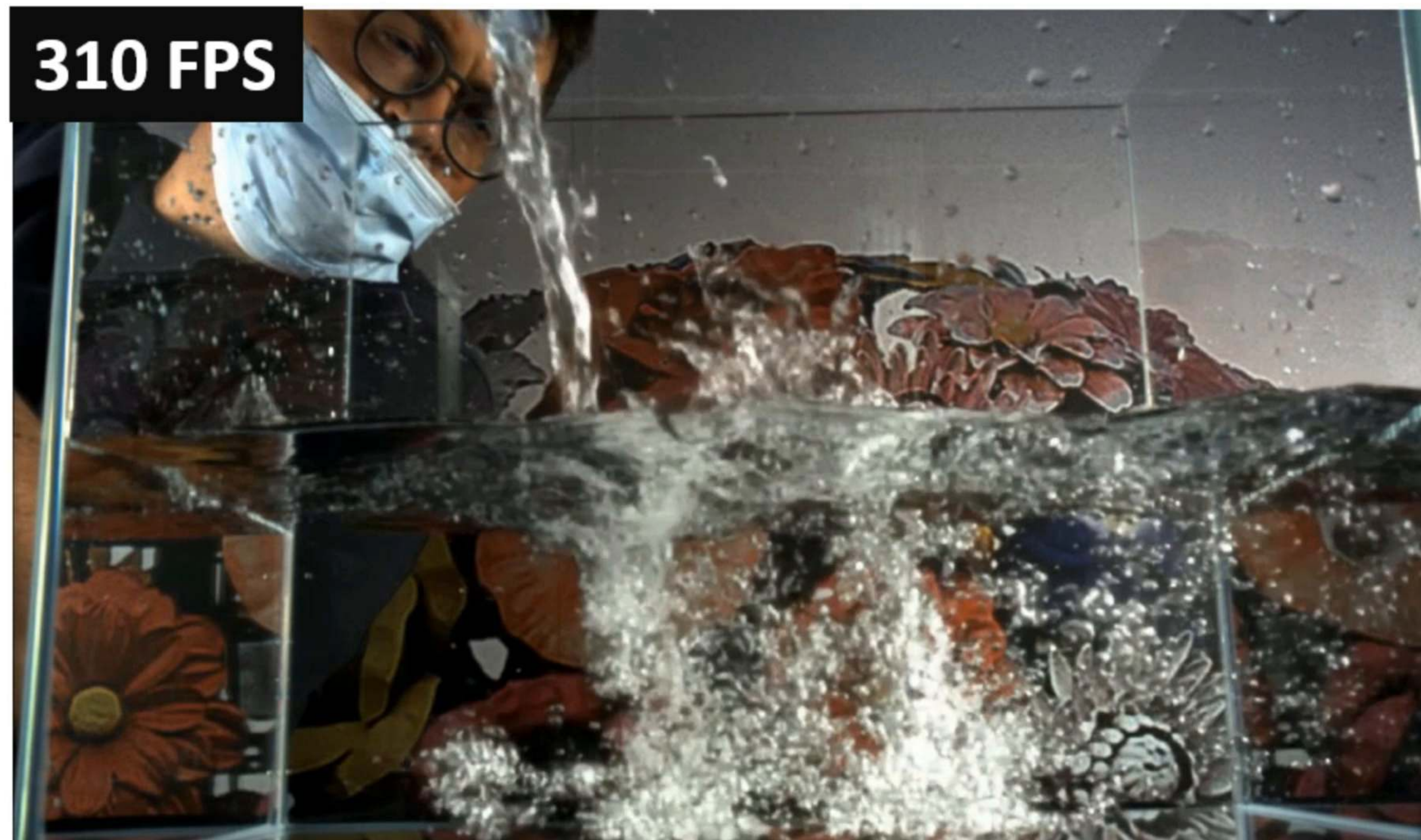
Time Lens: Event-based Video Frame Interpolation

28 FPS



low framerate video input

310 FPS

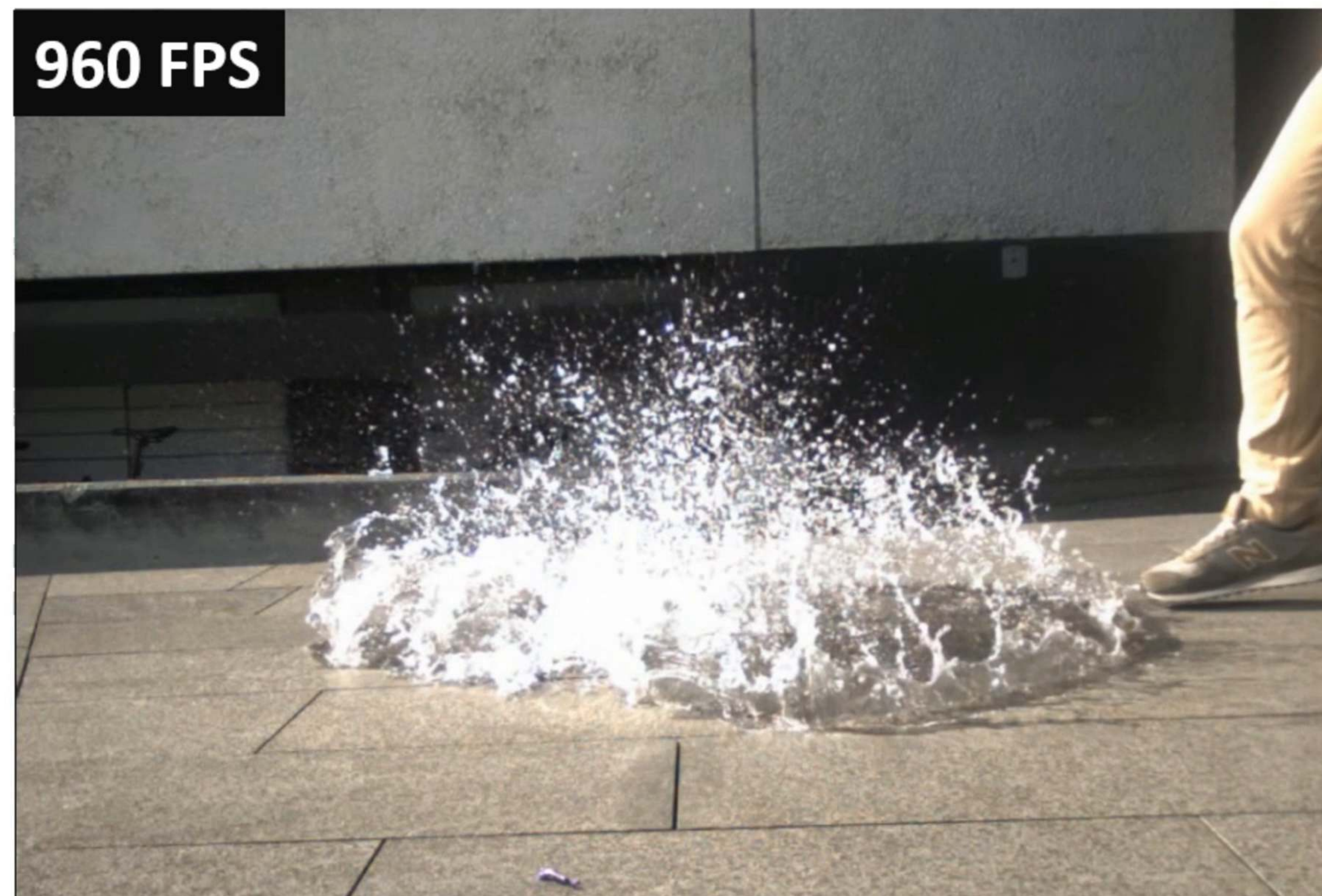


Time Lens (this work)

Time Lens: Event-based Video Frame Interpolation



low framerate video input



Time Lens (this work)

Time Lens: Event-based Video Frame Interpolation



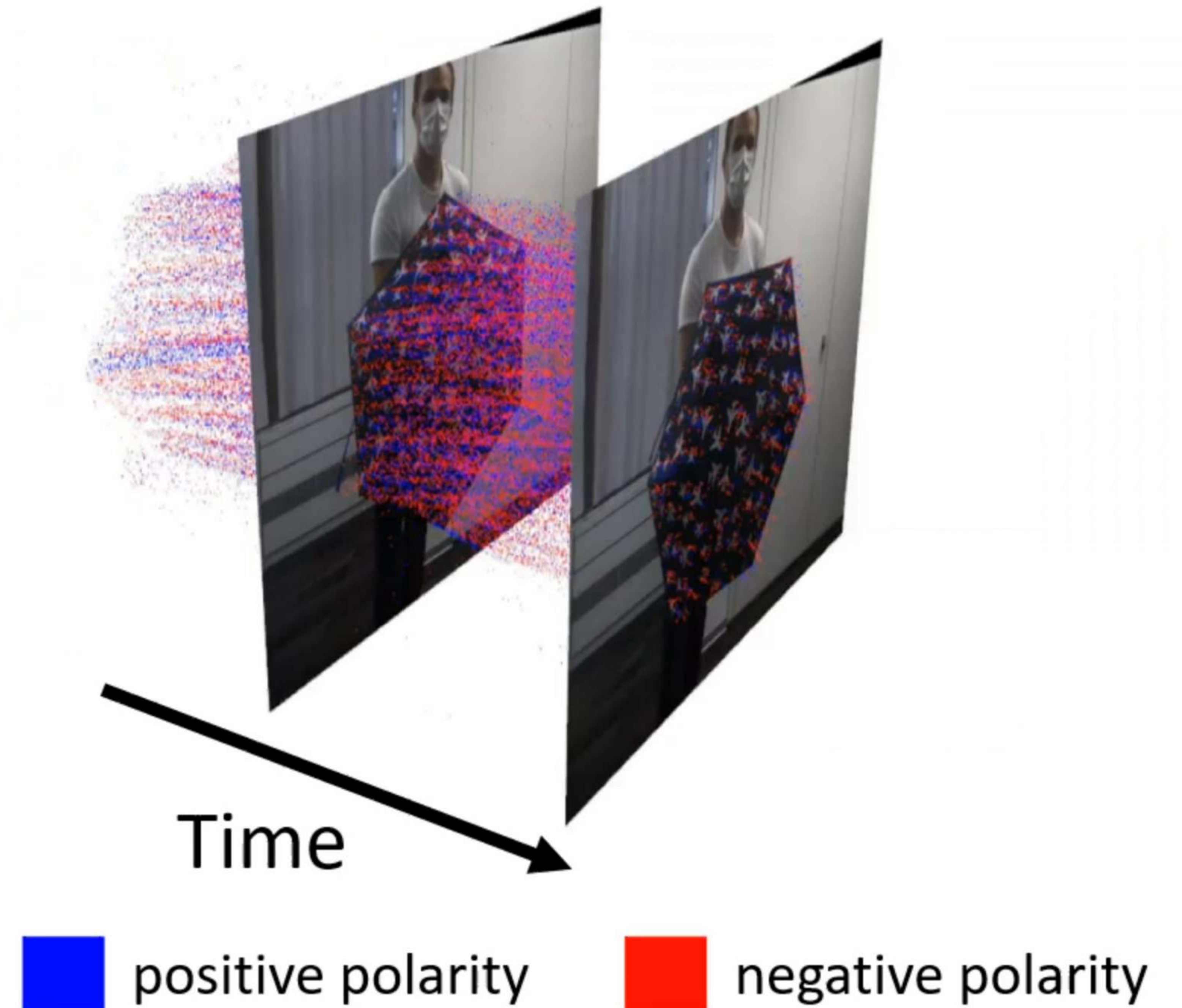
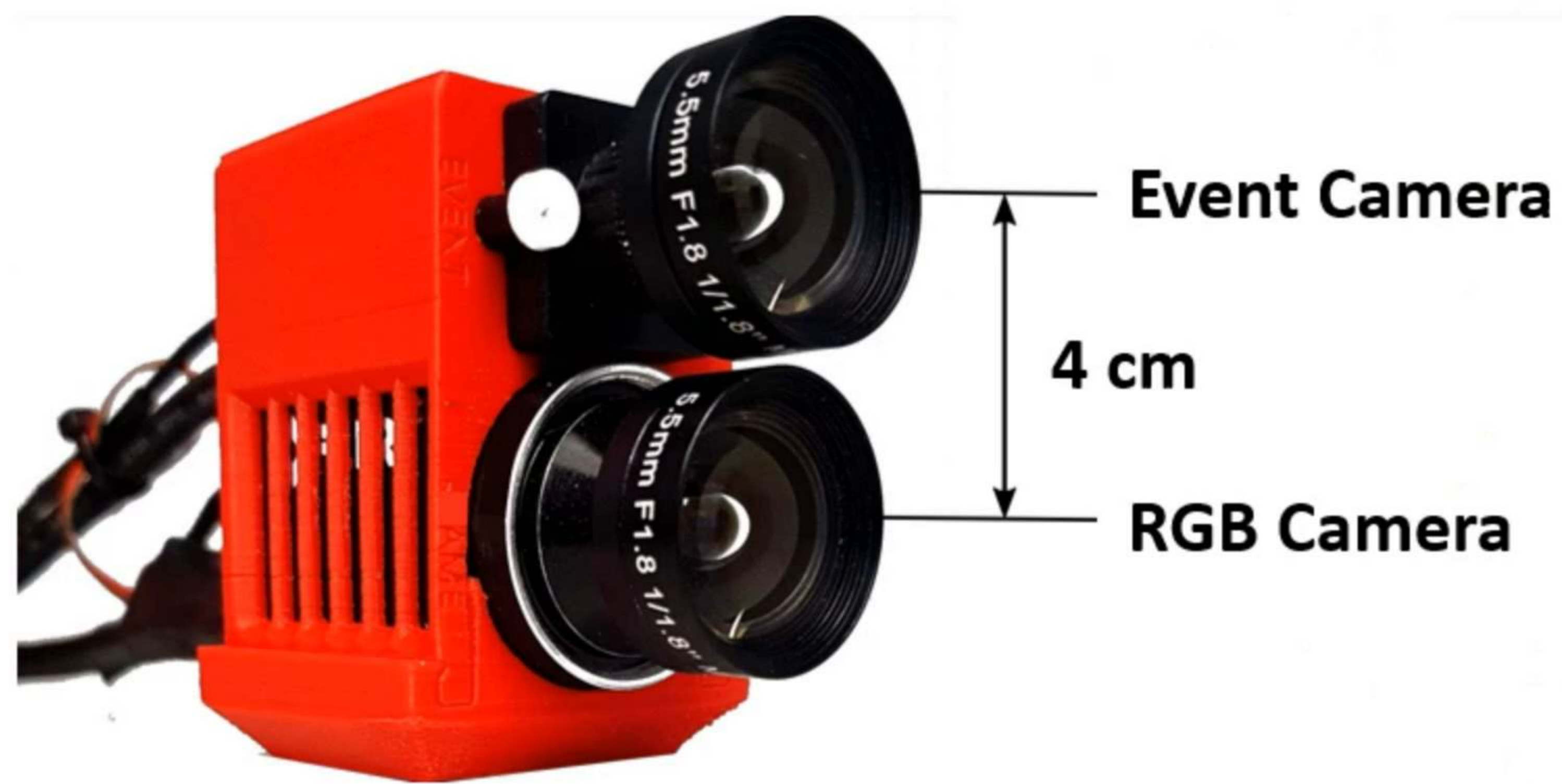
low framerate video input



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.



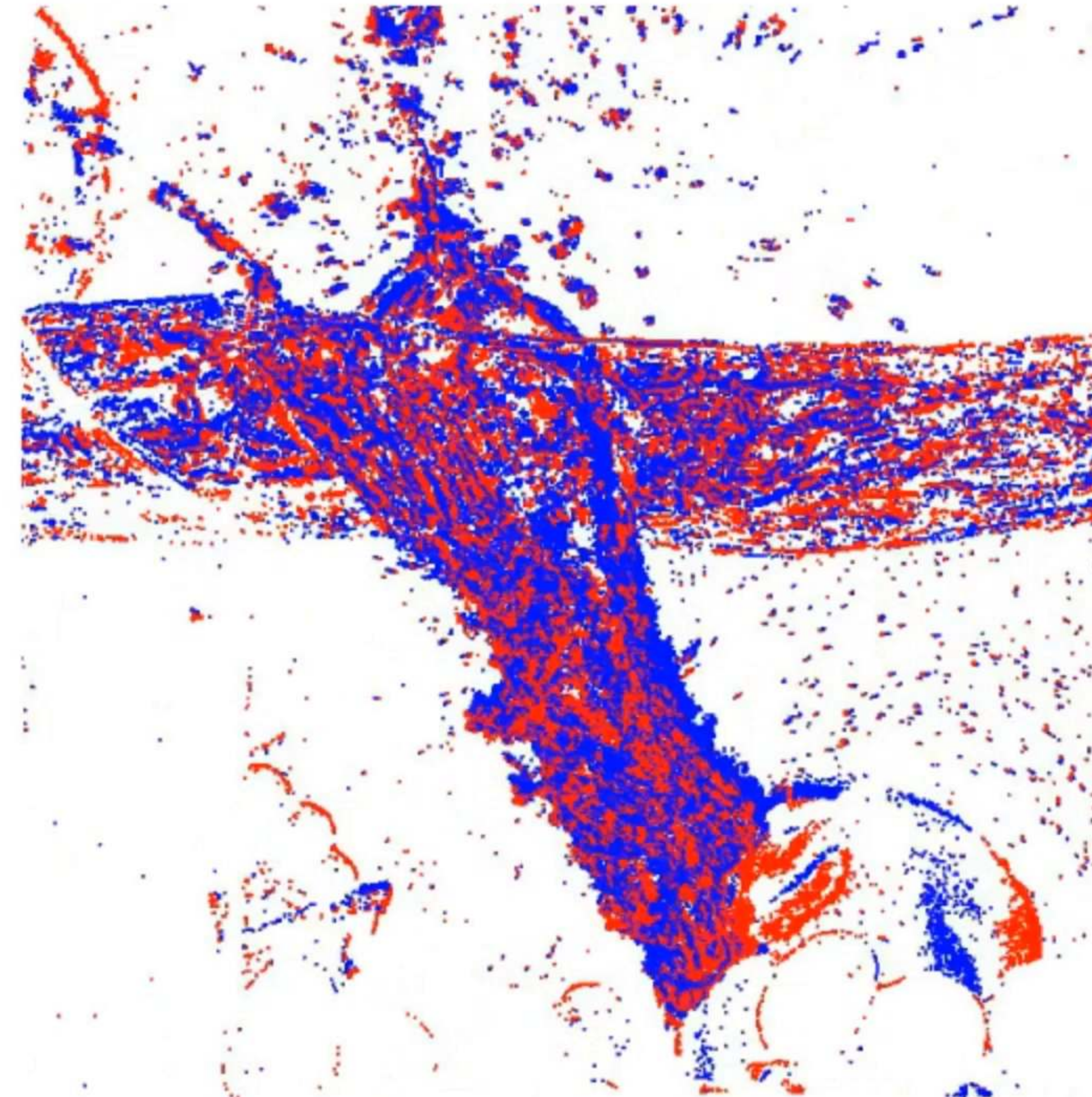
Time Lens: Event-based Video Frame Interpolation

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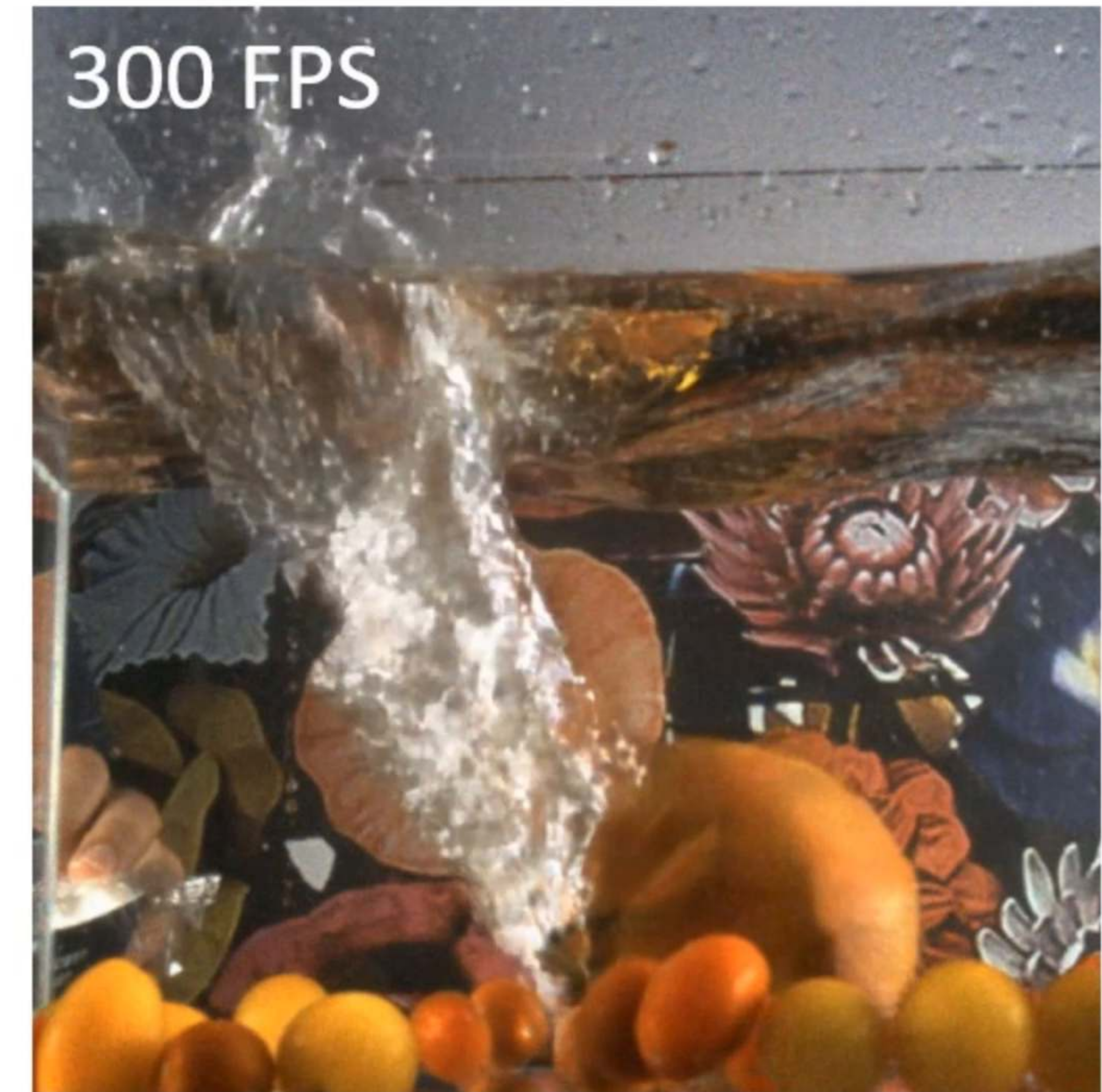
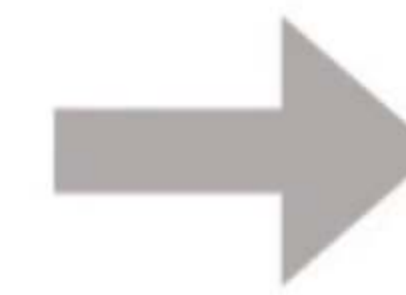


low framerate
video input

+



events

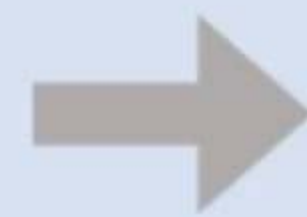


**high framerate
video (ours)**

Time Lens: Event-based Video Frame Interpolation

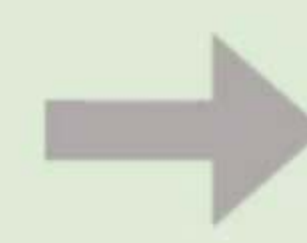
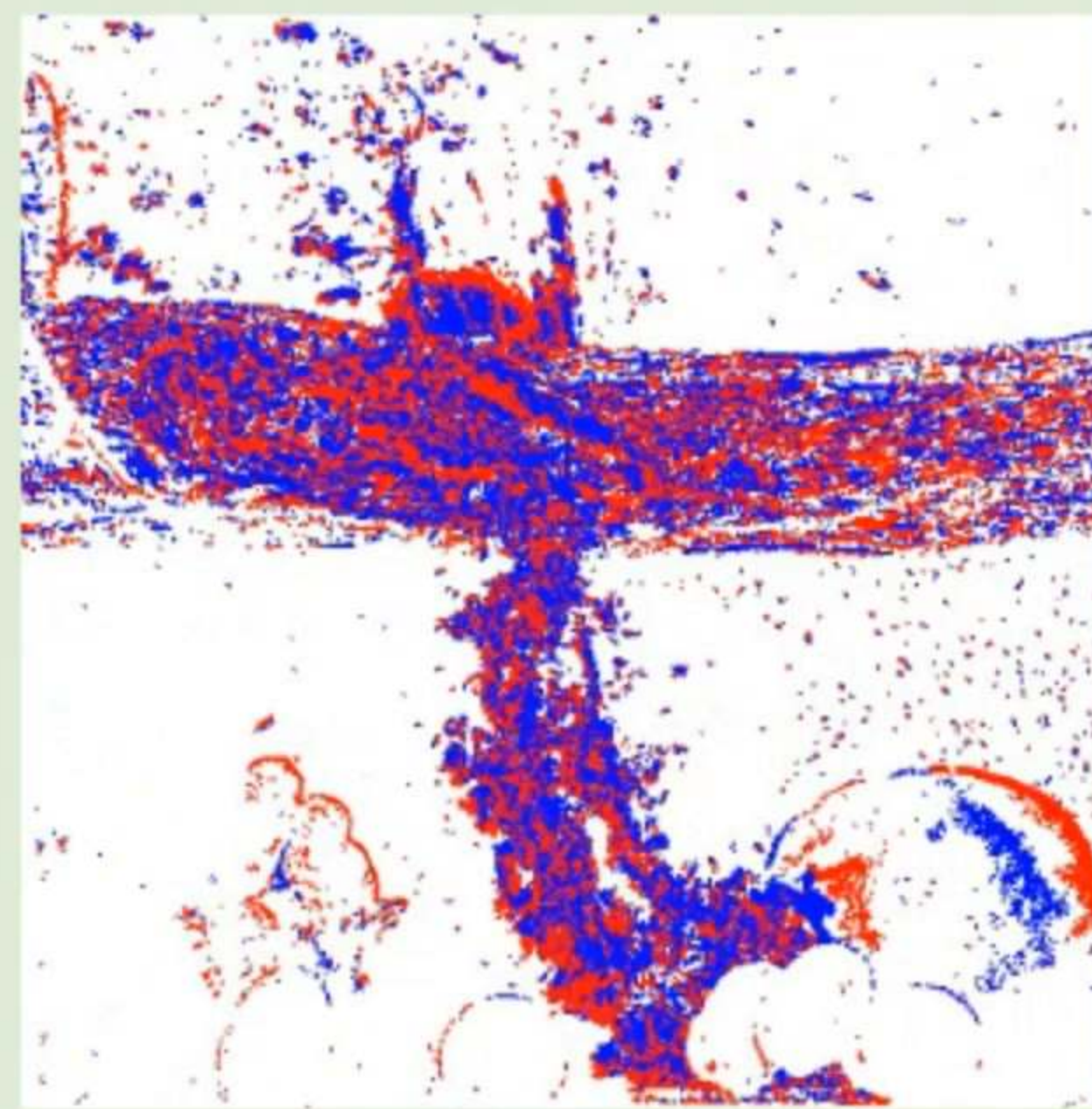
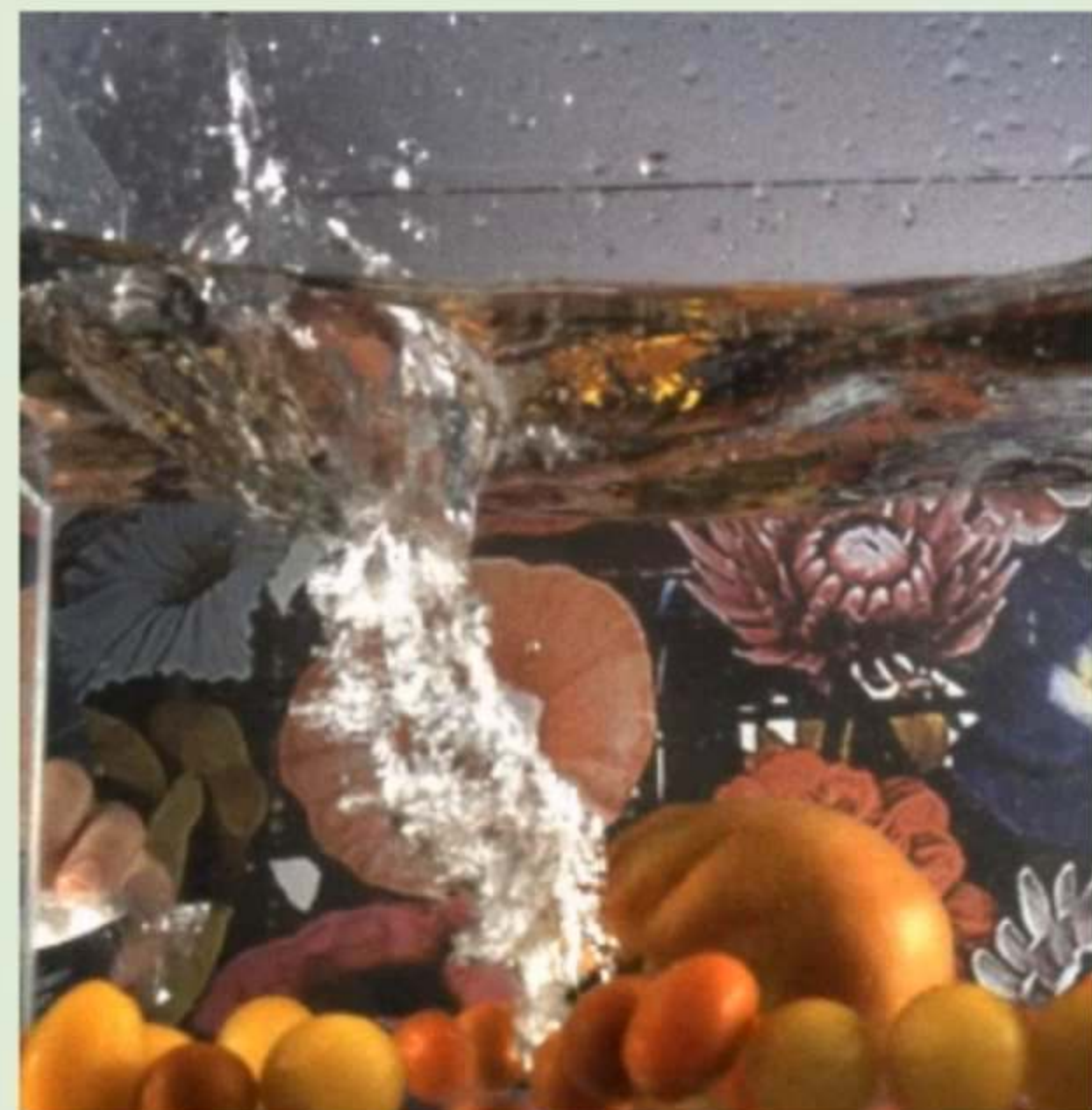


low framerate video input



high framerate video

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



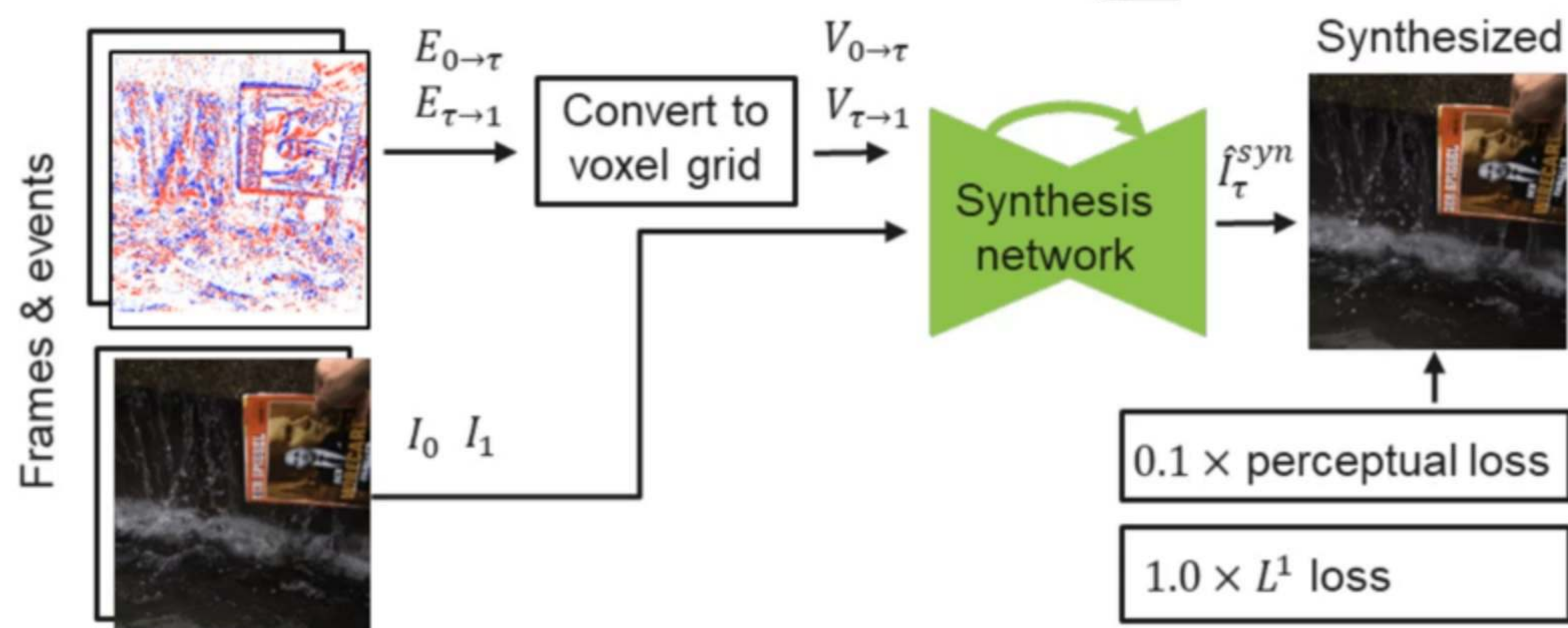
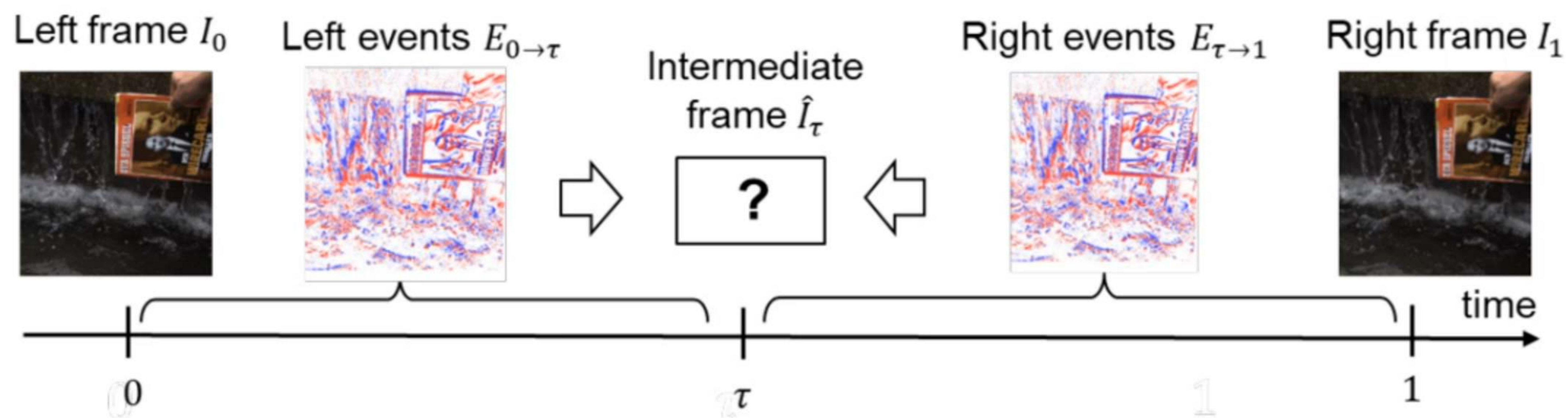
low framerate video input

events

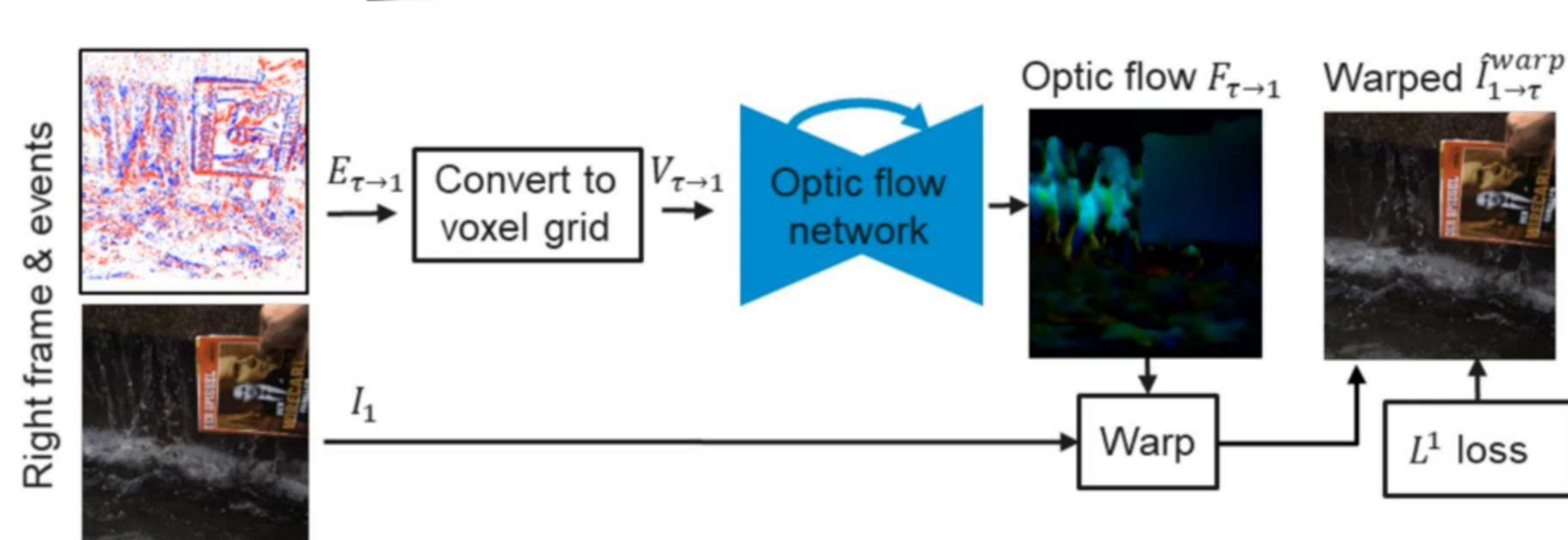
high framerate video

**Time Lens
(this work)**

Methodology



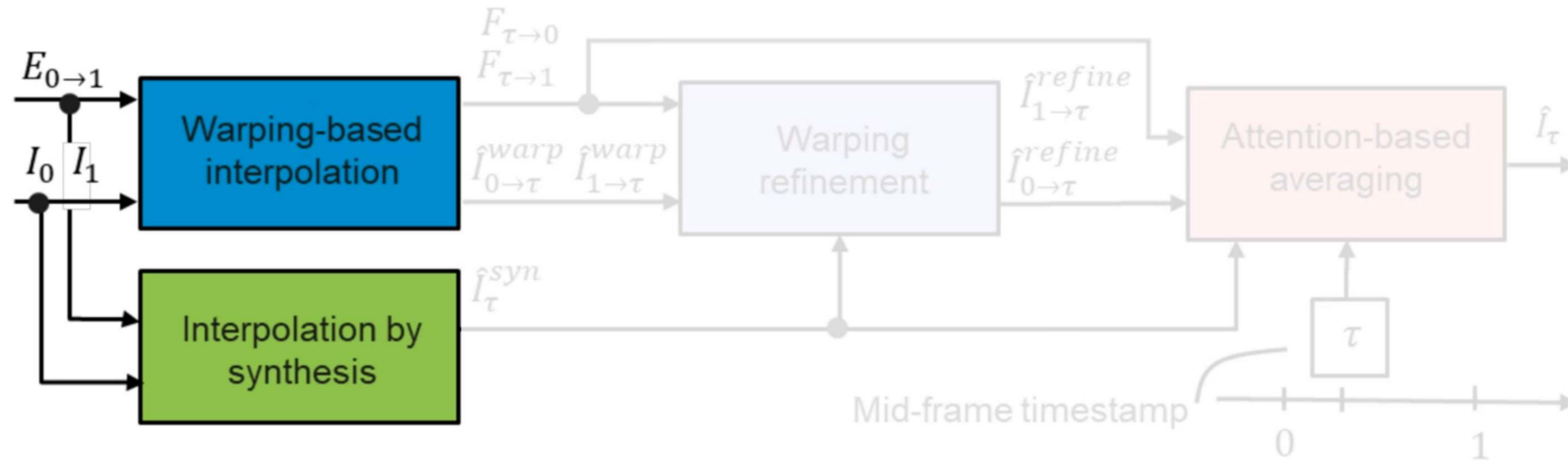
Synthesis-based Module



Warping-based Module

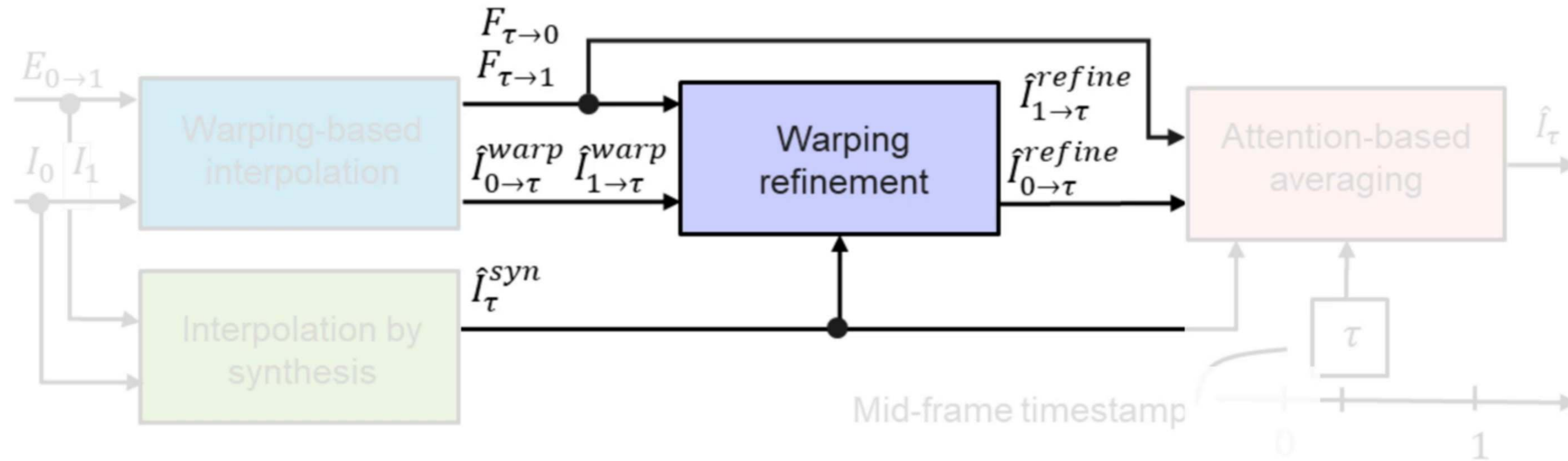
Methodology - Overview

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



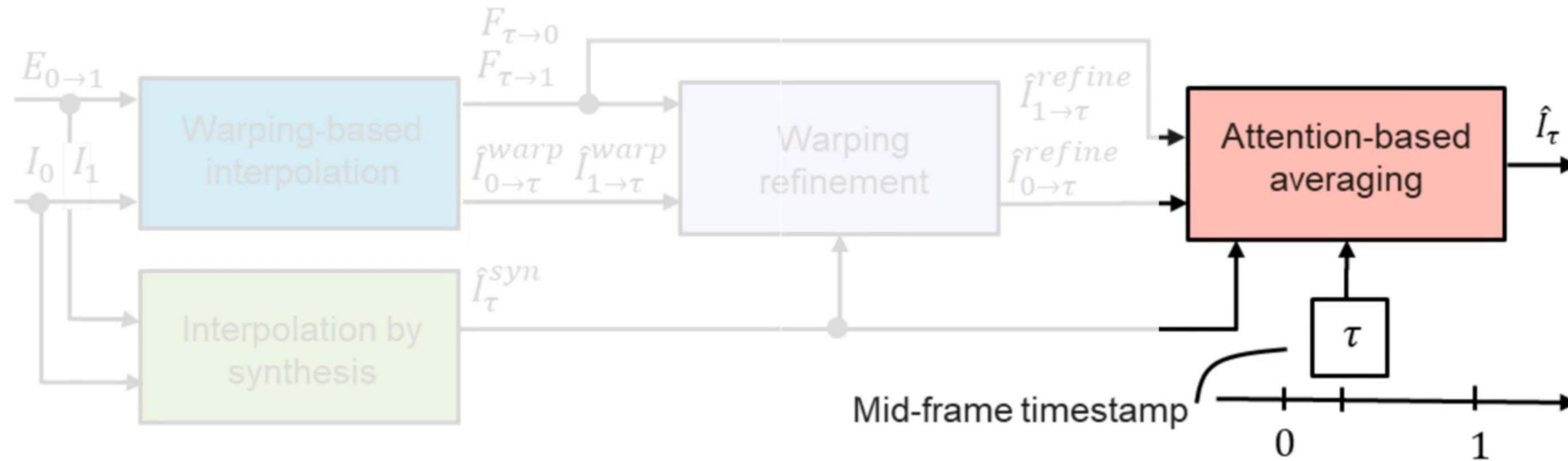
Methodology - Overview

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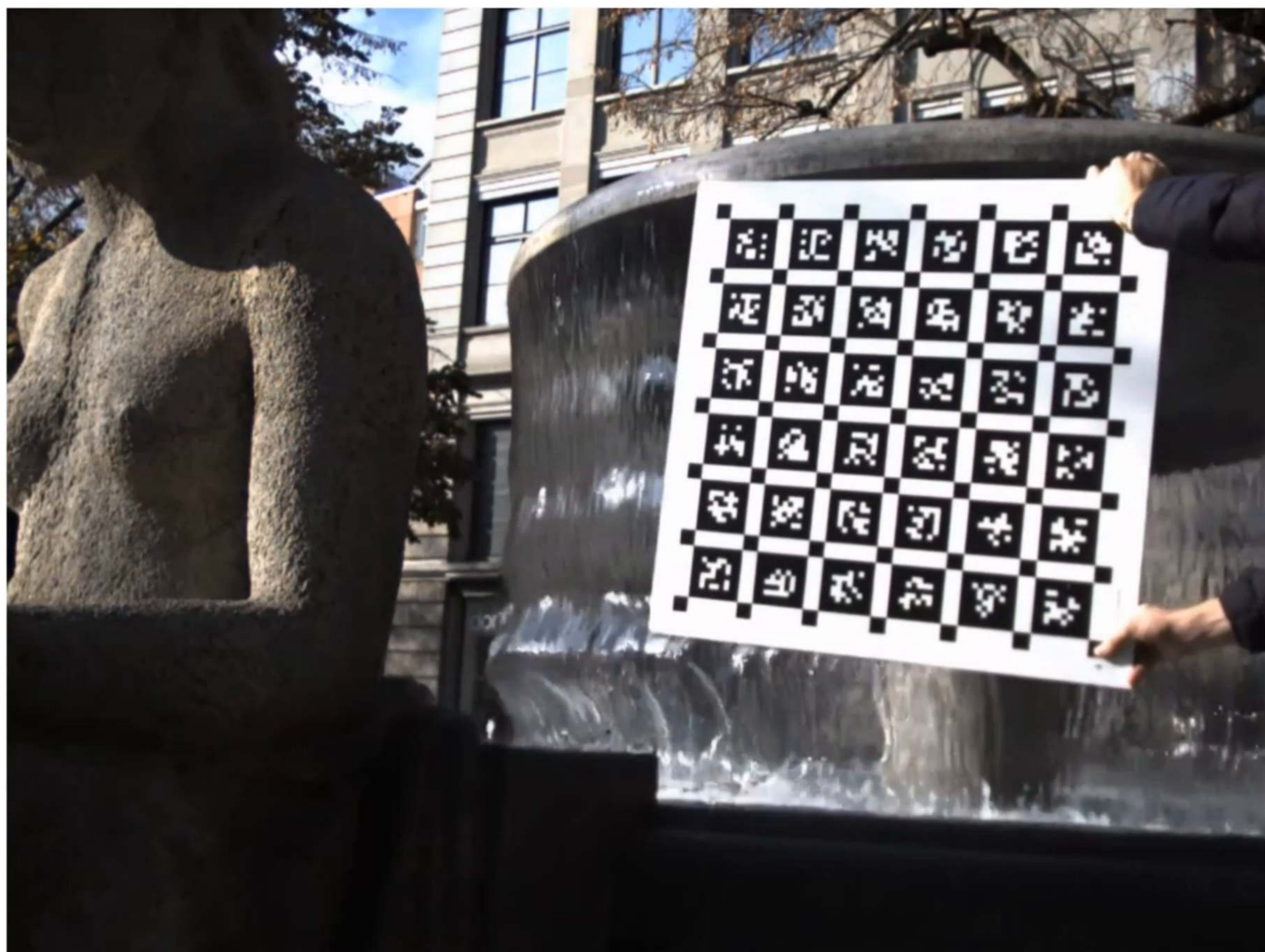


Methodology - Overview

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



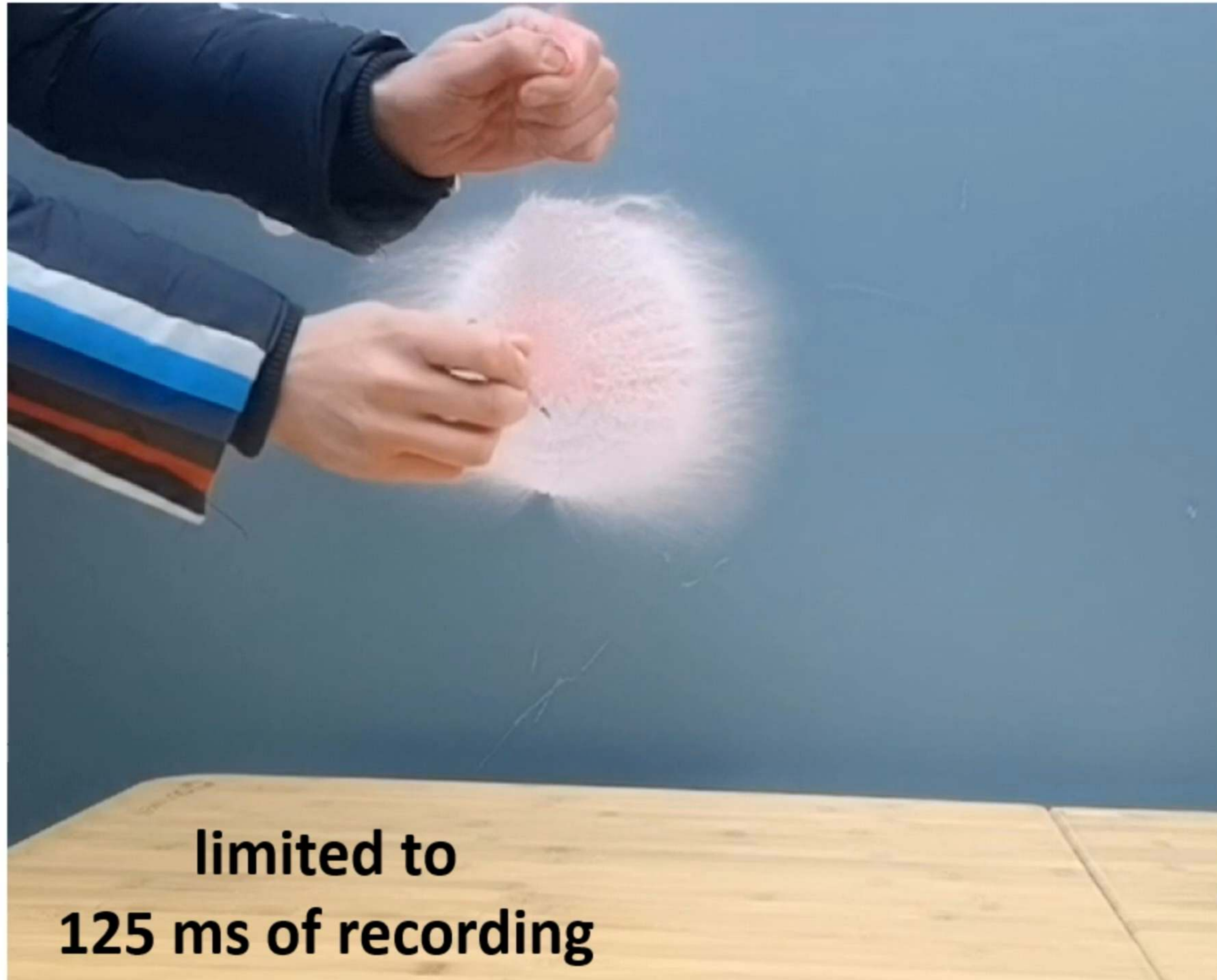
Time Lens (ours)



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

Upsampled from 1920 FPS to 7680 FPS



limited to
125 ms of recording

Huawei P40 Pro

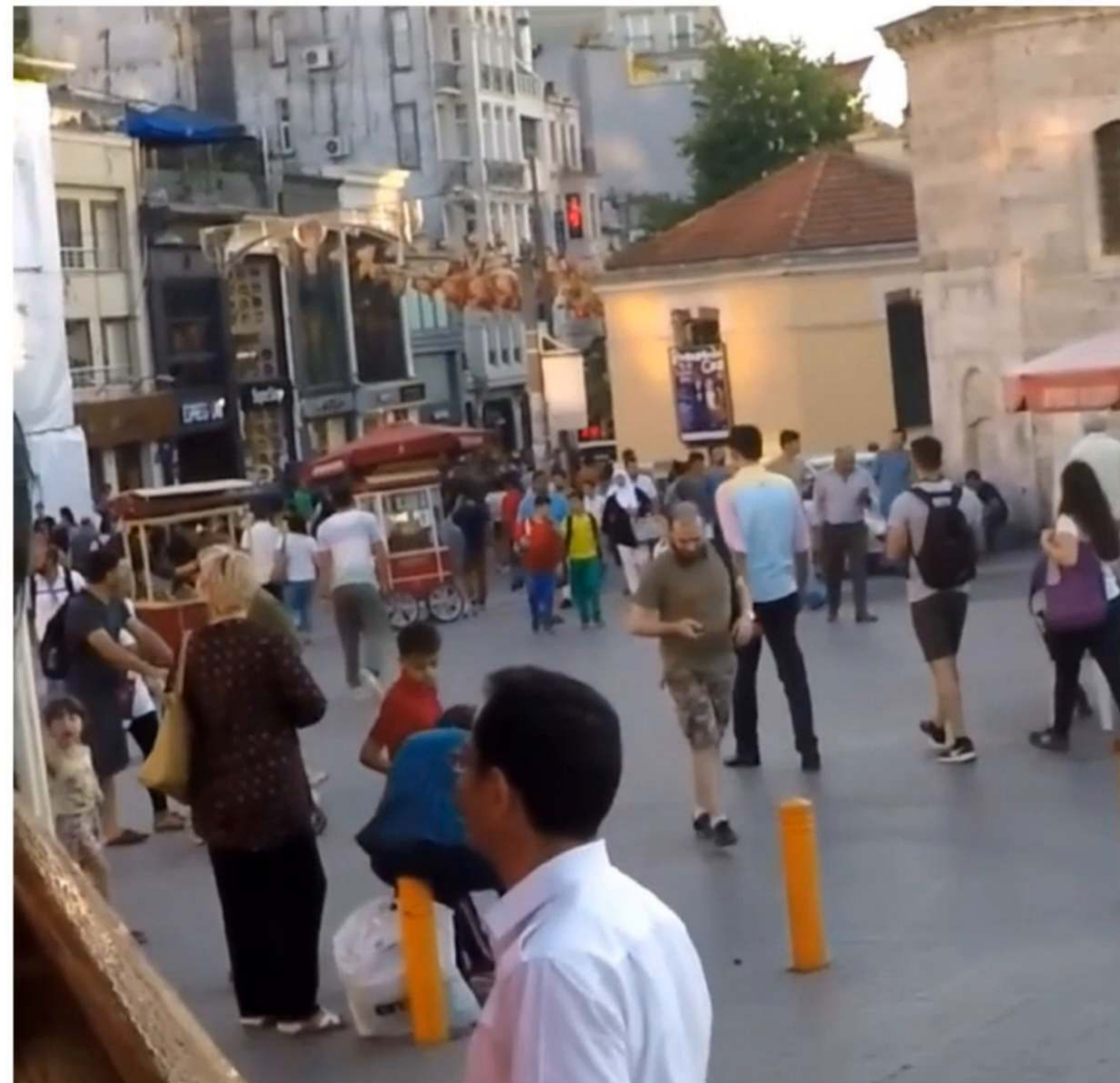
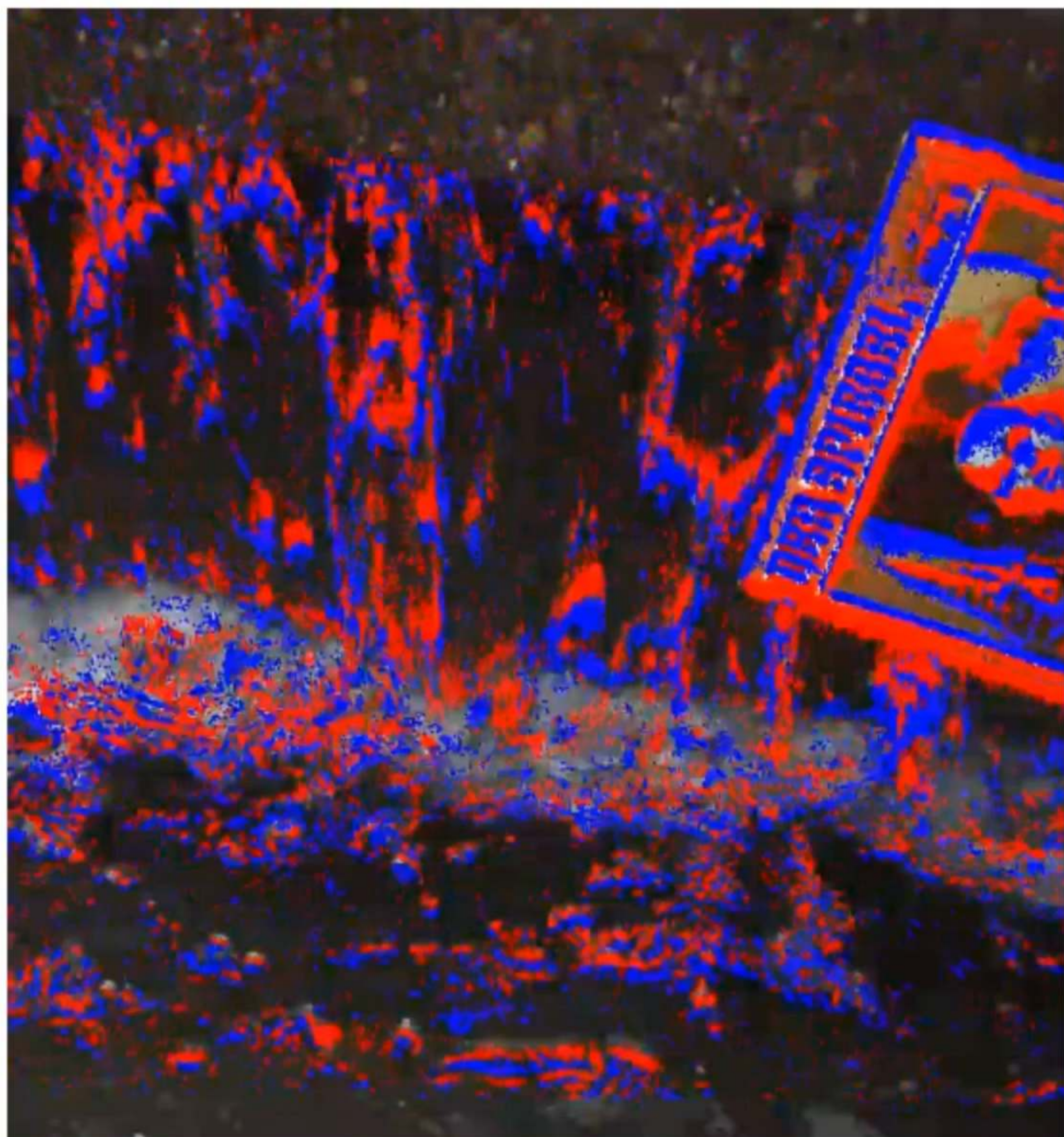
Upsampled from **160 FPS to 7680 FPS**



Time Lens (ours)

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.



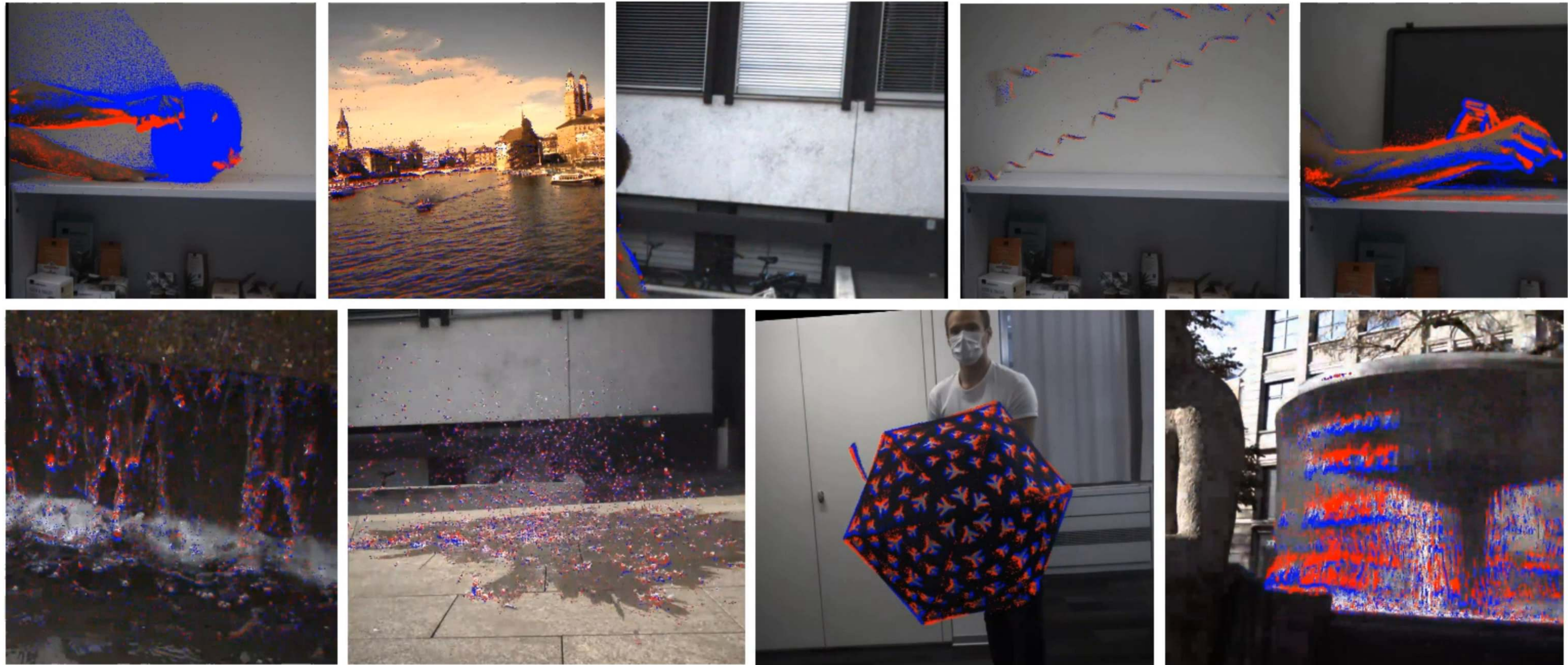
**High Speed Event and
RGB Dataset (HS-ERGB)**

GoPro [Nah CVPR'17]

HQF Dataset
[Stoffregen ECCV'2020]

High-Speed Event and Color Camera Dataset

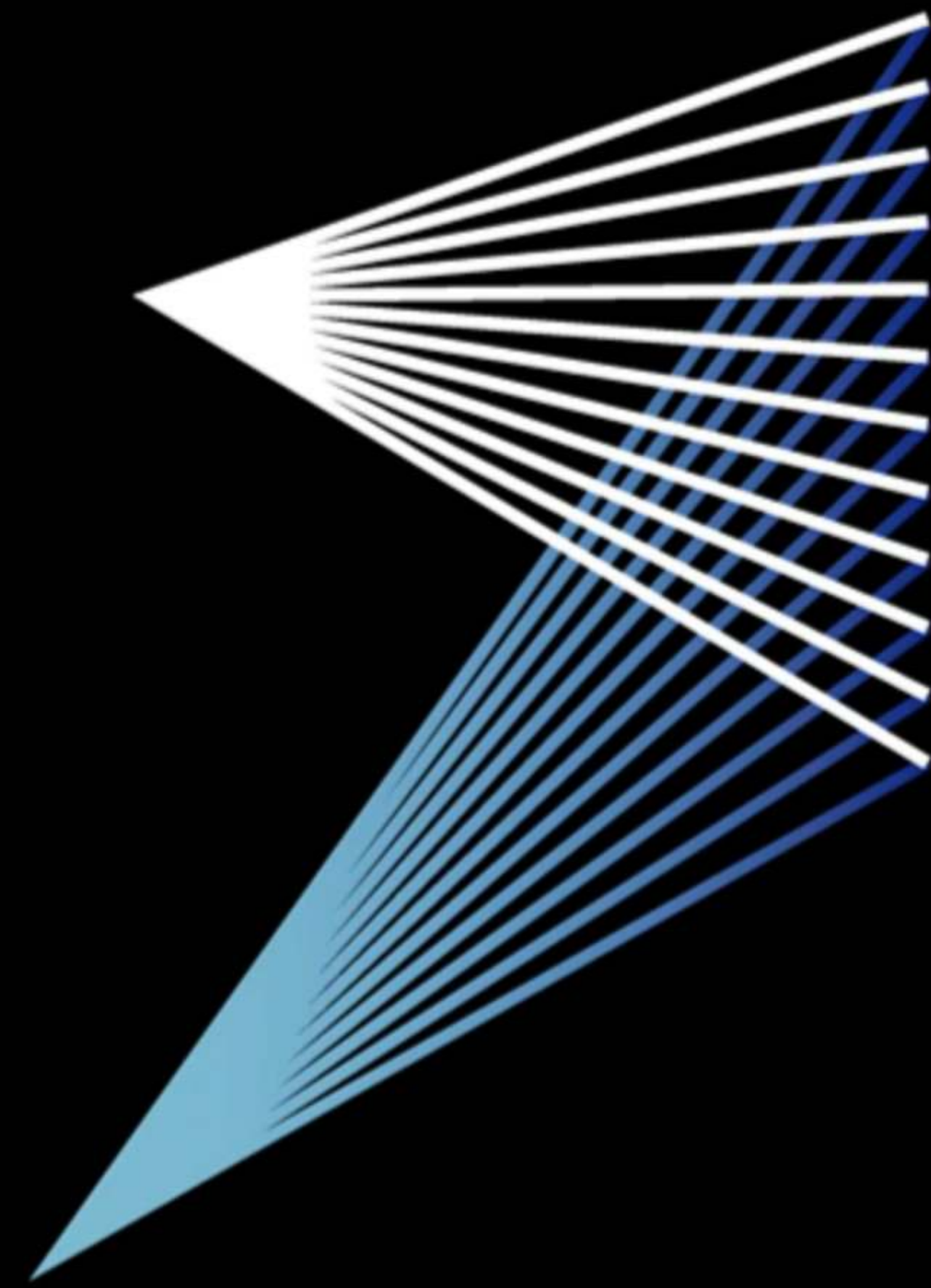
We release the first high resolution and high speed (160 FPS) event and frame dataset to push the limits of existing frame interpolation approaches.



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.

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