

Differences in BS's Spectral Splitting Ratios

Introduction

SilkyEvCam BothView is available in two 2 models, differentiated by the spectral splitting ratios of the beam splitter (BS).

Here, we mounted the same lens on SilkyEvCam HD, BothView 90:10, and BothView 50:50, and compared the event rates and images. We also compared images under low-light conditions using an ND filter.

- BothView T90:R10 model, Spectral splitting ratios: Frame side 90%, Event side 10%
- BothView T50:R50 model, Spectral splitting ratios: Frame side 50%, Event side 50%

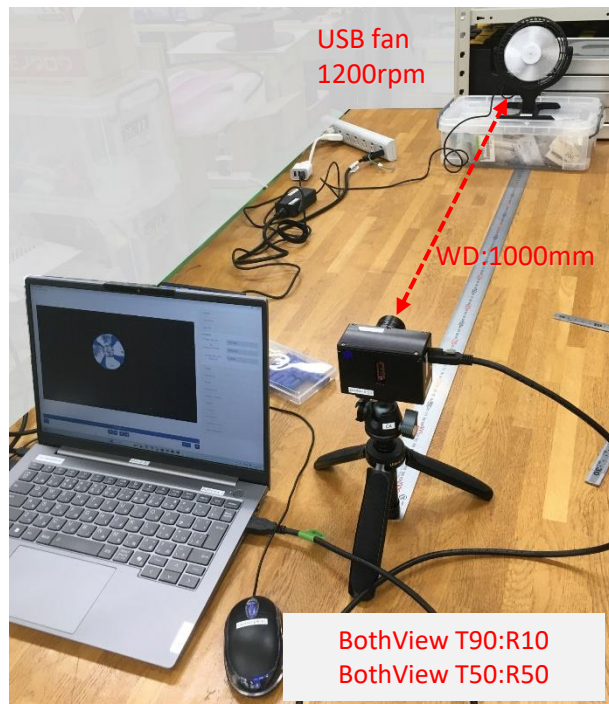
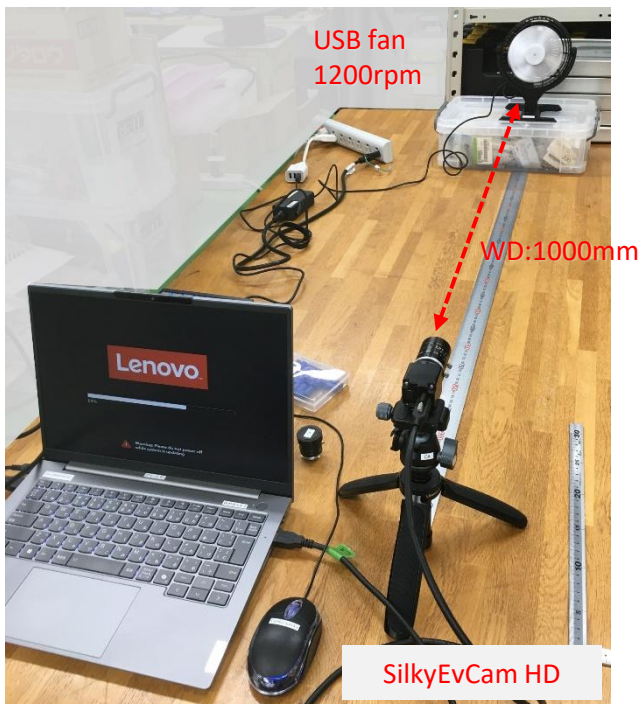
Test Environment and methods

Test Environment

- Mounted the same lens model on SilkyEvCam HD、BothView90:10 and BothView50:50
- Lighting consists of ceiling lights only (typical office setup)
- Distance between the USB fan and the front of the lens (WD) : 1000mm
- Captured using ND filter 1.20D (6% transmission) and without it

Test methods

1. Run the USB fan at low speed (1200rpm)
2. Measure the brightness near the subject (⇒approx. 760 lx)
3. Keep the lens aperture constant (fully open) without changing it
4. Start metavision_studio with SilkyEvCam HD, and record Event rate with default setting
5. Start metavision_studio with BothView(90:10/50:50) and record Event rate
6. In BothView(90:10/50:50), adjust the bias setting and record Event rate
7. To Similate low-light conditions, attached a ND filter (1.20D) to each camera, and record in the same manner



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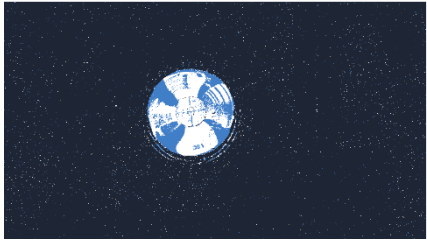
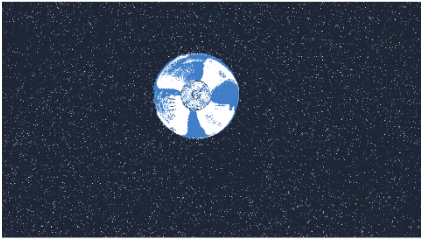
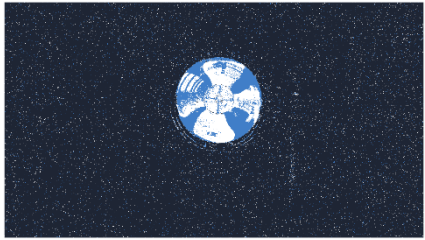
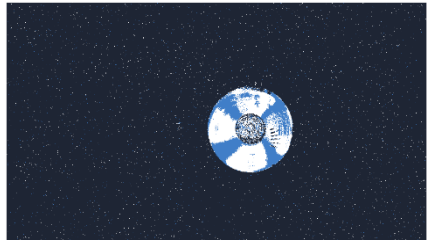
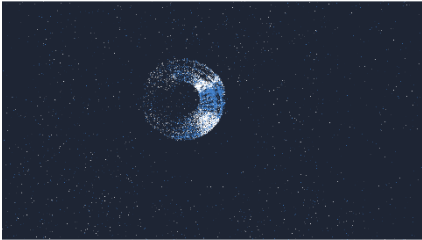
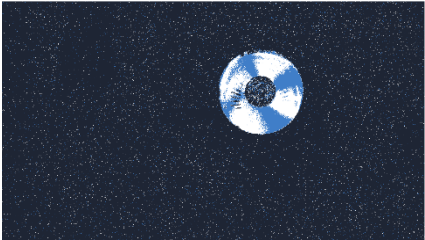


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Comparison of Event images and Event rate

In a bright environment, the effect of spectral splitting by the BS on the event rate is limited (upper row)
On the other hand, in a low-light environment, the event rate decreases due to the BS's spectral splitting (lower row).

metavision_studio (bias setting : default)

	SilkyEvCam HD	BothView 90:10	BothView 50:50
Bright envi. (w/o ND filter)	 Event rate: 41.1 Mev/s	 Event rate: 36.4 Mev/s	 Event rate: 41.1 Mev/s
Low- light envi. (w/ ND filter) (1.20D : transmiss ion 6%)	 Event rate: 28.5 Mev/s	 Event rate: 2.1 Mev/s	 Event rate: 17.8 Mev/s



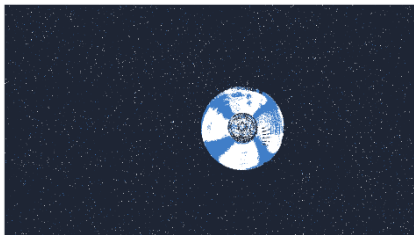
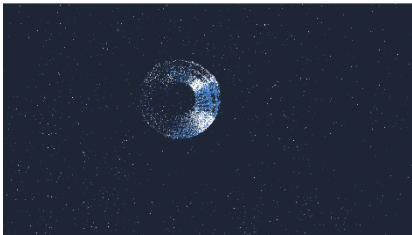
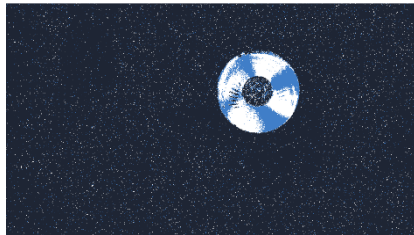
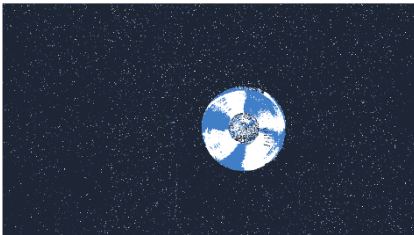
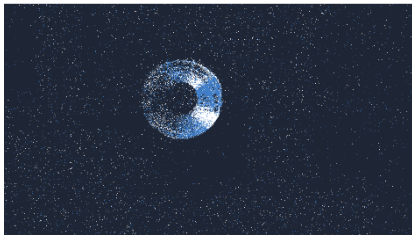
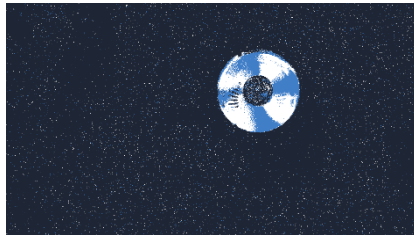
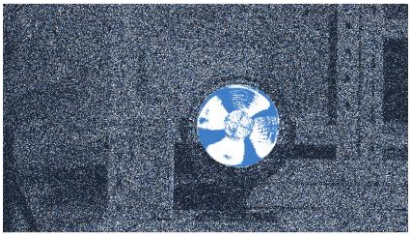
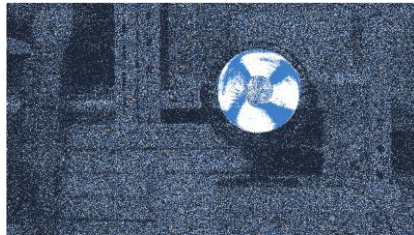
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Verification of improvements by changing the bias settings (Low-light environment)

We found that in low-light environment, event rate decreases due to the BS' spectral splitting. Therefore, we adjusted the bias settings of event sensor to verify whether improvements could be observed in the event images and event rate.

- In low-light environment, number of event decreases due to BS's spectral splitting (upper row)
- Changing the bias settings increases event rate, but it also leads to increases noise (middle row)
- Furthermore, making larger changes to the bias setting causes the noise to increase more significantly (lower row)

Comparison of changes of metavision_studio's bias settings in low-light environment

	SilkyEvCam HD	BothView 90:10	BothView 50:50
Bias default	 Event rate: 28.5 Mev/s	 Event rate: 2.1 Mev/s	 Event rate: 17.8 Mev/s
Bias adjustment Diff_off -10 Diff_on -10	 Event rate: 33.2 Mev/s	 Event rate: 9.0 Mev/s	 Event rate: 22.6 Mev/s
Bias adjustment Diff_off -30 Diff_on -30	 Event rate: 56.1 Mev/s	 Event rate: 33.0 Mev/s	 Event rate: 53.5 Mev/s

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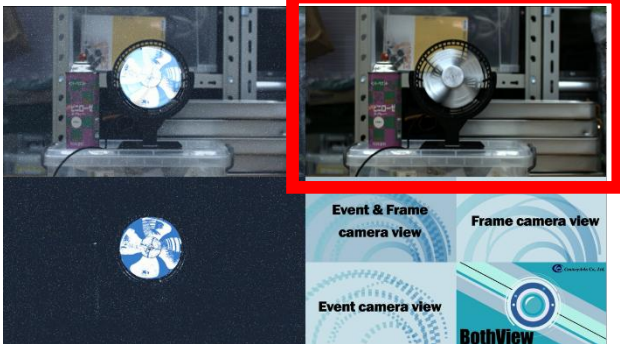
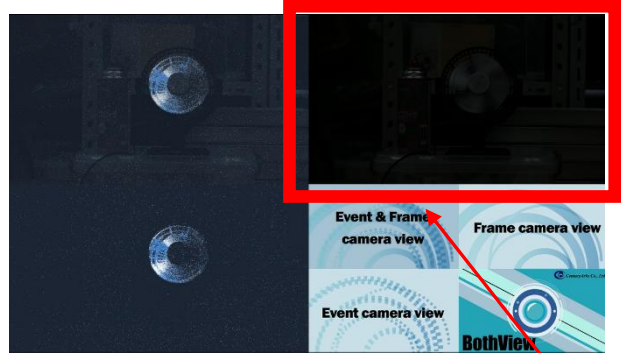
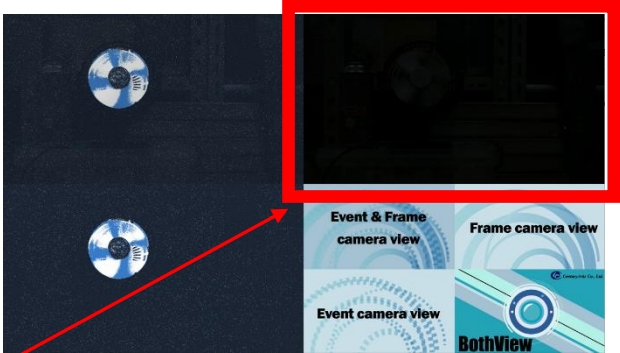
Comparison of images of BothView sample code

We examined how the frame images change depending on the spectral ratio of the beam splitter.

Here, please refer to the frame images.

Since the frame-side exposure settings are the same as those for the 90:10 condition, the image appears slightly darker

Captured with using parameter settings adjusted for the "90:10 in the brightness environment"

	BothView 90:10	BothView 50:50
Bright envi. (w/o ND filter)		
Low-light envi. (w/ ND filter) (1.20D : 6% transmission)		

With the settings optimized for the bright environment, the frame image shows almost nothing. However, by adjusting the frame camera parameters, the image can be improved to the level shown below. Nevertheless, since the adjustment is made by changing the exposure time or gain, side effects such as a reduced frame rate and increased noise may occur.



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Summary

We summarized the differences between the two models of BothView. We hope this will help you in selecting the appropriate model.

	BothView 90:10	BothView 50:50
pros	By leveraging the wide dynamic range, a key feature of event cameras, we can capture luminance changes event at 10% of the light. This allows us to allocate the remaining 90% of the light to frame camera, resulting in an increased frame rate.	We can capture more events along with luminance changes by allocating more light compared to the 90:10.
cons	With only 10% of the light allocated, the event camera may fail to capture luminance changes (i.e., events) compared to a standard event camera using 100% of the light. This effect is particularly pronounced under low-light environment.	Since only 50% of the light is allocated to the frame camera, it is necessary to increase the exposure time or apply digital gain. Increasing digital gain leads to higher noise.
uses	• Users who treat frame camera data as the main data and event camera data as supplementary (obtaining high-quality frame images while also using event data to complement them) • Users who want to increase frame rate of frame cameras • For subjects with sufficient light e.g., Time lens (frame interpolation), trajectories, tracking, etc.	• Users who treat event camera data as the main data and frame camera data as supplementary (using the generated event data, event if the frame images are somewhat rough) • Users who want to use BothView in low-light environment e.g., Monitoring phenomena at night, underwater, or inside equipment w/o lighting, also Monitoring fast phenomena in the night sky or outdoor where installing support lightning is difficult.

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Appendix

The person was captured using BothView (90:10/50:50) in a low-light condition below 1 lux. Under conditions of 1 lux or less, the frame camera captures nothing, but the event camera detects people.

Click the image below to watch the YouTube video. (Also note the difference in the frame image just before the lights go out.)

