

# Event-based Robot Vision

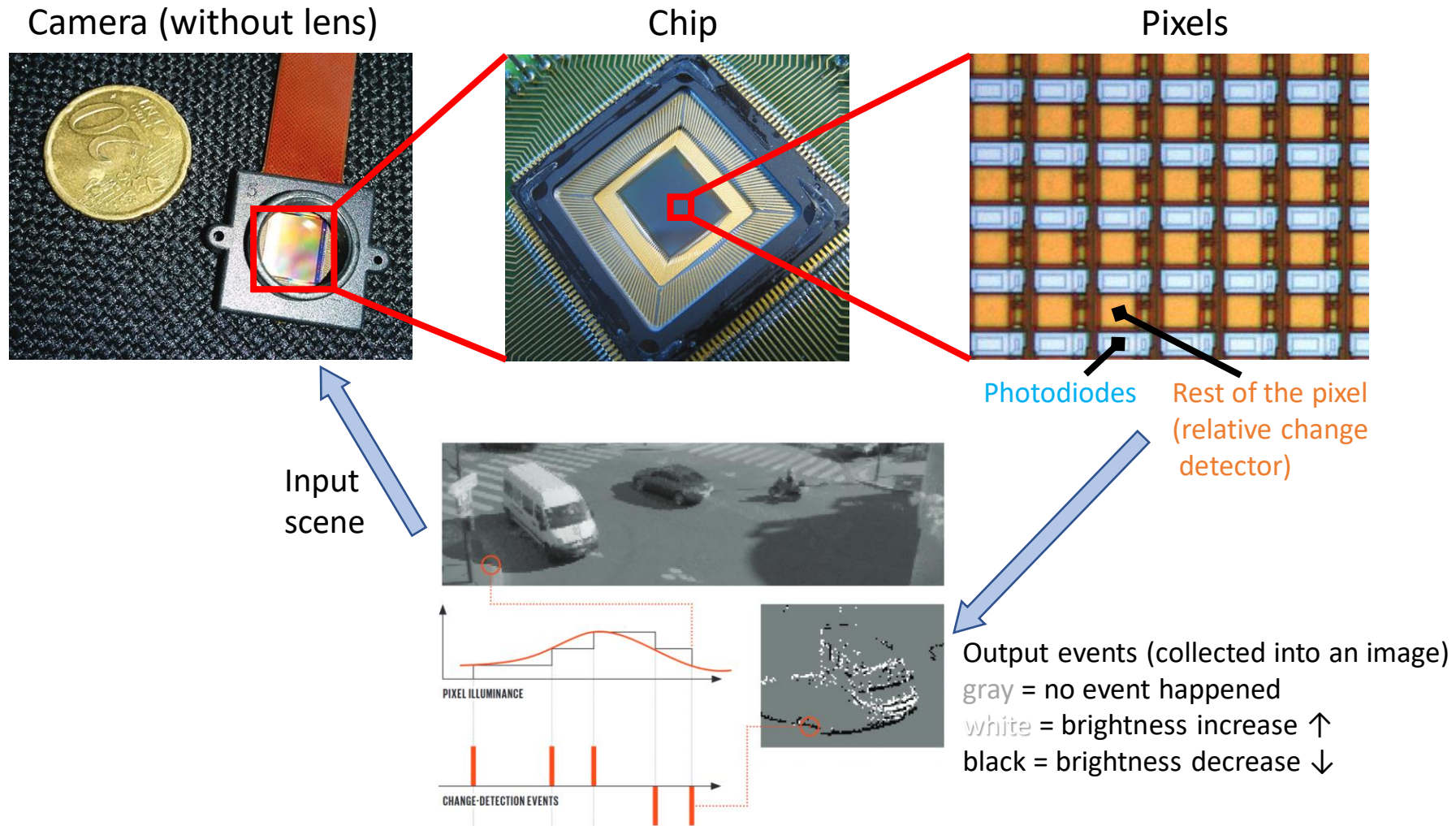
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# Giving Machines Humanlike eyes

Posch et al. IEEE Spectrum is a good introductory reading to the topic



# Sampling based on the scene dynamics

Sky, grass and trees  
change slowly.  
(Oversampled,  
redundant in video)

The golfer, club and  
ball move fast.  
(Undersampled,  
missing information  
in video)

**Frame-based cameras**  
sample the scene based  
on an external clock  
(e.g., 25 Hz)

**Event-based cameras**  
sample the scene based  
on how intensity evolves  
at each pixel



Frame-based sampling  
with individual frames  
superimposed.



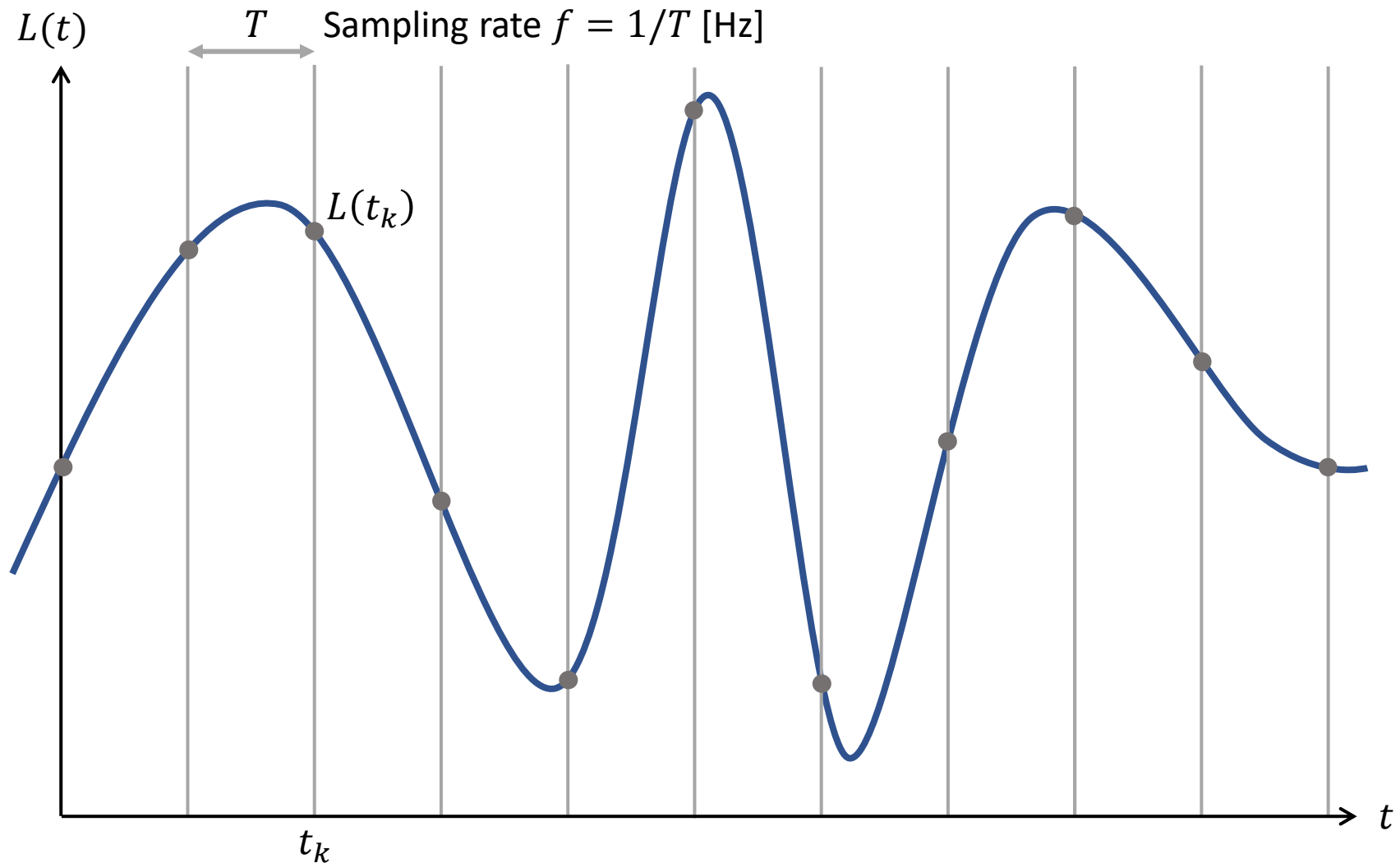
# Real data

Slow motion: 0.1x (play back 10 times slower)



# Traditional Sampling: equispaced in time

A sample is obtained at  $t_k$  multiple of a sampling interval  $T$ :  $L(t_k)$ , with  $t_k = kT$



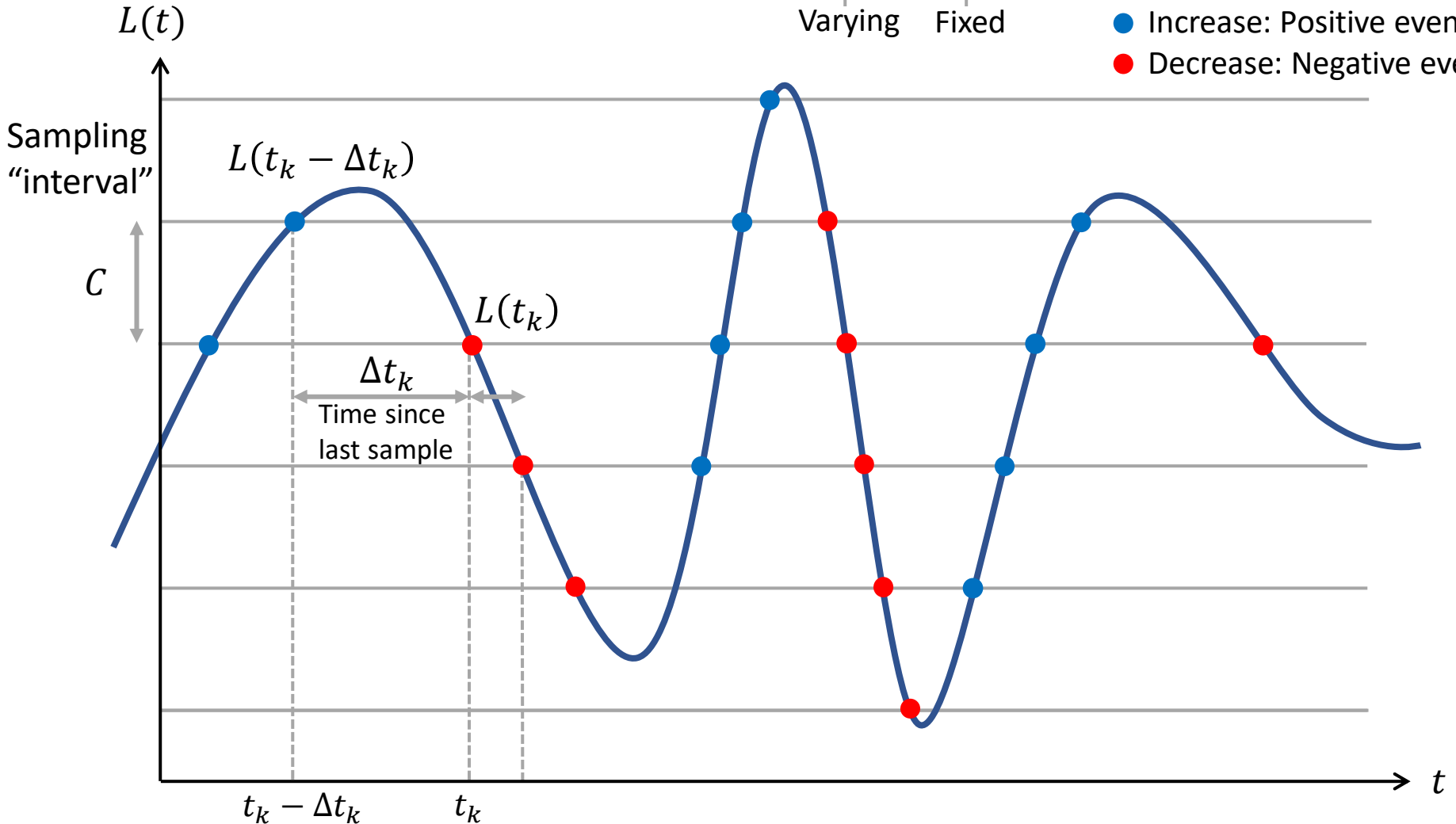
# Cross-Level Sampling: equispaced in range

A sample (event) is obtained when the signal *change* exceeds a predefined value  $C$

$$|L(t_k) - L(t_k - \Delta t_k)| > C$$

Varying      Fixed

- Increase: Positive event
- Decrease: Negative event





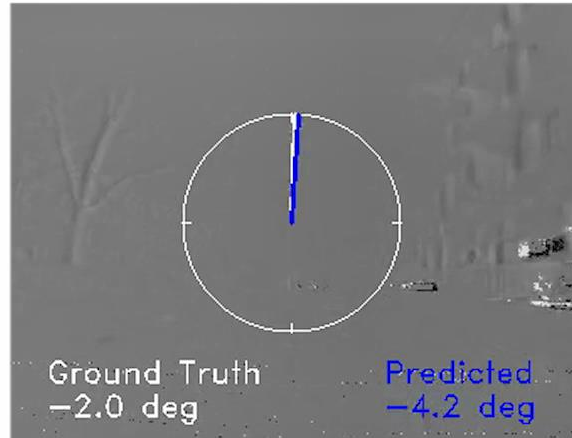
# Asynchronous sampling

- Event frames obtained by accumulating event polarities may look like differences of video frames, but they are not the same:
  - Different dynamic range
  - Different speed (i.e., motion blur)

Grayscale



Grayscale diff.



Events



# References

## Reading:

- Posch et al. [\*Giving Machines Humanlike Eyes\*](#), IEEE Spectrum, 52(12):44-49, 2015. [PDF](#)
- Mueggler et al., [\*The Event-Camera Dataset and Simulator\*](#), Int. J. Robotics Research, 2017. [PDF](#)
  - Pages 1-3 and Fig. 2
- H. Rebecq et al., [\*ESIM: an Open Event Camera Simulator\*](#), CoRL 2018.