Latency Analysis

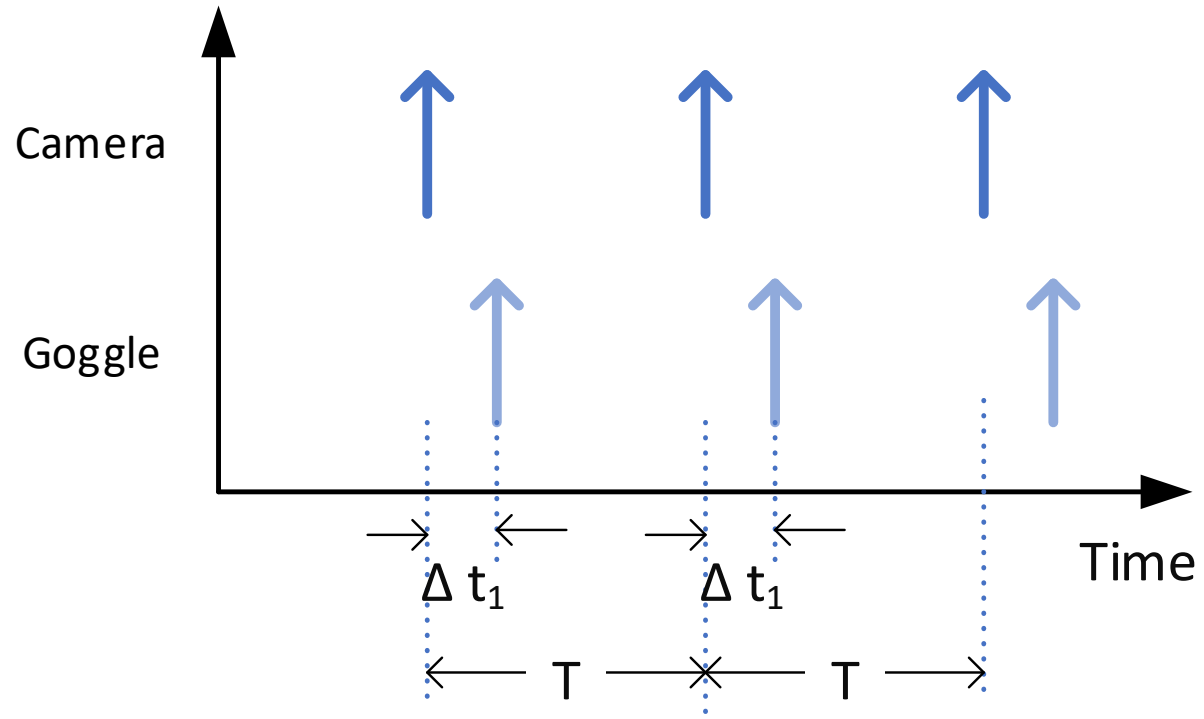
of

Analog (NTSC) vs HDZero 60/ 90

Definition: Pixel latency (Δt_1)

Assume:

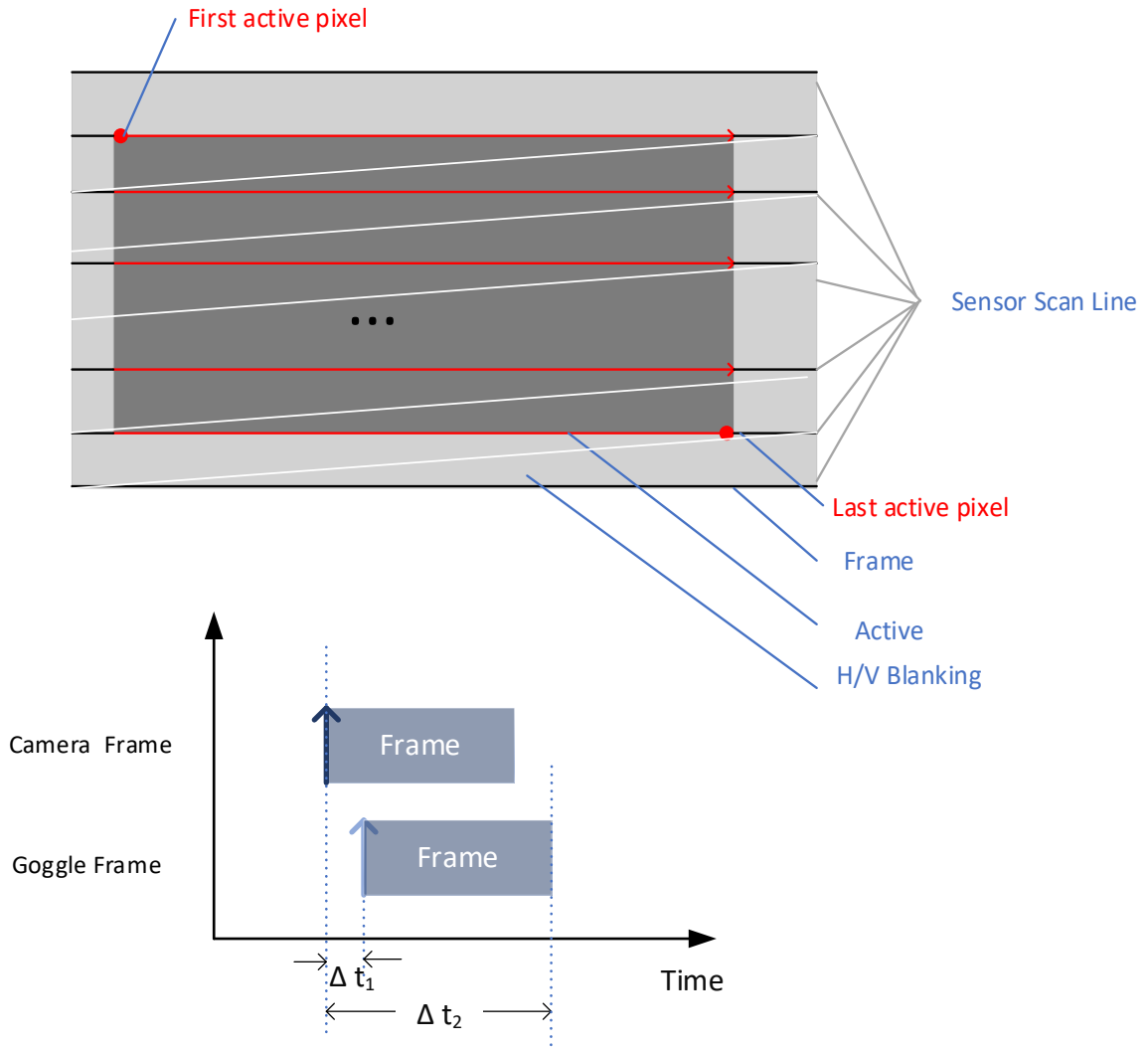
- Camera sensor has only 1 pixel;
- Camera sensor samples every T seconds, frame rate = 1/T;
- Goggle display has only 1 pixel;
- Latency is defines as Δt_1;
- When Δt_1 *is constant, it is a fixed latency system*



Definition: Frame latency (Δt_2)

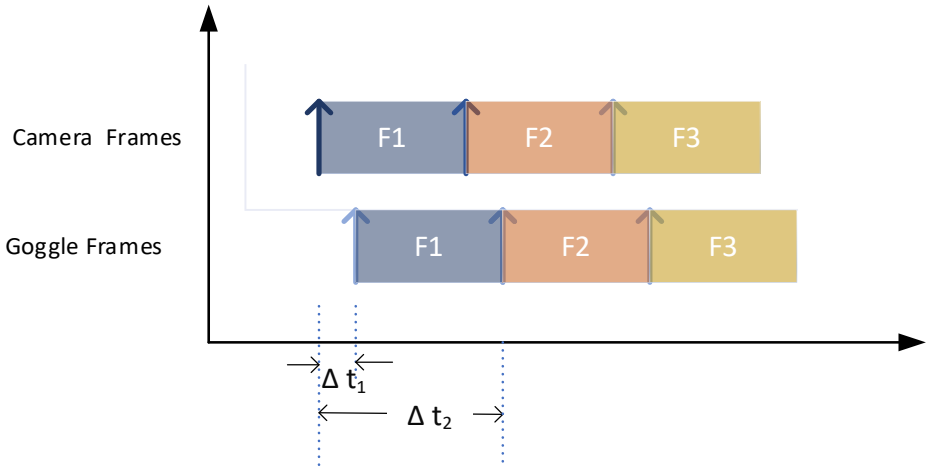
- Low latency camera sensor uses rolling shutter;
- CMOS sensor scans line by line;
- There are horizontal and vertical blanking period;
- When a light is lit in front of CMOS sensor, the first active pixel is lit up, then the first line, 2nd line…
- The time difference between first active pixel and the last active pixel is approximately equal to frame period due to extra H/V blanking period, that is
  - 16.67ms for 60fps system
  - 11.11ms for 90fps system
- In summary, it will take CMOS sensor one frame time to output whole image when a light is lit in front of CMOS sensor

  $\Delta t_2 \approx \Delta t_1 + T$ *(Where T is frame period)*



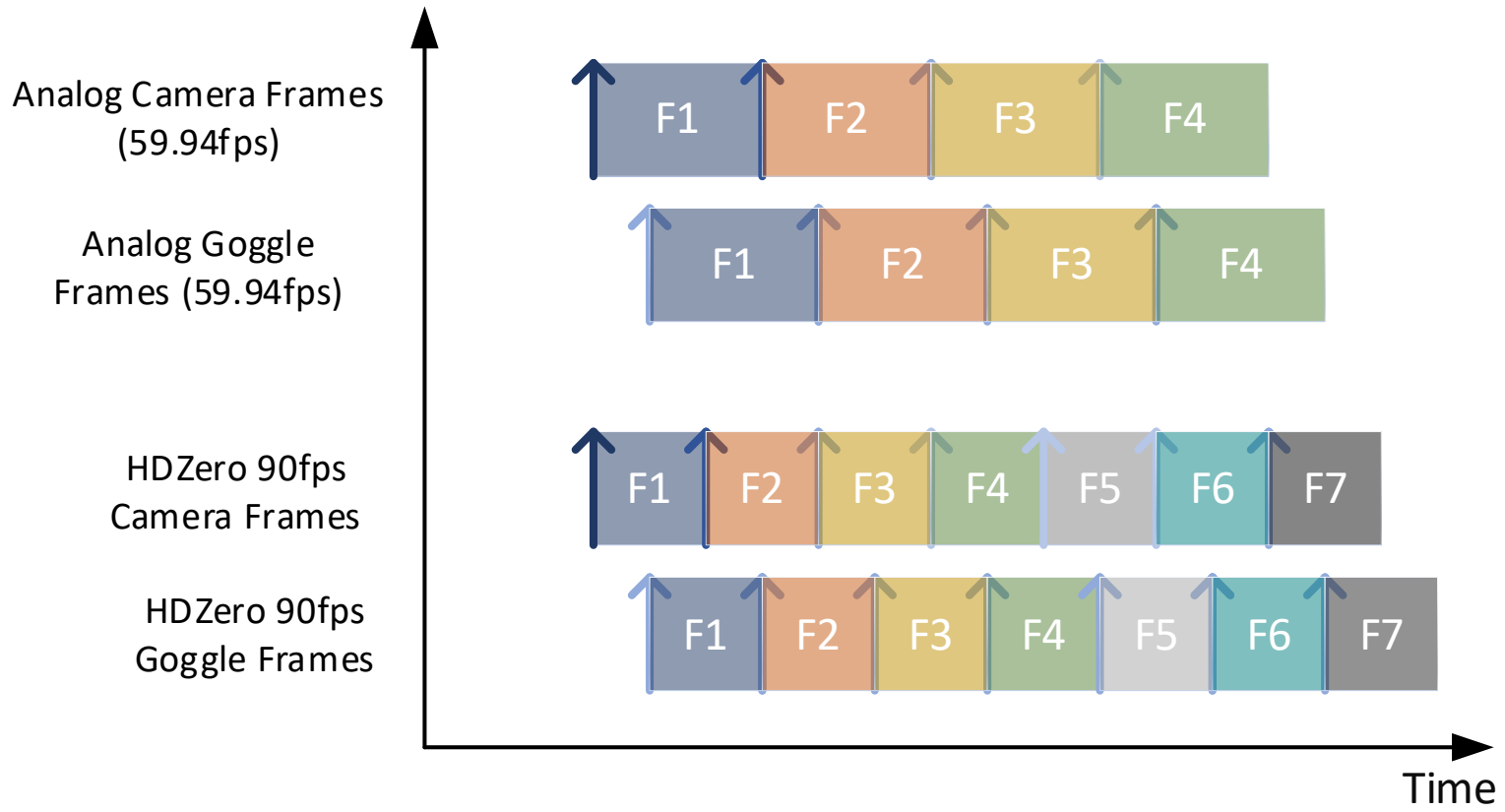
Analog vs HDZero

- For Analog:
  - *Δ t_1 = ~2ms*
  - *Δ t_2 = ~2ms+T = ~18.7ms*
- For HDZero 60fps
  - *Δ t_1 = ~3ms*
  - *Δ t_2 = ~3ms+T = ~19.6ms*
- For HDZero 90fps
  - *Δ t_1 = ~3ms*
  - *Δ t_2 = ~3ms+T = ~14.1ms*
- *Summary*
  - *HDZero has 1ms more pixel latency than analog*
  - *HDZero 60 fps has 1ms more frame latency than analog*
  - *HDZero 90 fps has 5ms less frame latency an than analog*



HDZero 90fps

- 3.37x more info
  - 720*540*90/(720*240*60)=3.37x
- 1.5x smoother
  - 90/60 = 1.5x
- 5ms less latency
  - 19ms for Analog
  - 20ms for HDZero 60fps
  - 14ms for HDZero 90fps



Thank you.

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