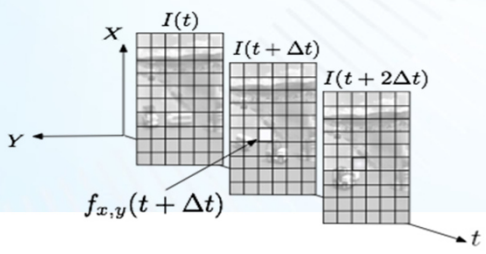
Pixel-individually Auto-sampling Image Sensors

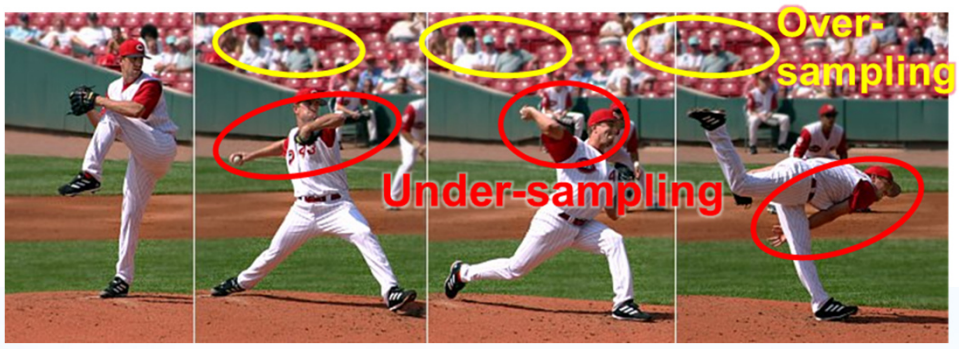
IMAGE SENSORS TAKE IMAGES

- State-of-the-art image sensors are useful and efficient for exactly ONE thing: **Photography**
- In MACHINE VISION **changes** and **motion** of objects carry the relevant information!
- **Images** (frames) carry **ZERO dynamic information**
- Current solution: acquire a **series of images** and look at them one after the other to find out what`s happening!



LIMITATIONS IN MACHINE VISION – DYNAMIC SCENES

- When dealing with **change or motion** this paradigm of visual acquisition becomes FUNDAMENTALLY FLAWED!
- **One frame rate** for all pixels → always WRONG!!
- NO relation between **frame rate** and **scene dynamics**
- Simultaneous **over-sampling** AND **under-sampling** of scene!



- **Machine vision deals with a mix of USELESS and BAD quality data!**
- Has to invest in **resource/power-hungry processing** to make up for INADEQUATE acquisition

SUMMARY STATE-OF-THE-ART MACHINE VISION

- Strict **temporal resolution** vs. **data rate** relation (power, resources)
- Data **redundancy** (over-sampling)
- **Information loss** (under-sampling)
- **Complex, resource-hungry** processing
- **Limited dynamic range**

Nothing can be done about this as long as all pixels share a COMMON timing source (frame clock)

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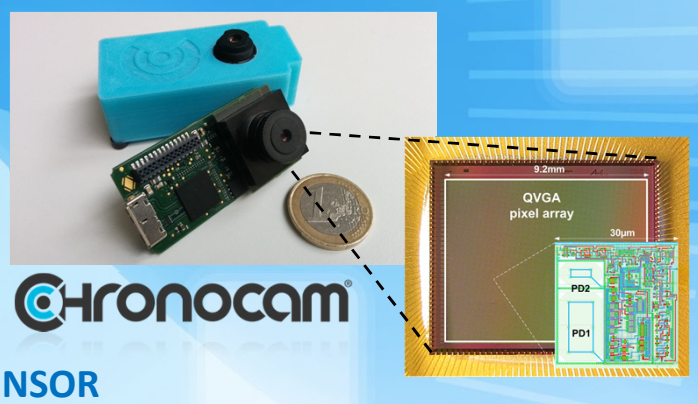


ATIS SENSOR

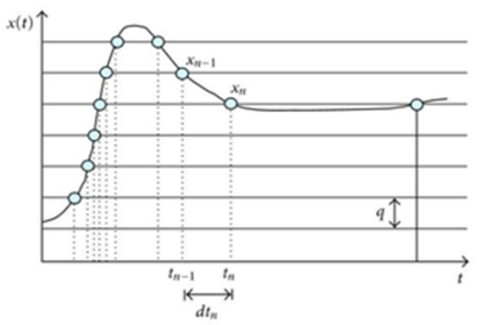
- not one sampling rate for all pixels (=frame rate) …
- but as many as it needs, to adequately capture all different dynamics in a scene

→ **as many sampling rates as number of pixels**, and

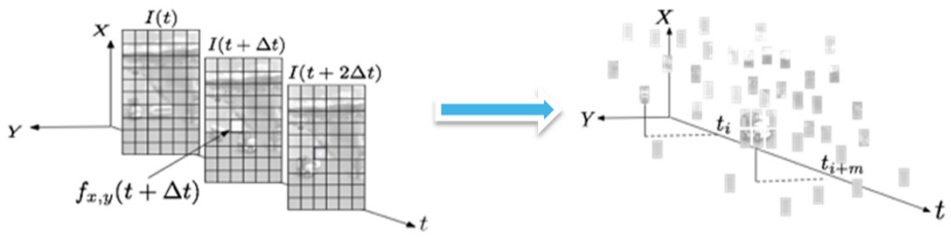
→ **sampling rates** can pixel-individually **vary**

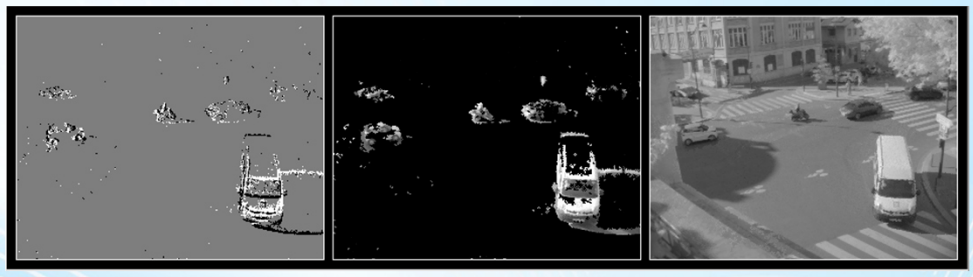
– on the fly

- **How? Put the pixel in control**: Each pixel individually controls its own sampling based on its input (light)
- Different parts of the scene are sampled at different rates – depending on the present dynamics!



- **Sampling points defined by the signal**
- **Fast sampling** when signal **changes fast**
- **No sampling** when signal does **not change**





Pixel circuits react fast

→single sampling point accuracy down to microsecond precision

→pixel-individual sampling rates from mHz to kHz

Strict temporal resolution vs. data rate relation is no more!!

→High-speed vision @ low data rate

(compression factors 10s – 1000s)

Log level sampling, autonomous pixels, time-domain encoding of intensity

→High dynamic range: 120-140dB

A new paradigm of dynamic vision acquisition …

- high-speed
- wide dynamic range
- low-data rate compressive sensing
- low-power

… at the same time!