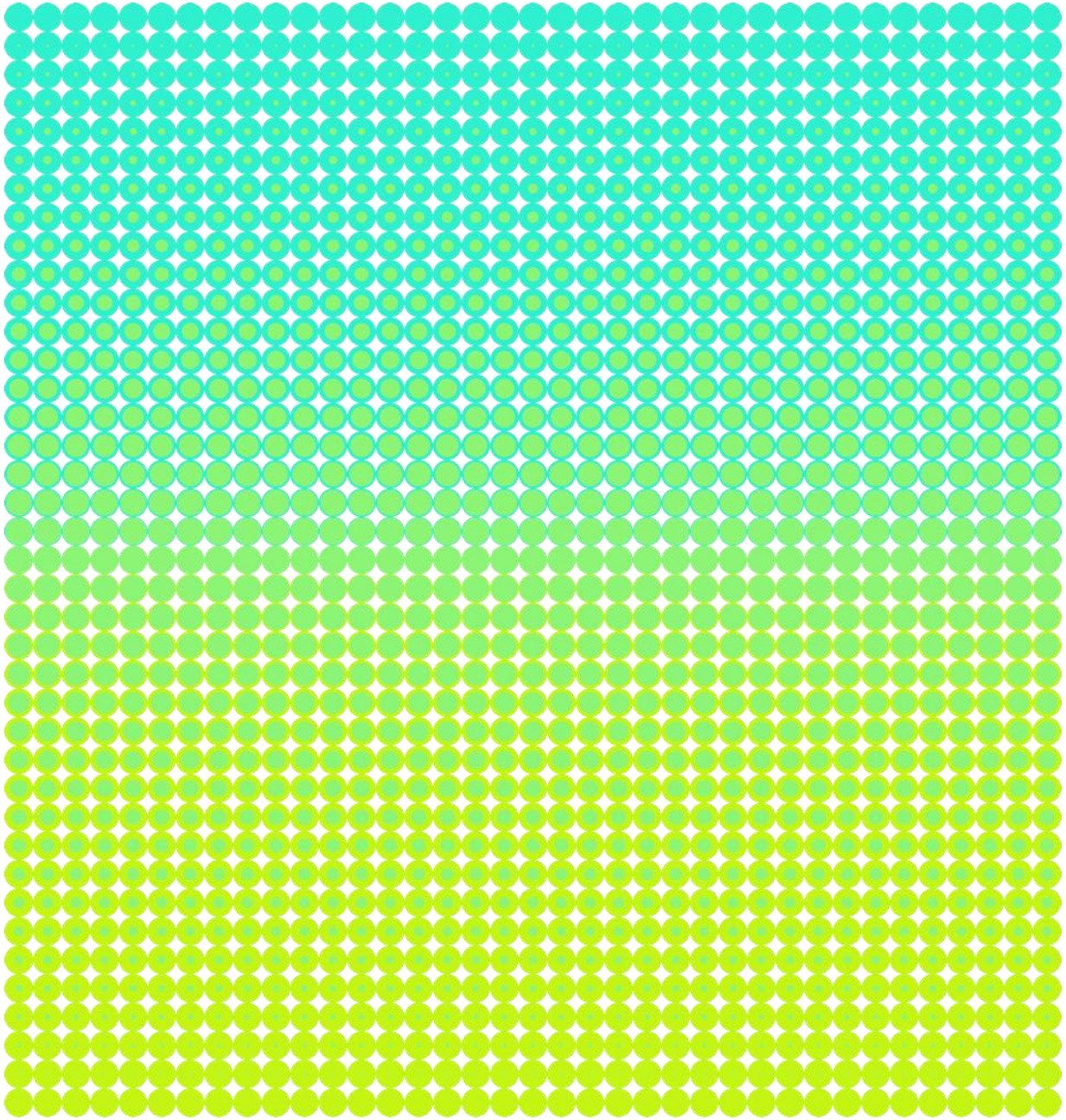


Flash LiDAR System-on-Chip

City driving ADAS : fast, safe and simple

Claude Florin, CEO

30-10-2019

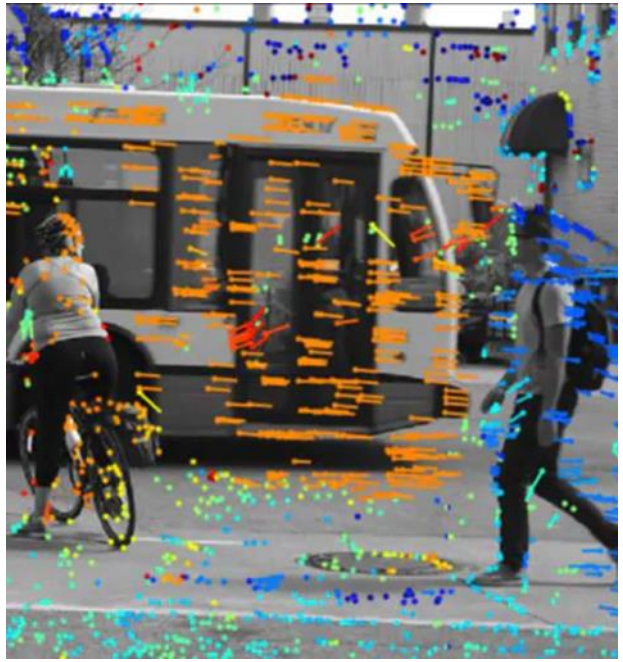
www.fastree3d.com
claude@fastree3d.com
+41 79 866 1000

fastree 3D

Automotive safety LiDARs requirements

Speed / resolution

<10ms < 3m reaction
Recognize pedestrians/cyclists



Safety

Lower false detection,
enable ADAS city tests

Affordability

CMOS proximity sensors
shipping in billion units

Source : NXP https://blog.nxp.com/automotive/radar-camera-and-lidar-for-autonomous-cars

Flash LiDAR objectives

fastree 3D

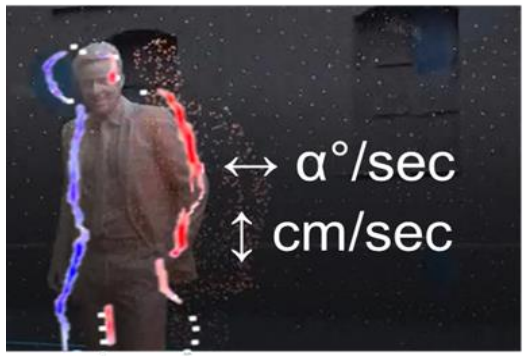
Fast

√ Detecting in less than **10ms**,
React in less than **3m**

Safe

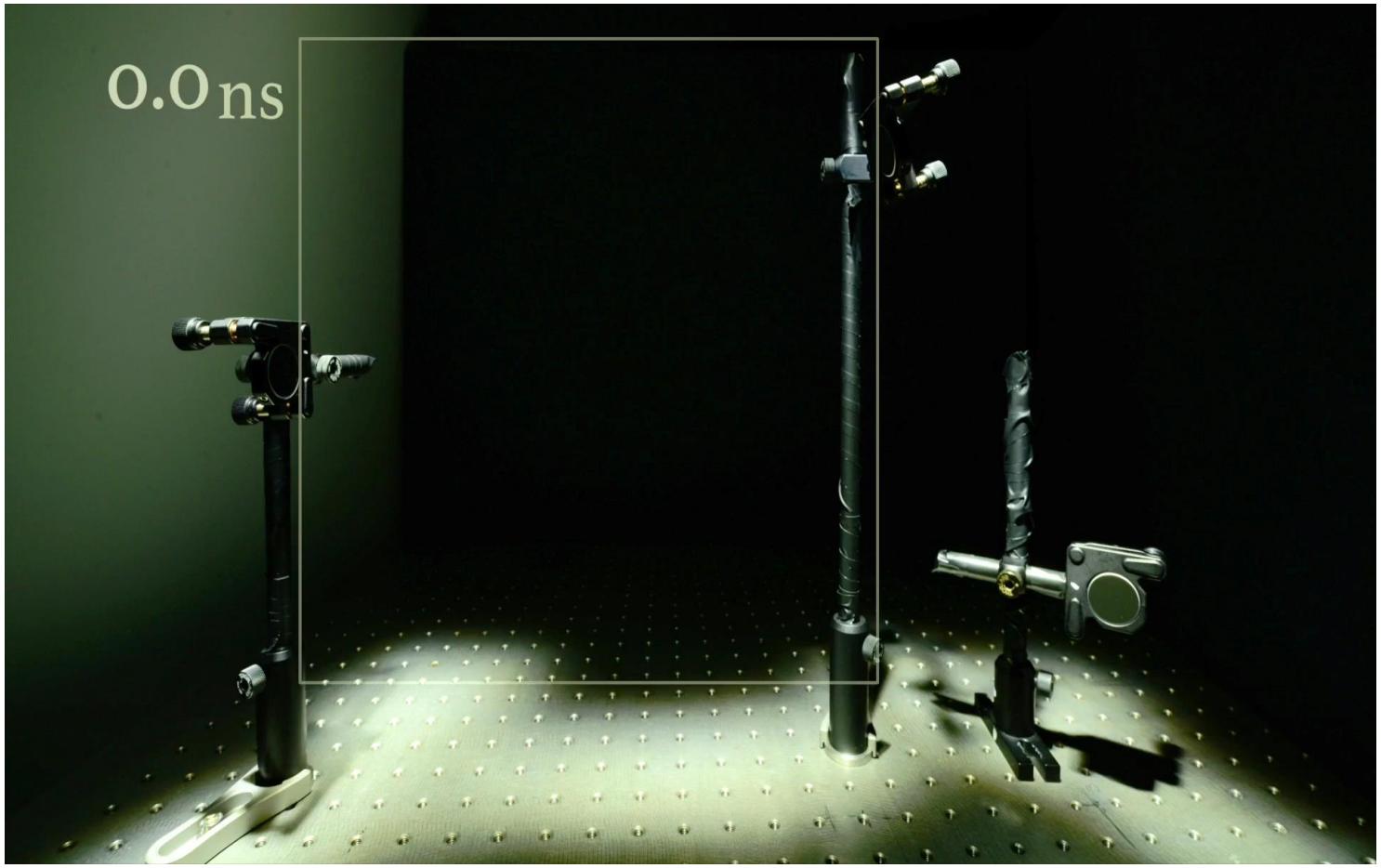
√ Supress interferences,
Adjust in **real-time** to light conditions

Smart



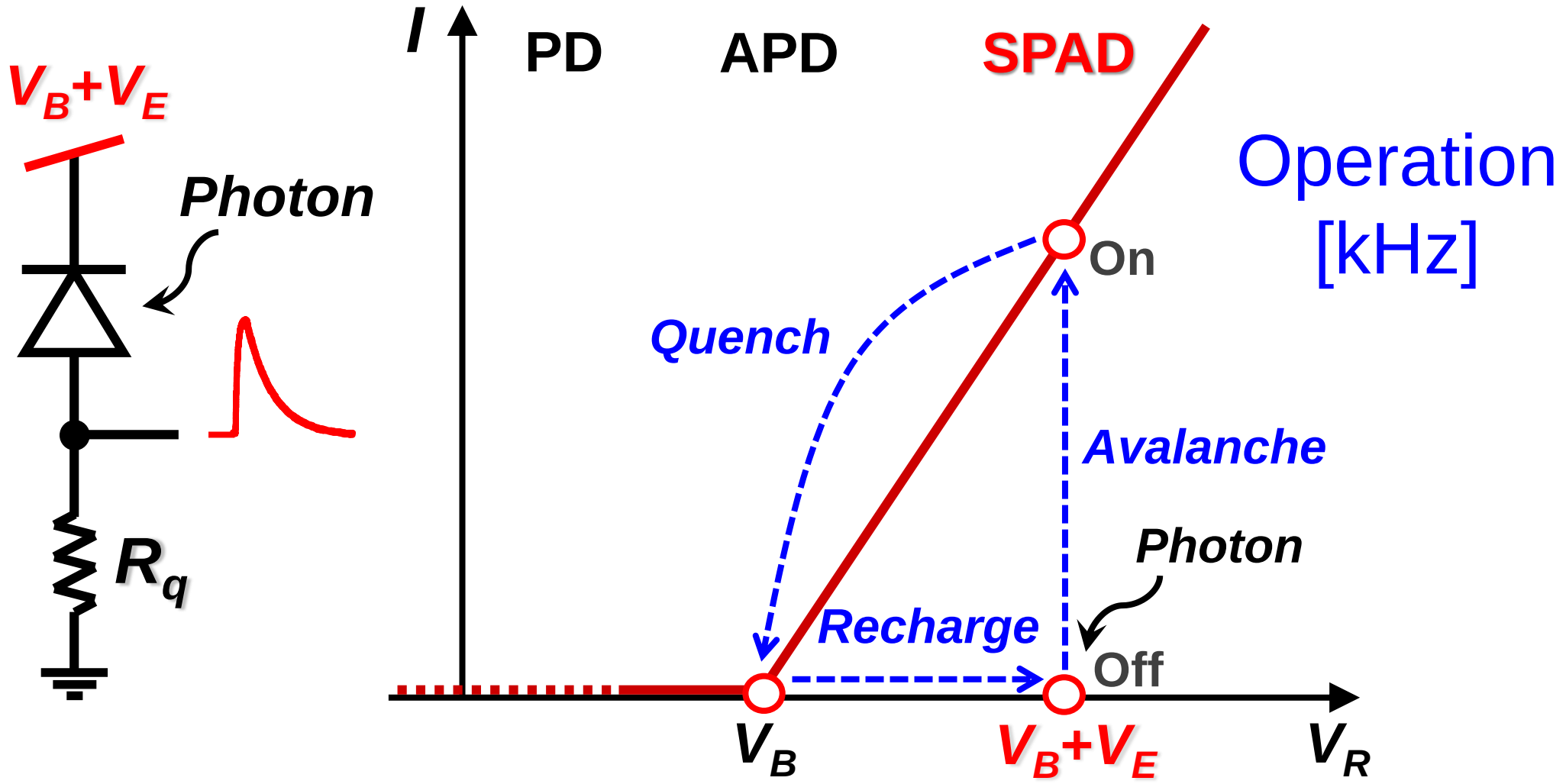
√ Detect distance,
Speed, **direction** and **threshold** limits

Fast : Single Photon Counting



G. Gariepy et al., Nature Communications 6:6021 doi: 10.1038 2015

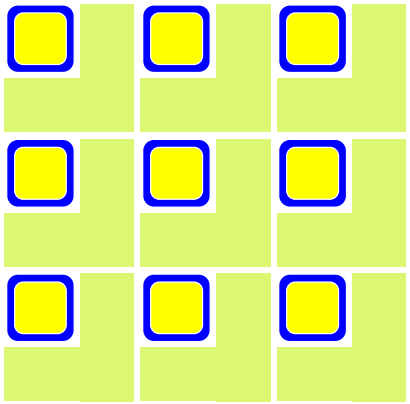
Fast : Single Photon Avalanche Diode



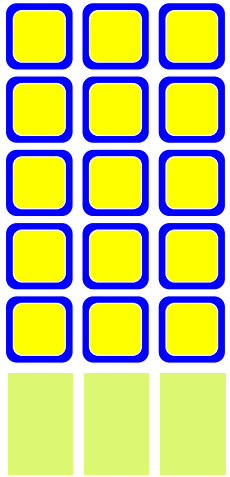
Operation [kHz]

Fast : full array Time of Flight capture

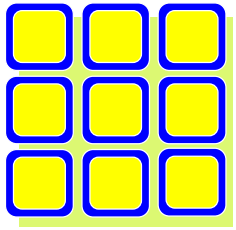
“Flash”, no scanning



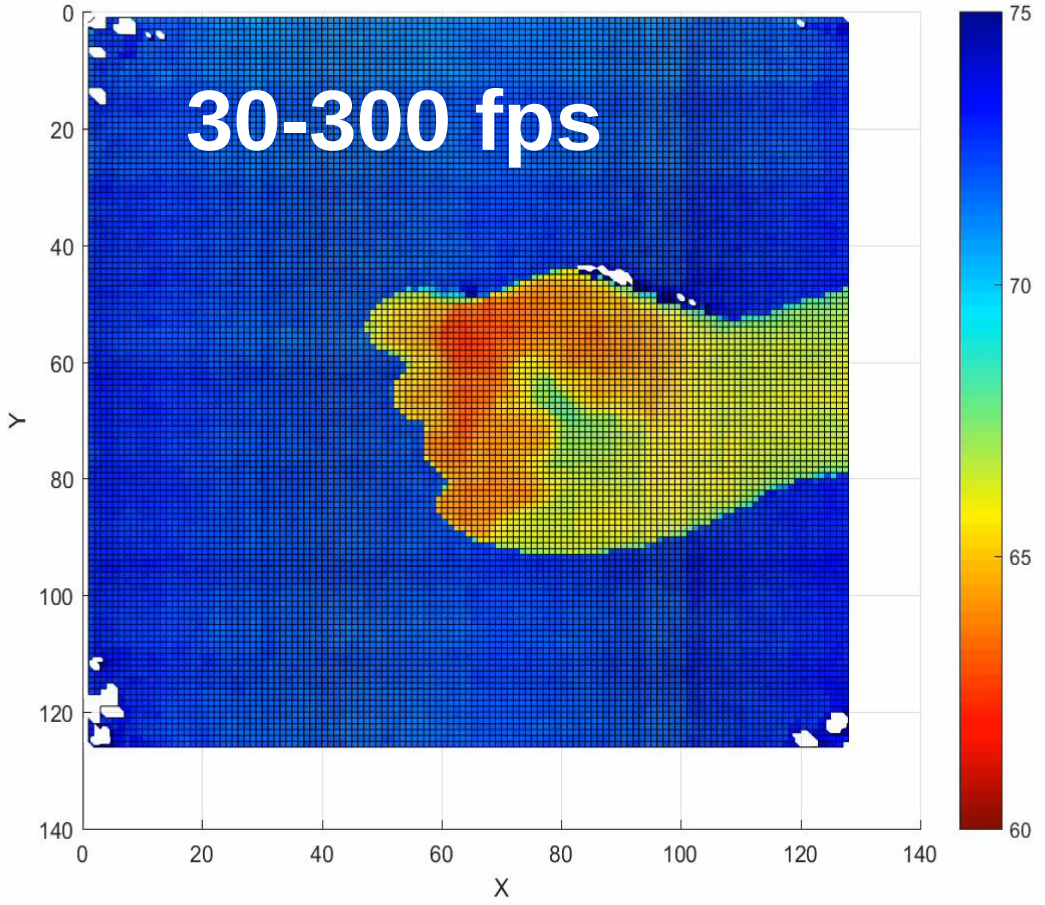
Fully parallel



Column parallel

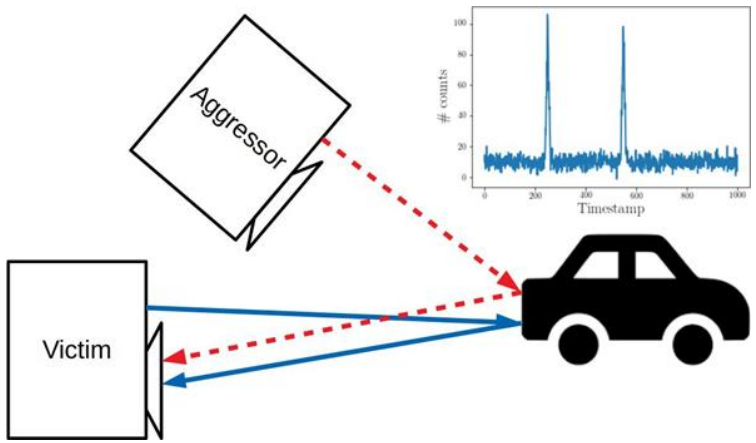


3D Integration



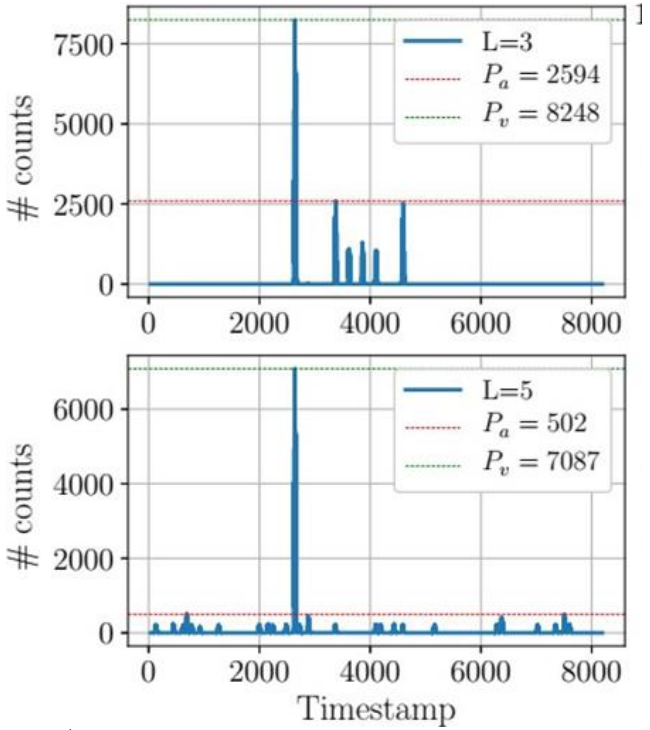
Safe : optical interference mitigation

Interference



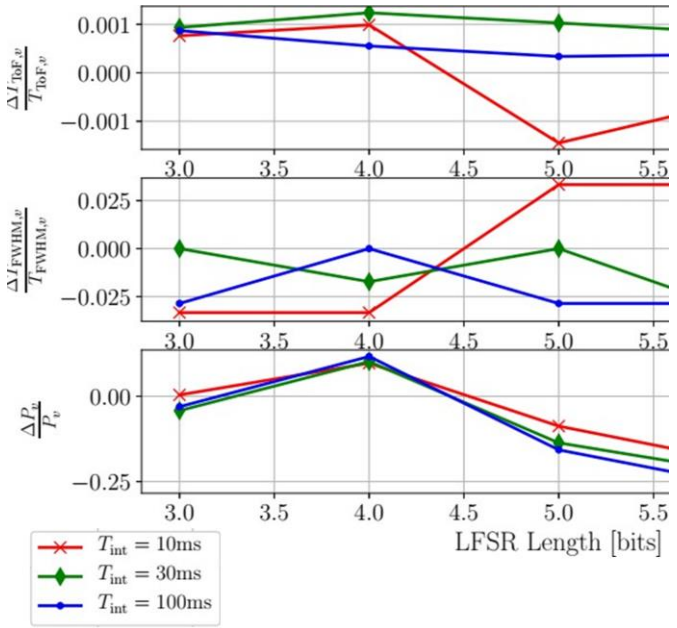
- ✔ Time-Correlated Single-Photon Counting operation
- ✔ No coordination among LiDARs
- ✔ Independent number of LiDARs

> 35 dB interference reduction



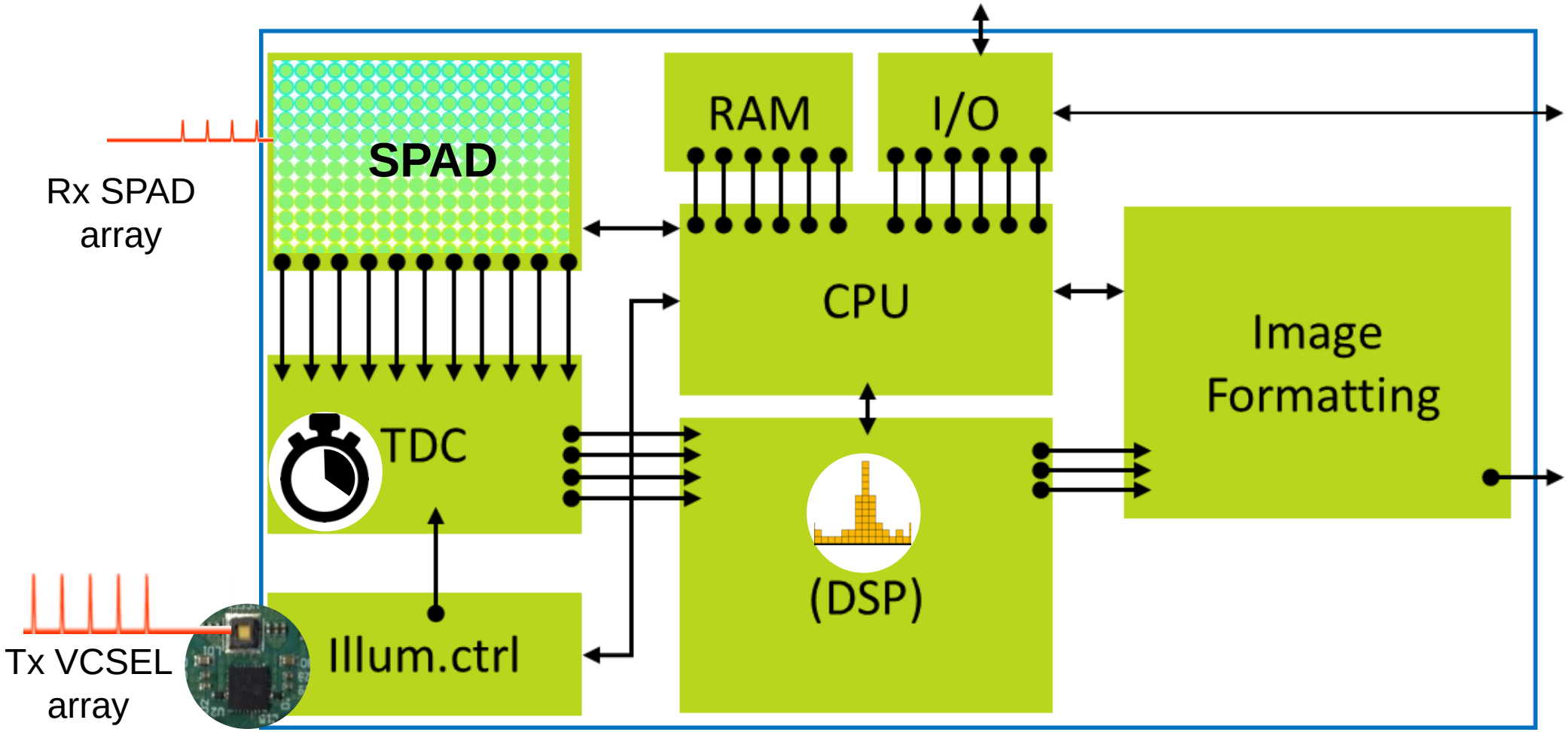
- ✔ Random delay pulsed illumination (6 bit LFSR)

Minimal impact



- ✔ 0.1% ToF measure deviation
- ✔ < 25% LiDAR signal intensity reduction (worst case)

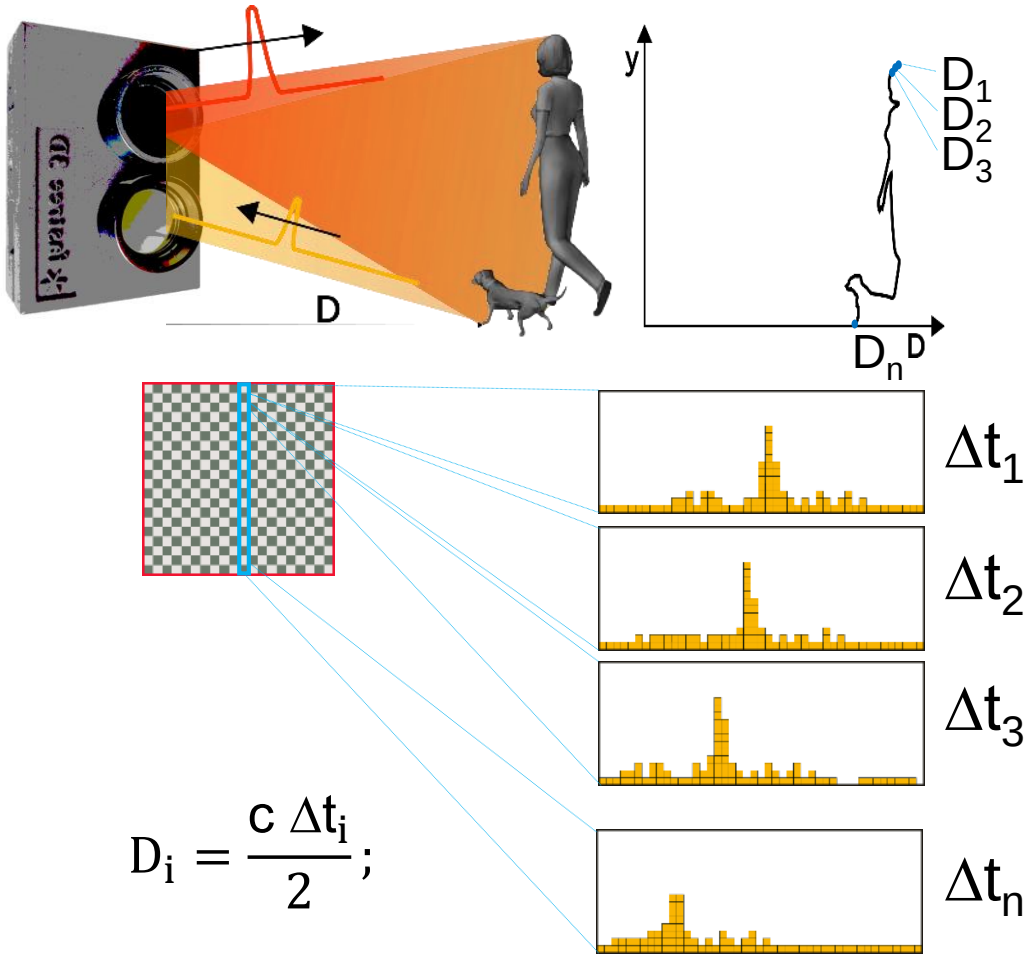
Smart : System on Chip architecture



Smart : statistical processing

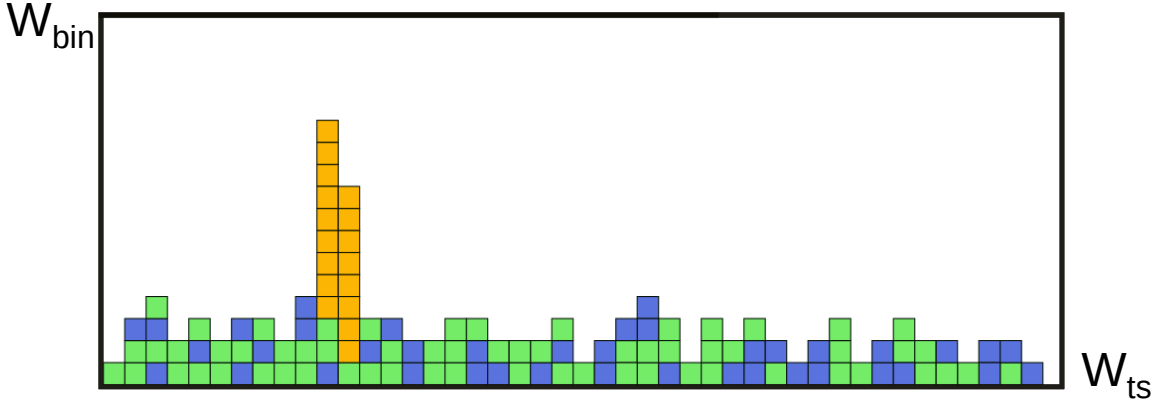
fastree 3D

n-Pixels



$$D_i = \frac{c\,\Delta t_i}{2};$$

On-chip TCSPC processing



W_{ts} = 13 bit

W_{bin} = 8 bit

M_{QQVGA} = 1.2 GB

Signal

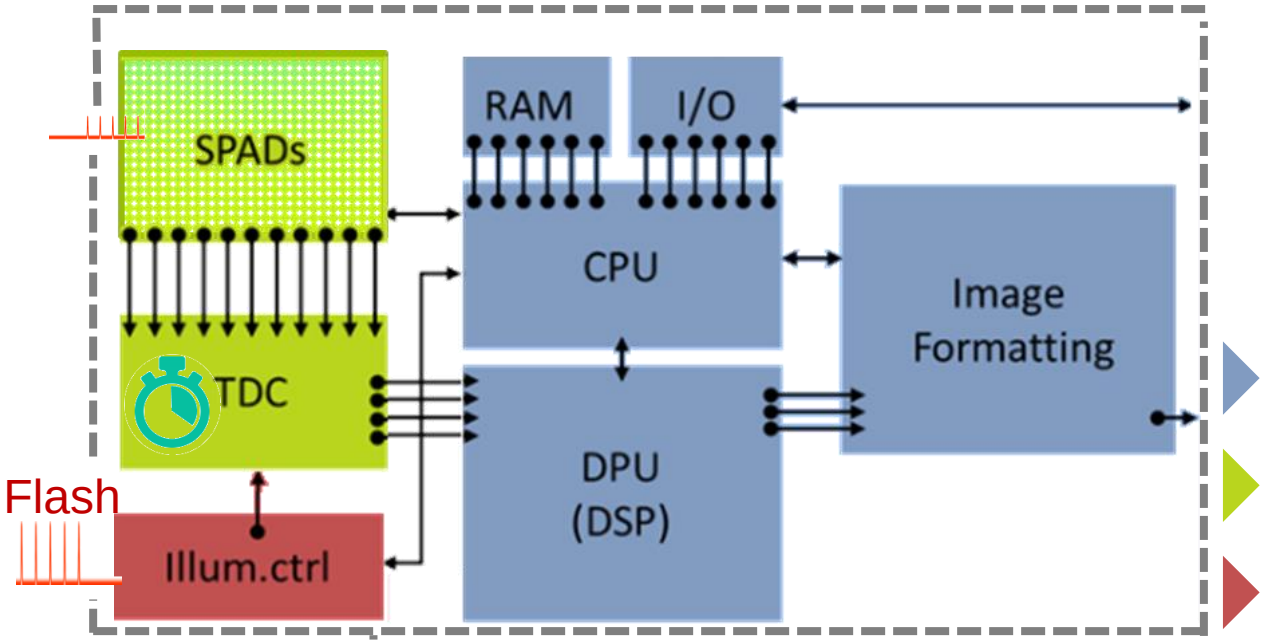
DCR

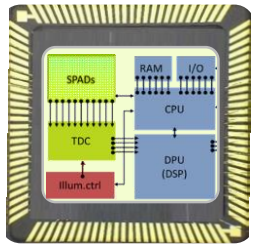
Sun

Compression < 2 MB

Smart : application development

Flash LiDAR system on chip

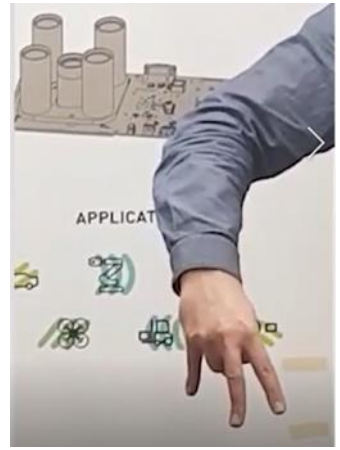




SPAD Single photon detector
TDC time digital converter
DSP digital processing
Laser controller

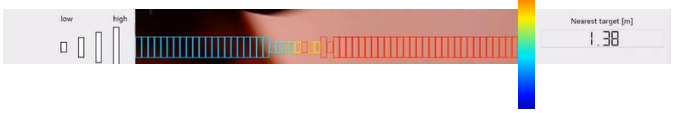
Hardware kit / FPGA

DSP digital processing on FPGA

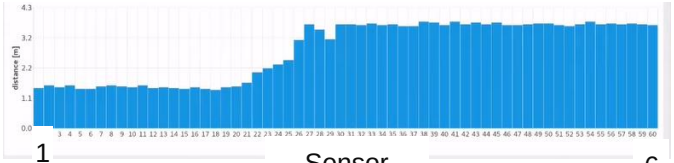


↕Confidence levels

Distance (color coded)



Distance

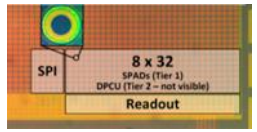
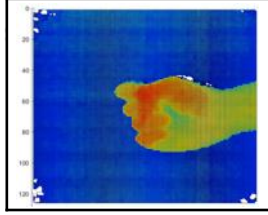


Technology transfer project

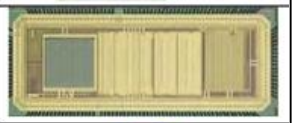
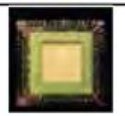
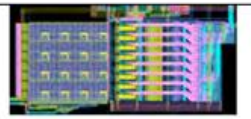
R&D support

- EPFL
- TU-Delft
- FH-Biel
- R&D

EPFL's detectors

	• Largest SPAD array • 512 x 512 to 1M pixels
	• 11 Gbit/s output data • 252 x 144 pixels
	• 3D stacked D-ToF sensor • Processing 45/65nm) • Distance > 150 m • Precision (σ) >15 cm
	• Flash video demonstration • 126 × 128 pixels at 30 fps

Fastree3D prototypes

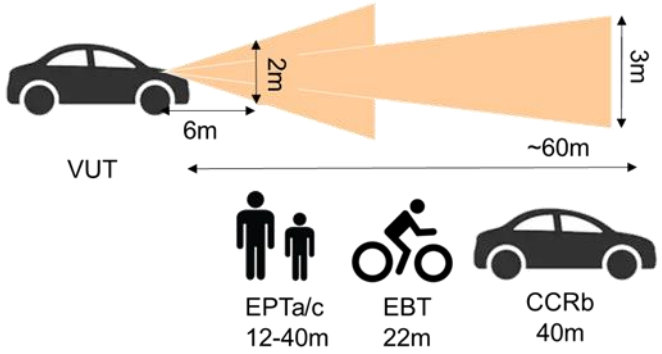
C1001C	
C1002A	
3D-IC	
L3-SPAD Piccolo	
C1004A	
T1000	
C1003	

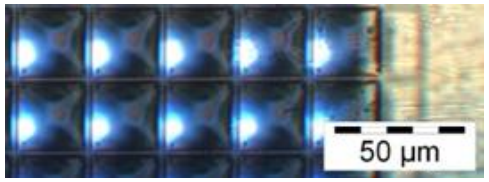
Source : EPFL http://aqua.epfl.ch/ C. Bruschini, P. Padmanabhan, E. Charbon © 2019 Swisspad 2 - JSTQE 2019 ; Ocelot VLSI 2018 / JSSC 2018 ; Mantis ISSCC 2018

Cooperation opportunities

Optics

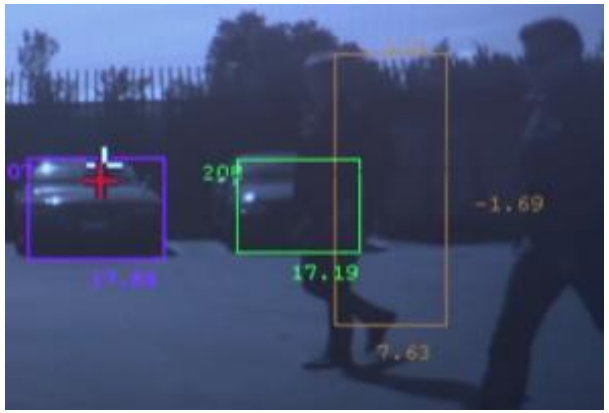
- Beam shaping
- Micro-lenses



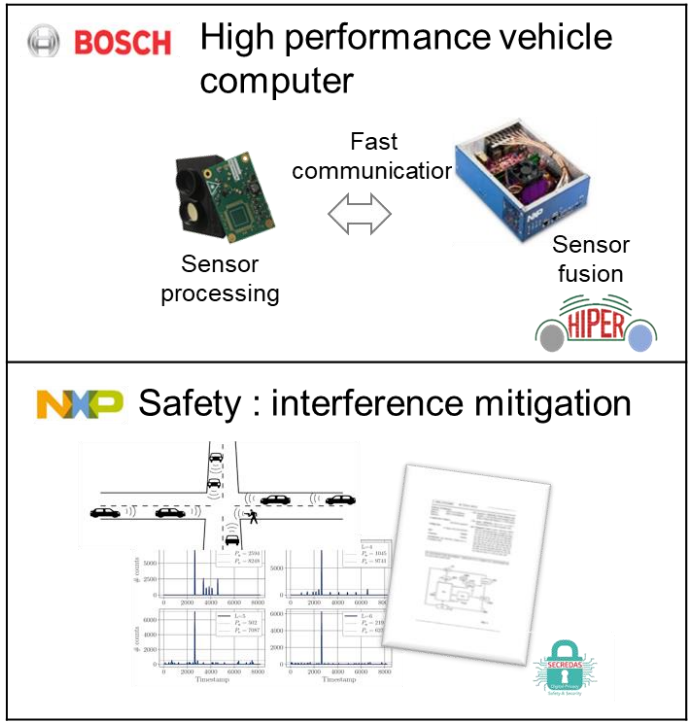


Integration

- Sensor fusion
- Embedded AI

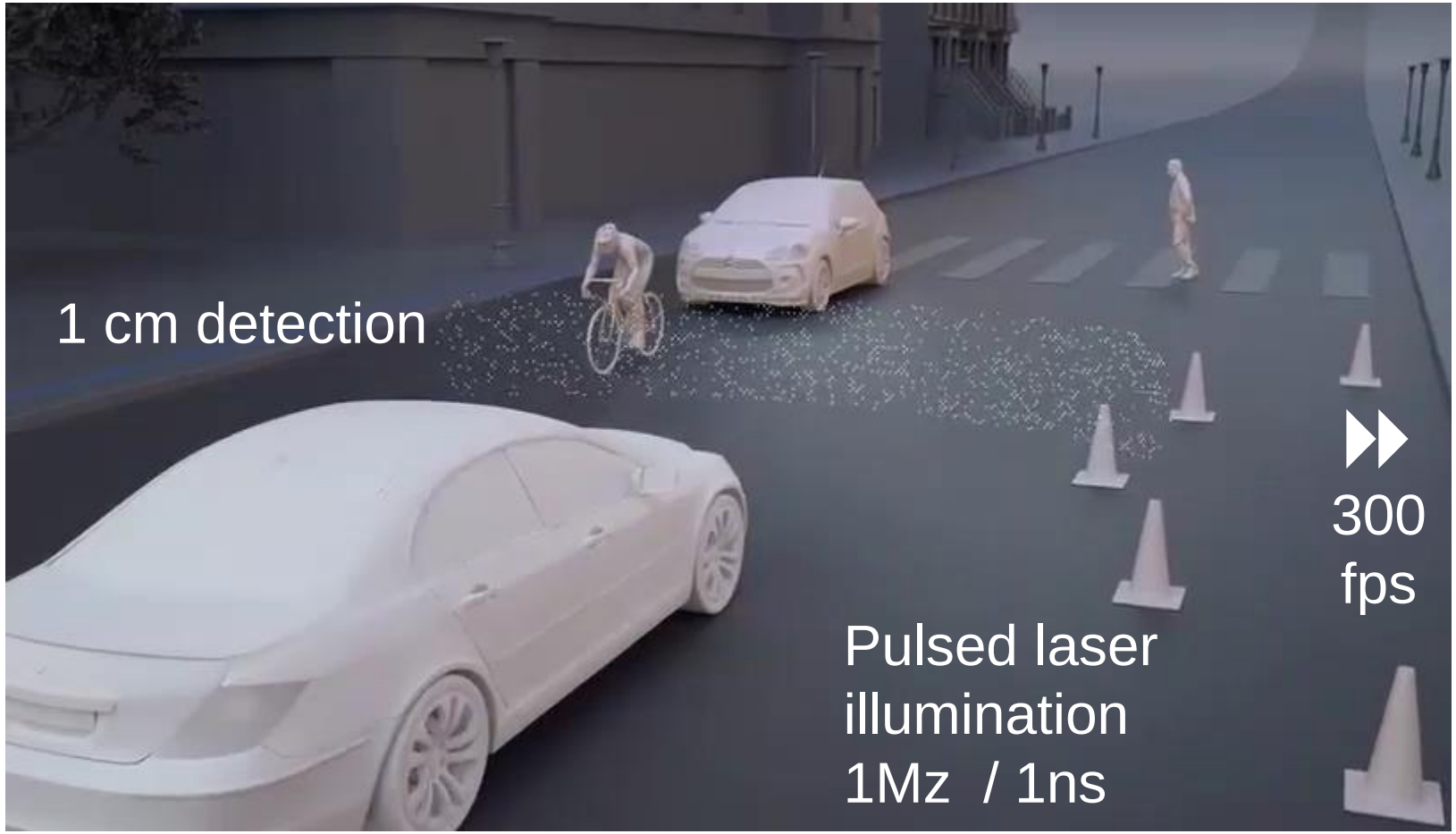


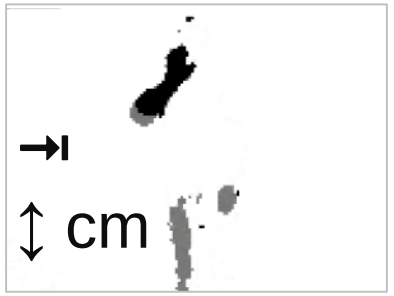
Joint R&D Financing

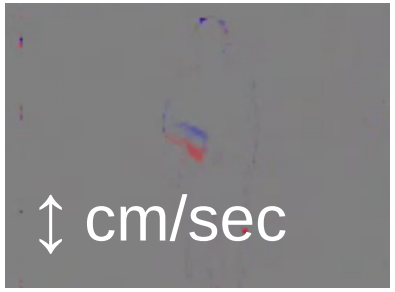


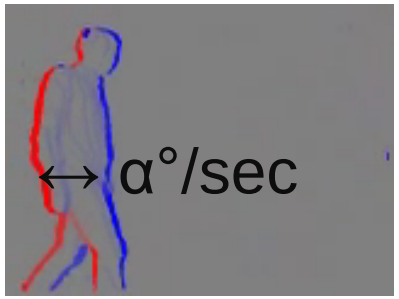
Flash LiDAR sensing system on chip

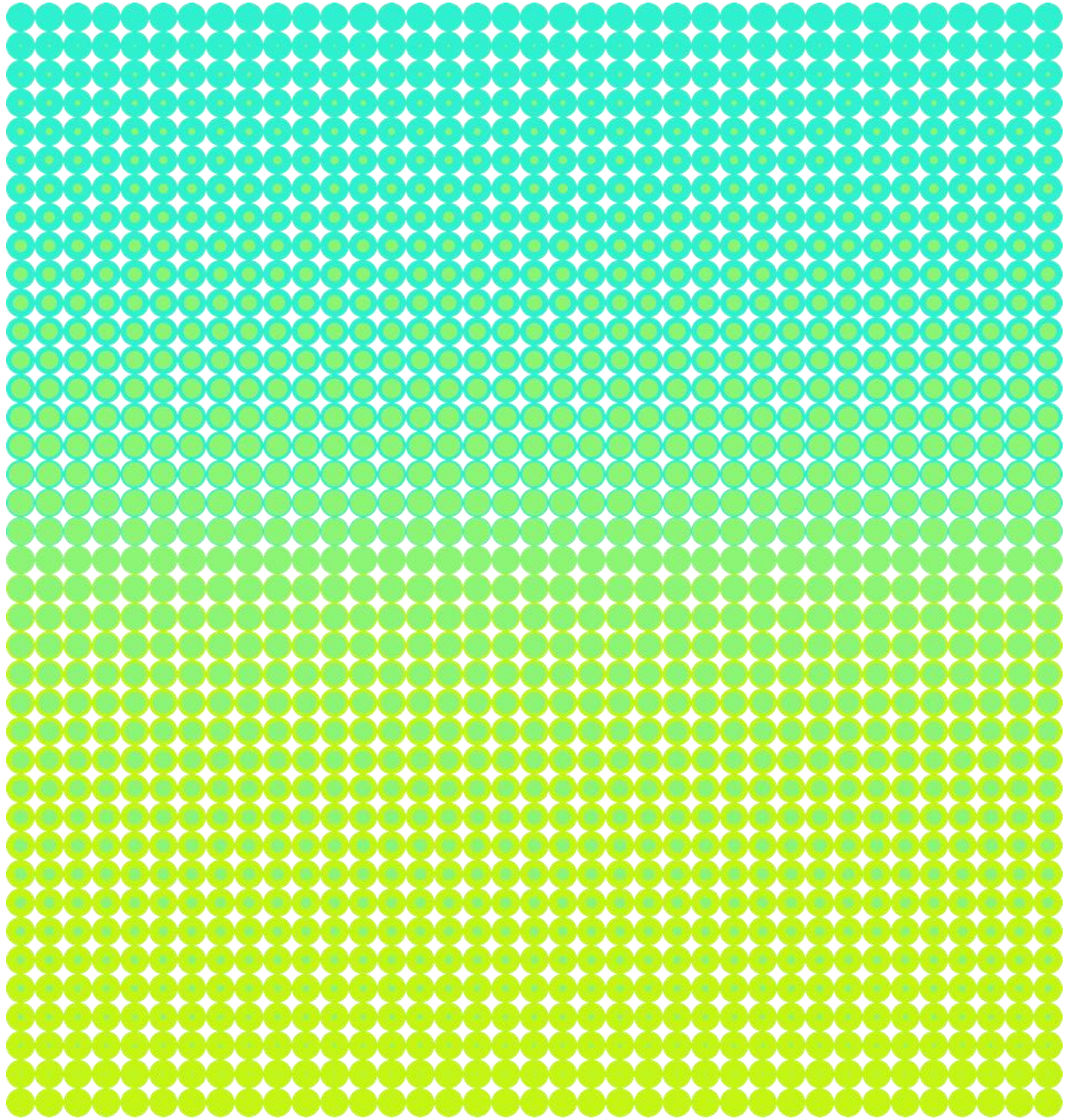
fastree 3D











Faster, safer, smarter LiDARs

Automotive safety

Autonomous vehicles

fastree 3D

This presentation was presented at EPIC Meeting on LIDAR Technologies for Automotive 2019

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