**3D Imagers for intelligent devices**

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**Single Photon Avalanche Diode**

- **10 years of research (2 EU R&D)**
  - ![SPAD Image](image.png)
  - 0.35µm to 65nm CMOS (25-15 µm pitch)

**Spads for 3D Time-of-Flight**

- Measuring the time between the generation of a light pulse and the detection of the reflected pulse
  - ![ToF Diagram](image.png)
  - **Time of Flight processor**
  - **Flexible FPGA design**
  - **Near Infrared (>800nm)**
  - **Rapid prototyping**
  - **USB3 interfacing**
  - **Pulsed laser / micro LED**
  - **Long detection range (>30m-50m)**
  - **High resolution (3mm/20ps)**
  - **High frame rate (1’000-10’000 fps)**
  - **Low cost standard CMOS standard manufacturing**
  - **Single photon detector (SPAD)**
  - **Digital measurement (20 ps)**

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**Industrial vision challenges**

- **Autonomous robots, vehicles and machine vision**

  - **Requirements**
    - Safety (lowest ambiguity)
    - Speed (10-20m/s)
    - Accuracy (>1m)
    - Range (1m-50m)
    - Day & low light operation
  - **State of arts**
    - Sensor networks
    - Multiple 1D/2D cameras
    - Image/video processing
    - “Sensor fusion”
    - Calibration
  - **Problems**
    - Complex/lows processing
    - Low resolution
    - Ambiguity
    - Low range < 15m

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**Automotive ADAS challenges**

- **Range**
- **Blinding**
- **Backscatter**
- **Autonomous**
- **Eye safety**

  - **Requirements**
    - # of cameras: 8
    - # of different cameras: 4
    - # of additional radars: 5
    - Limited at night and poor visibility conditions.
    - No good cost effective solution for imaging / sensing for autonomous vehicle in all weather scenarios.

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**Market Growth**

- **Addressable 3D vision market**
- **Total robotic and machine vision market (+automotive 2020)**

- ![Market Growth Graph](image.png)

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**Fastree3D SA**

- **Founded in 2013**
  - **Achievements**
    - 2 prototypes:
      - Line-sensor 256 pixels
    - Array sensor 32x32 pixels
- **Business Model**
  - B2B Licensing (2014)
  - B2B Product: ToF camera (2016)
- **9 patents**
- **5 employees (2 FTEs)**