Low-cost Platform Technology for **LWIR Sensor Arrays** for Use in Automotive Night Vision and Other Applications

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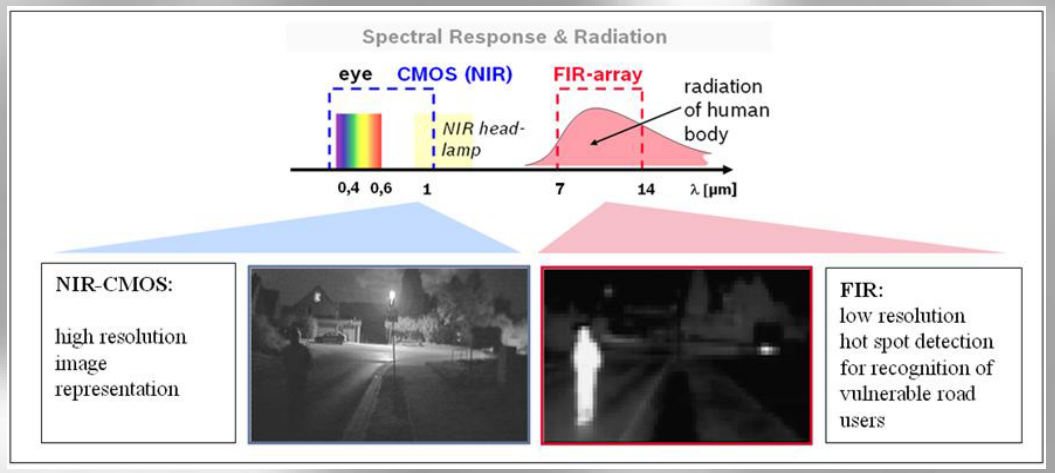
Multi-spectral Approach to Automotive Night-Vision



- NIR-CMOS imager presents a natural and high-quality view to user
- FIR imager gives temperature information
- NIR allows state-of-the art detection of road-signs, lane boundaries etc.
- FIR allows differentiation of "dead" and "living"
- Data fusion of NIR and FIR allows high alarm rates with low false positives

ADOSE

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ADOSE

ADOSE Project no. 216049:

Reliable Application Specific Detection of Road Users with Vehicle On-Board Sensors

ADOSE Website: http://www.adose-eu.org

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Low-end Requirements

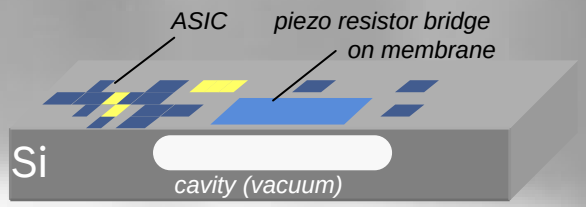
Example Scenario:

- Extra-urban
- Single-lane road (i.e. no Autobahn)
- v_{max} = 100 km/h
- Detection distance 120m
- Minimum hot-spot size for a human 1 x 5 (hor. X vert.)
- Thermal resolution 0.5 K

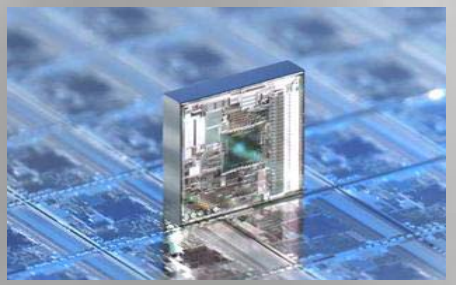
FIR camera requirements		Remark
Hor. Field of View (FOV):	± 12°	For data fusion with NIR
Angular Resolution:	4,18 pixel / °	Defined by smallest object to be resolved @ 120m
Object Temperature resolution:	< 500 mK	for hot-spot detection; no image display; NETD<300mK for chip @F#1 optics
Frame Response:	> 12,5 Hz	for 3 verifications of object in the NIR image
Array Size:	100 x 50 pixels	Defined by FOV and angular resolution
Wavelength Range:	7-14 µm	Spectral emission maximum of vulnerable road users

How to Do "Low-cost"

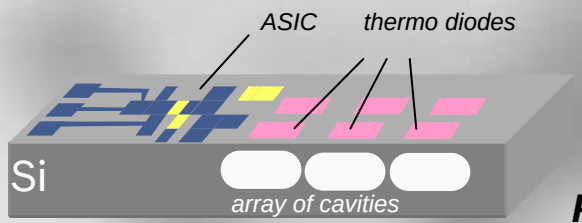
Take a well-established, high volume MEMS-process ...



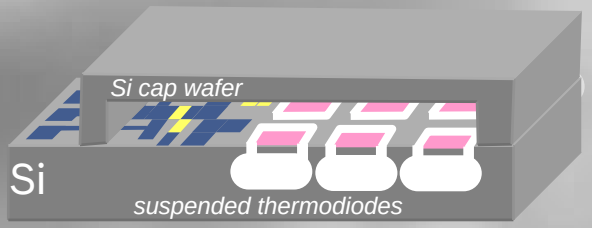
Pressure sensor



... and use it for a completely different type of sensor



Far-infrared-array



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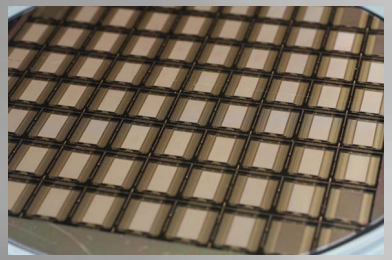
ADOSE Achievements

- Proof-of-concept demonstrator finished
  - 42 x 28 pixels
  - 5 Hz
  - .5 K NETD@F#1
- First ADOSE silicon ready
  - 100 x 50 pixels
  - 12.5 Hz thermally, 25 Hz read-out
  - .3 K NETD@F#1 (target)
- Transfer to Bosch MEMS facility started
- Chip-on-board assembly verified (with FhG IZM, Berlin)
- Demonstrator boards, housing and optics ready (with FhG IZM, UMICORE)



Ascend From Low-end (RTFIR development goals)

- Shrink down the pixel structure
- Use the capabilities of more recent CMOS for more ROIC functionality
- Implement a new low-noise read-out concept
- Utilize a new wafer-level encapsulation technology to reduce chip cost
- Improve the absorption
- Develop a new low-cost FIR-optics process (@ FhG IWM)

	ADOSE	RTFIR
Pixel Pitch [µm]	100	28
Absorber area [µm²]	4700	345
Fill factor [%]	47	44

Unless otherwise stated all activities done by BOSCH & IMS chips with partners

RTFIR

„Thin Un-cooled (RT) FIR-Imager
With Nano-scaled Absorption Layers“

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Conclusion and Outlook

- Concept for low-cost, low-end FIR imager was proven
- 1st gen. BOSCH low-cost FIR chip (100x50) in transfer to fab
- Low-cost platform development for 2nd gen. (QVGA+) started
- Next steps:
  - Pixel shrink
  - New ASIC
  - New wafer-level encapsulation
  - Low-cost optics