OVERLOOKING THE LANDSCAPE

DIFFERENT LIDAR APPROACHES TO AUTONOMOUS DRIVING

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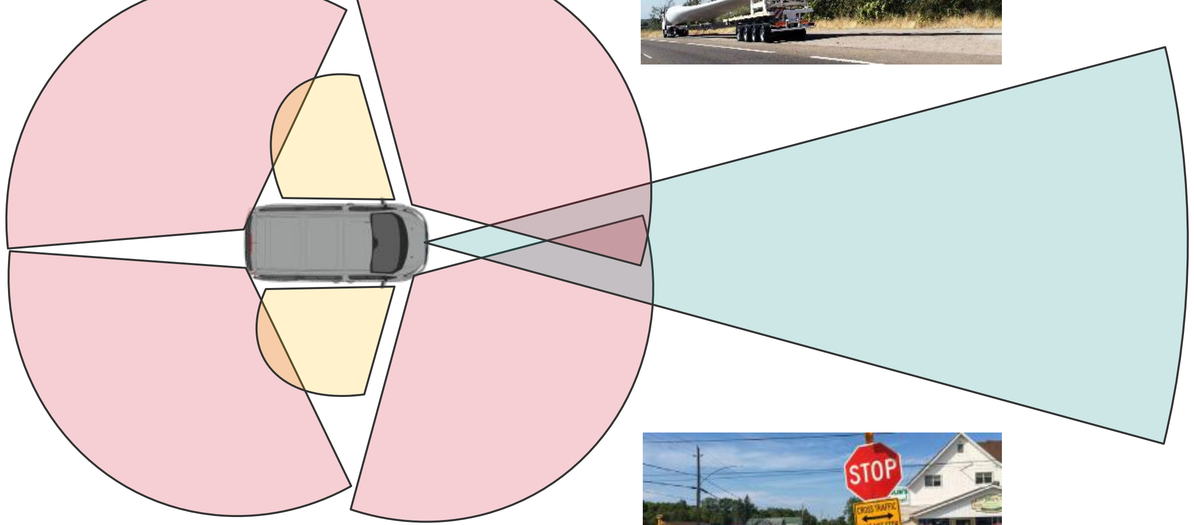
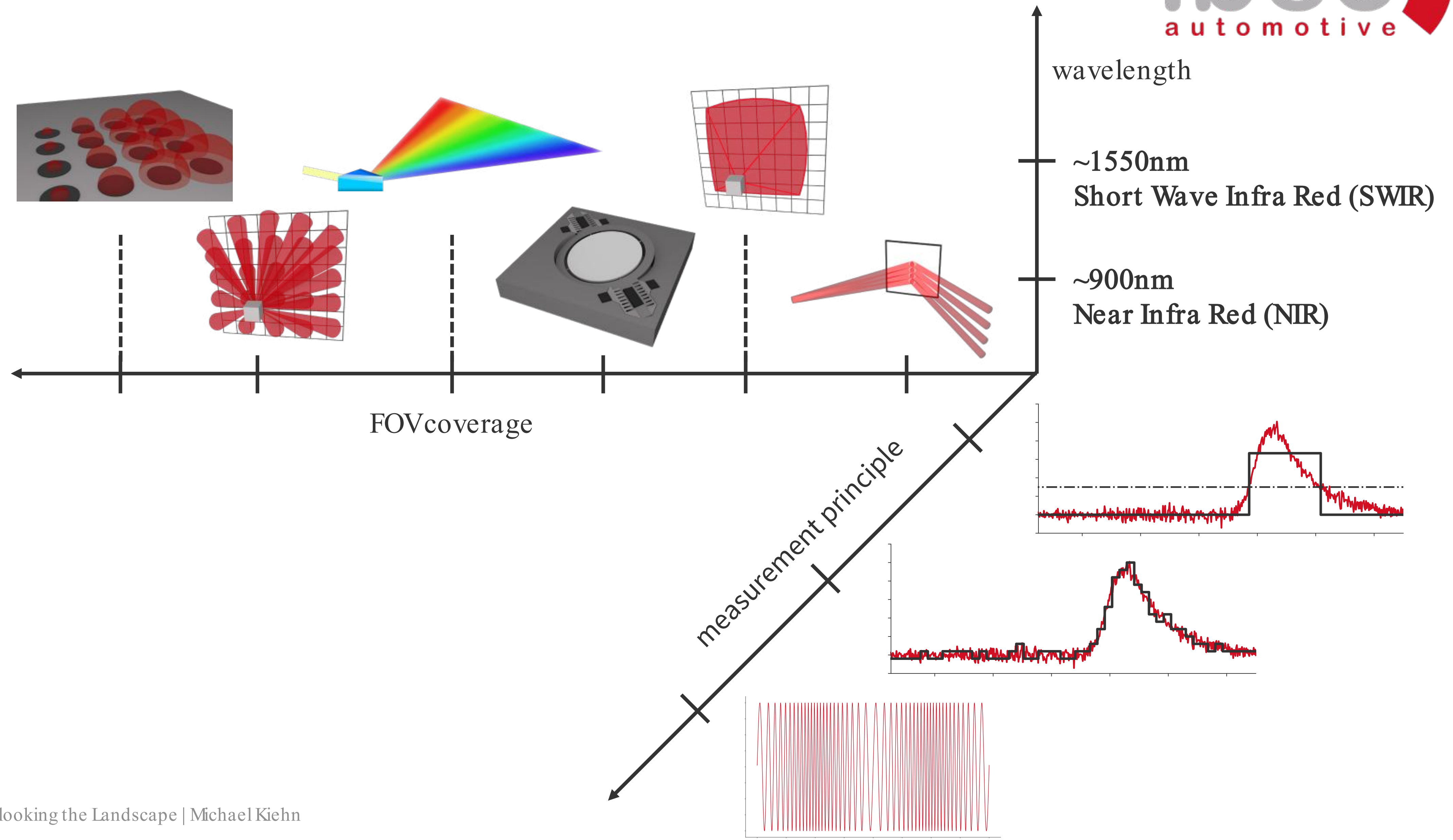
BASIC REQUIREMENTS & CORNER CASES

- Target market: L3 + L4 ADAS/AD
- Premium Market needs a system for highway pilot (L3) **AND urban driving (L4) WITH lane change starting 2027**
  - L4 ➔ requires 360° surround view with high resolution LR in front and lower resolution LR in the back, covering all corner cases
  - L3 ➔ fast follower will request solutions for Highwaypilot/Traffic Jam assistance, without lane change

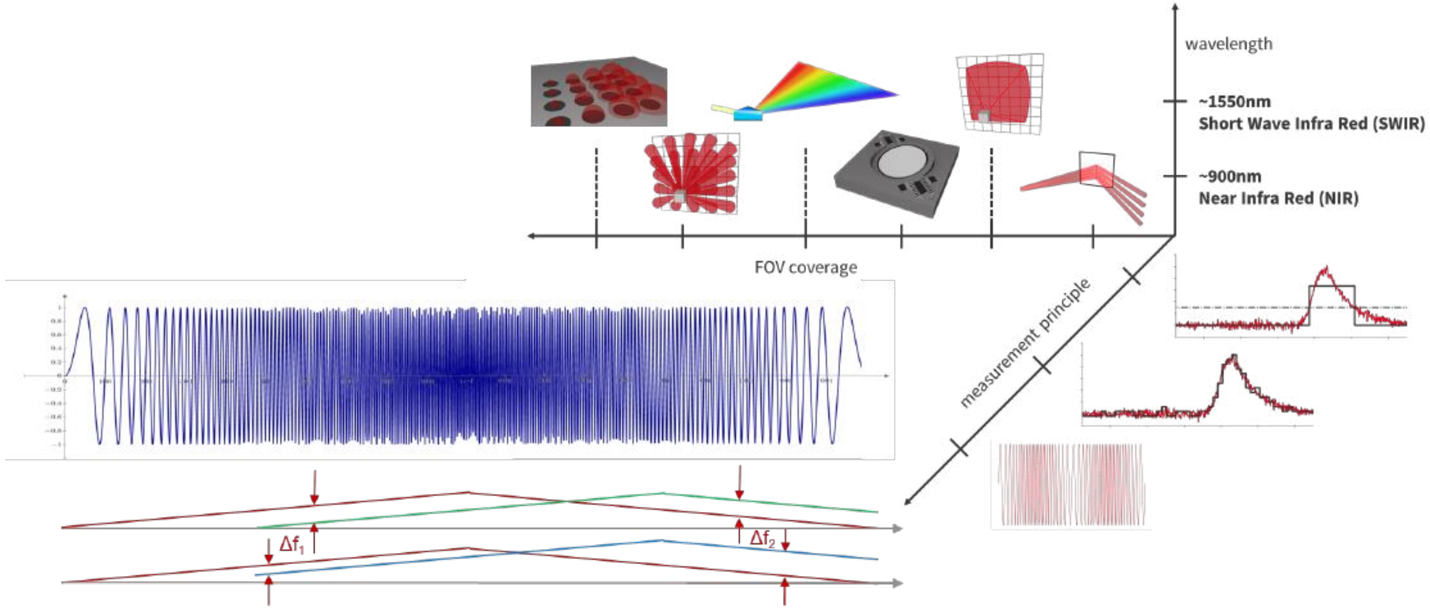


Schematic: 360° Set up (not in scale)

AUTOMOTIVE LIDAR DESIGN SPACE



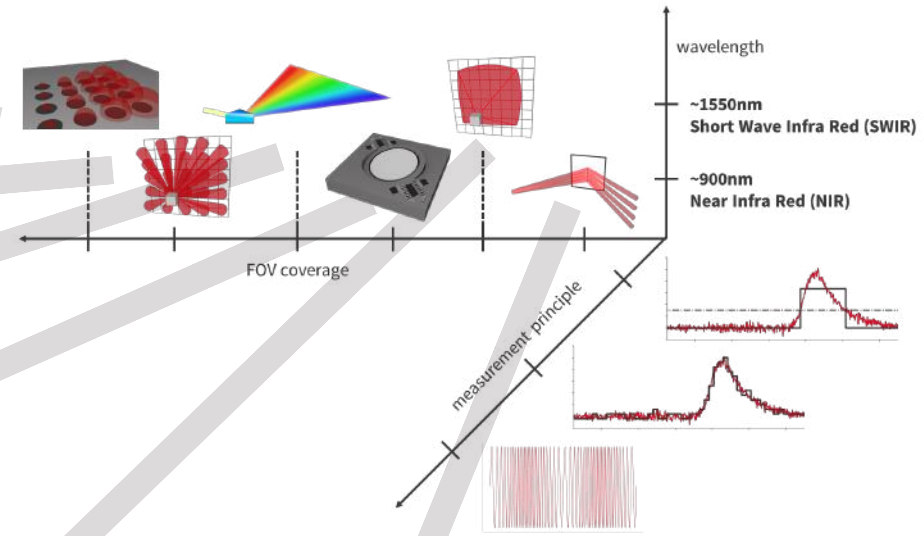
AUTOMOTIVE LIDAR DESIGN SPACE
MEASUREMENT METHOD



- Range depends on power (SNR)
- Requires high bandwidth electronics
- Low processing effort
- Measures real speed by tracking
- Currently most commonly used

- Range depends on coherence length
- Requires Silicon photonics circuits
- Significant processing power required
- Measures radial speed directly
  - Real speed by tracking
- Adopted by a few Lidar companies

AUTOMOTIVE LIDAR DESIGN SPACE
SCAN METHOD



Optical Phased Array (OPA)

+ Solid state
– Low energy efficiency

Sequential Flash

+ High energy efficiency
– Lacking flexibility

Spectral Scan

+ Solid state
– Requires tuneable Laser

MEMS Mirror

+ Small form factor
– Mechanical robustness

Flash

+ Solid State
– High peak power

Mechanical Scanning

+ Large field of view possible
– Mechanical robustness

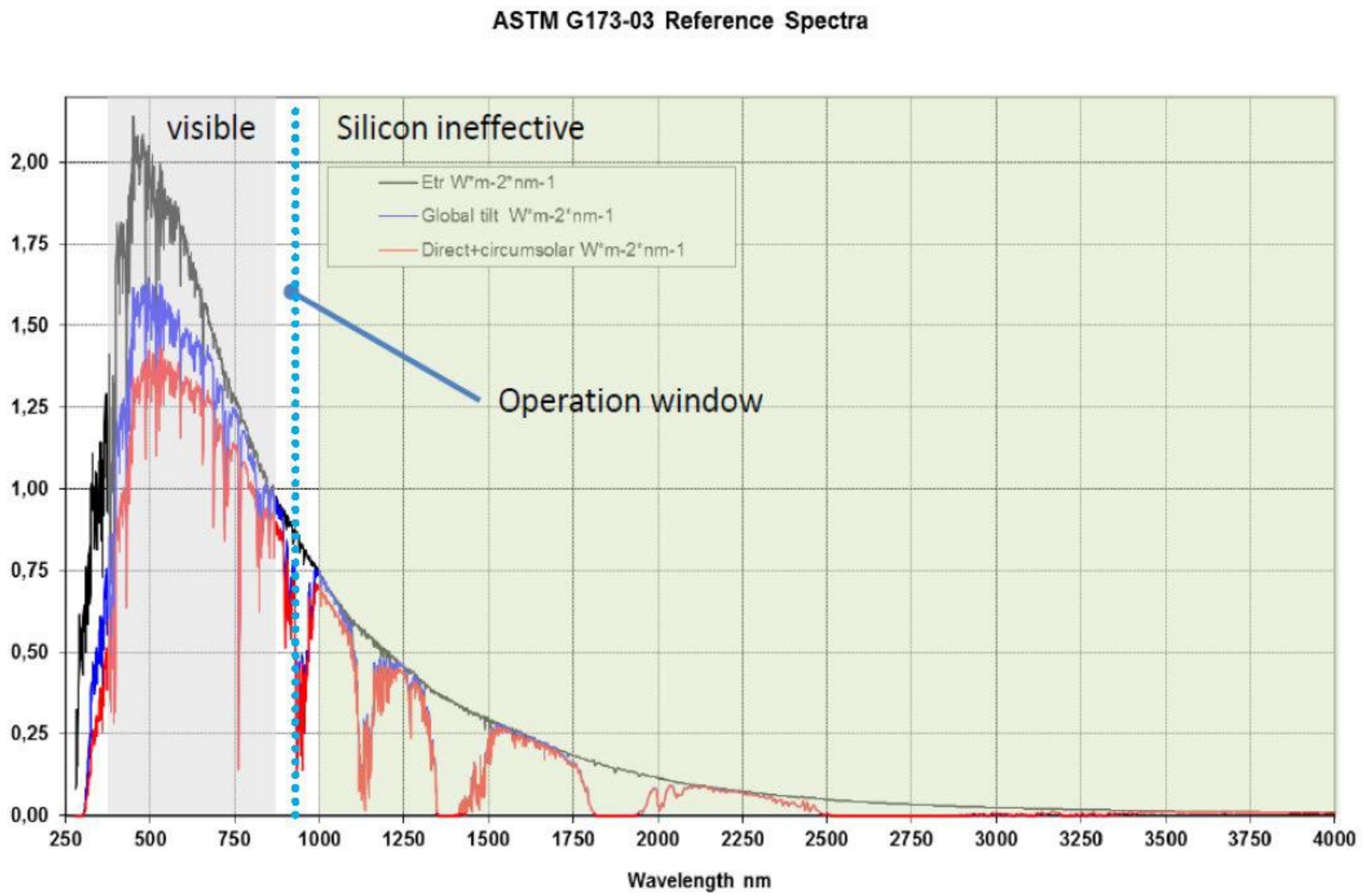
CORNER INTEGRATION AS EXAMPLE

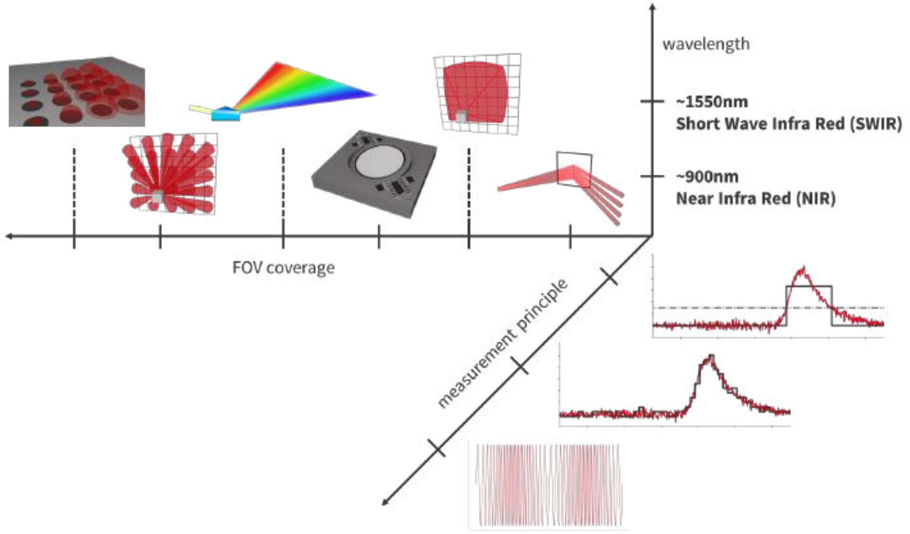
- Field of views >120° always lead to undesirable vehicle designs especially for passenger cars
- This constraint is independent from technology and supplier

Design friendly integration → maximum sensor FoV approx. 120° horizontal

AUTOMOTIVE LIDAR DESIGN SPACE
WAVELENGTH

ibeo automotive





- ~905 nm
  - + Silicon-based detectors
  - – Lower Eye safety limits
- ~1500 nm
  - + Higher eye-safety limits
  - – IR (non-silicon) photo detectors

CORNER CASES

Intersection crossing:

- Detection of worst case object: „approaching motorcycle“

Lane change:

- Detection of worst case object: „approaching motorcycle“

Near range & cut in:

- Requires large HFoV

Overhanging Load:

- Requires large VFoV

Small obstacles:

- High range and fine resolution

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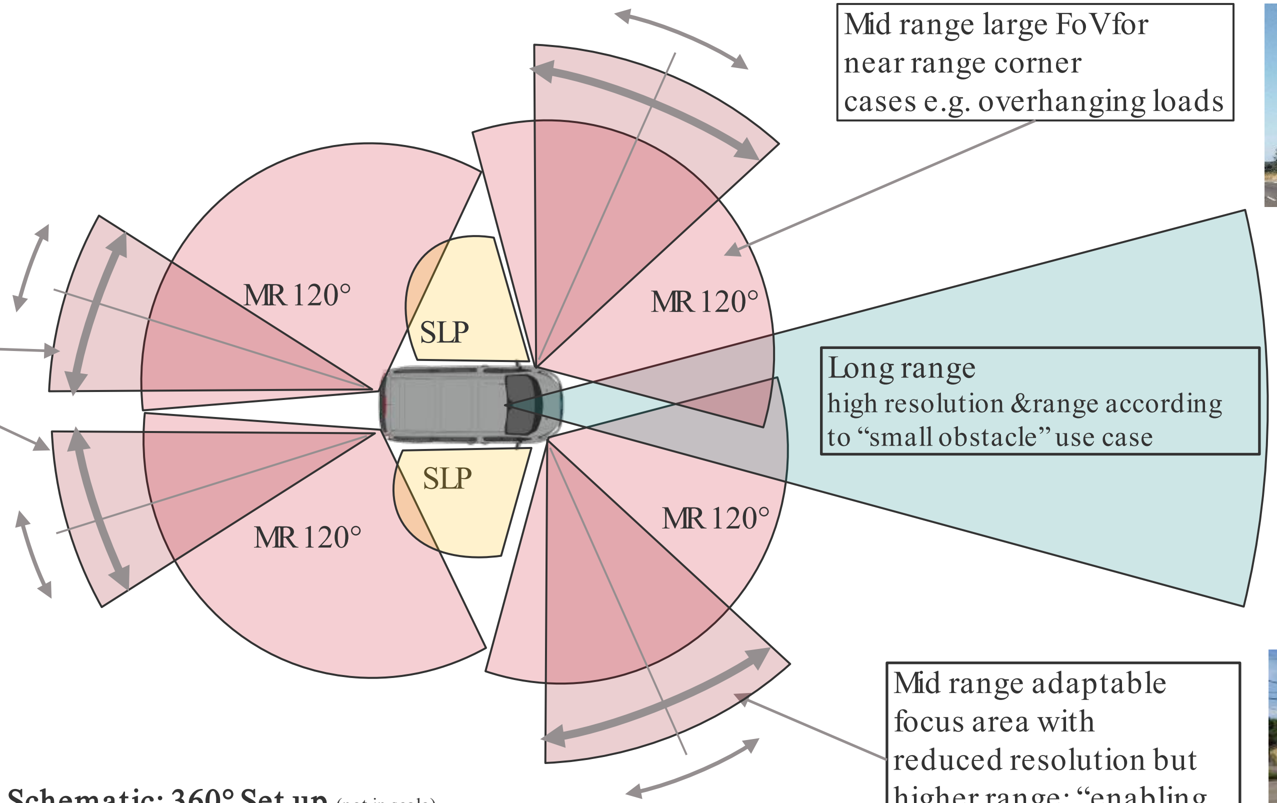
Mid range adaptable focus area with reduced resolution but higher range: enabling "lane change – approving vehicle detection"



Mid range large FoV for near range corner cases e.g. overhanging loads

Mid range adaptable focus area with reduced resolution but higher range: "enabling intersection crossing"

Schematic: 360° Set up (not in scale)
4x120°; 1 LR front and 2 SLP to the side