

Logistic AGV: Sensor Selection and LiDAR

Presented by:

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Goals for the Presentation

- Educational, for decision makers and system designers who haven't introduced automation to their applications
- LiDAR brief introduction and application consideration

Topic Coverage

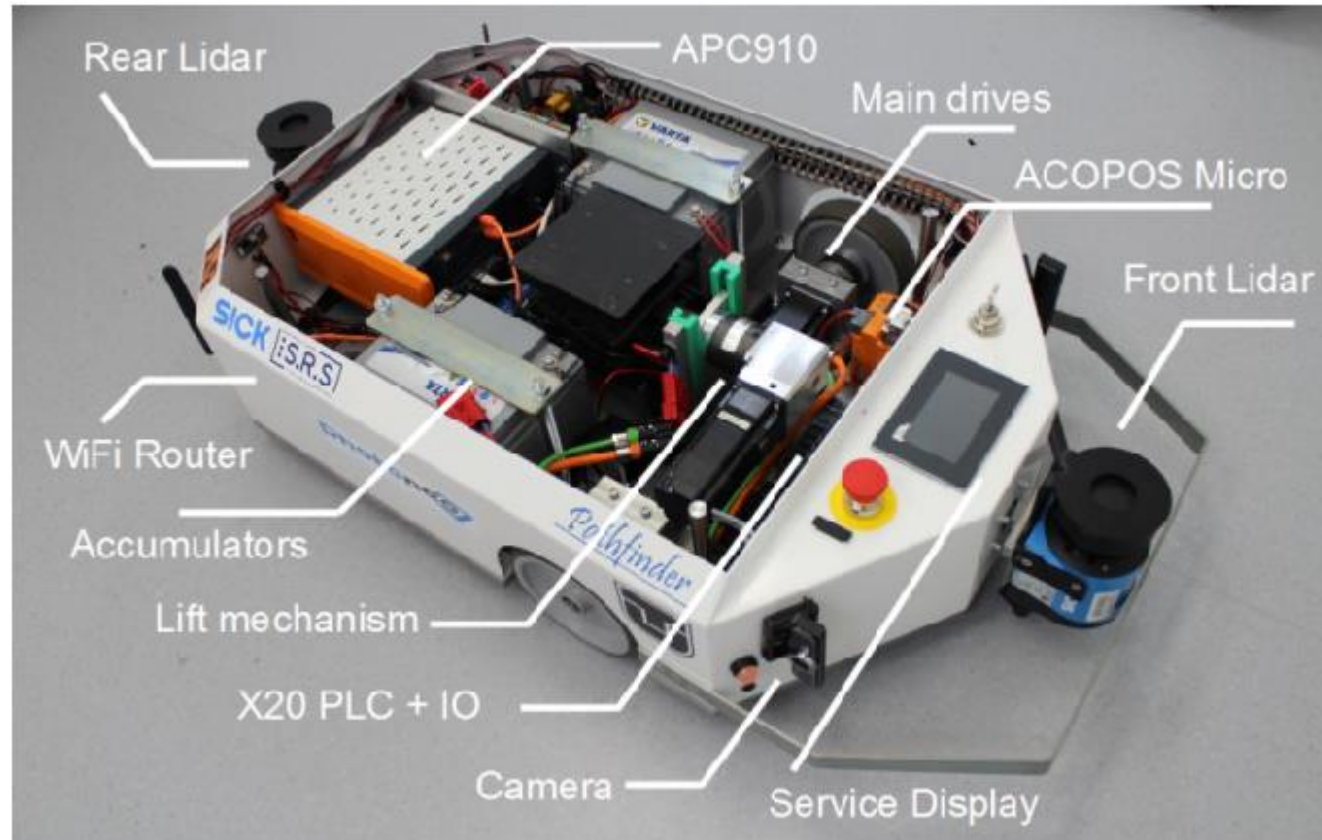
- What is LiDAR?
- What can LiDAR do, what cannot?
- How to Select LiDAR?

Logistic AGVs



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AGV Structure in General



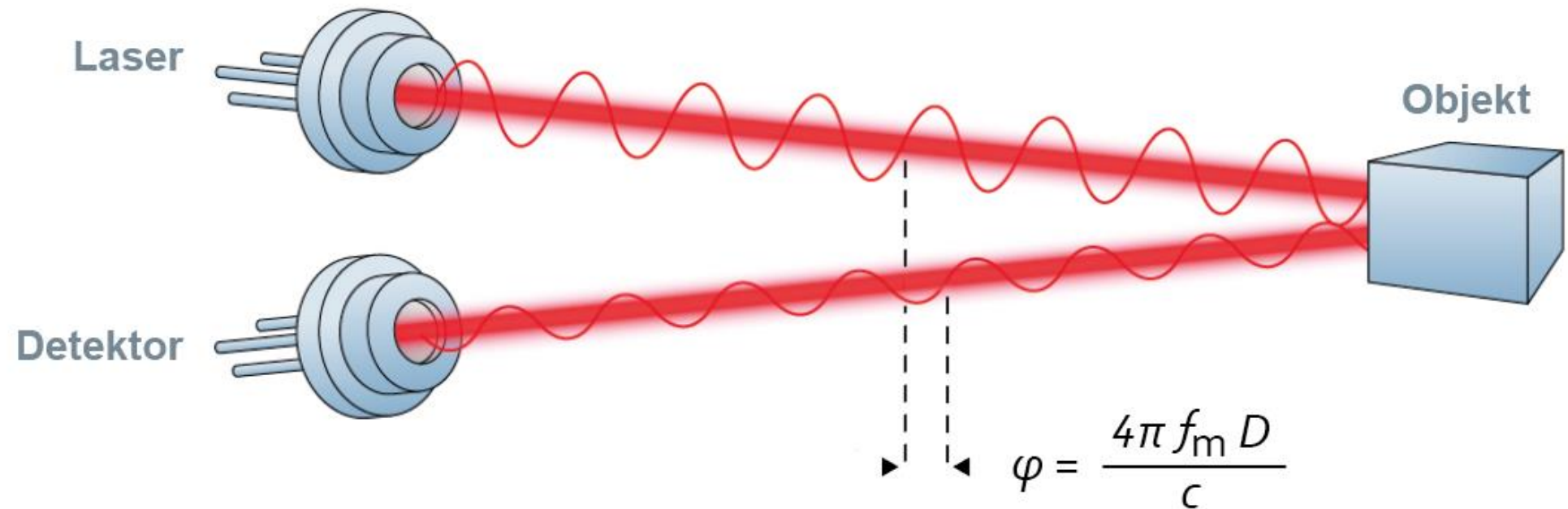
Sensors for AGV

- Camera
- Bar code scanner
- RFID
- Sonar
- Radar
- Laser distance sensor
- LiDAR: **L**ight **D**etection **A**nd **R**anging

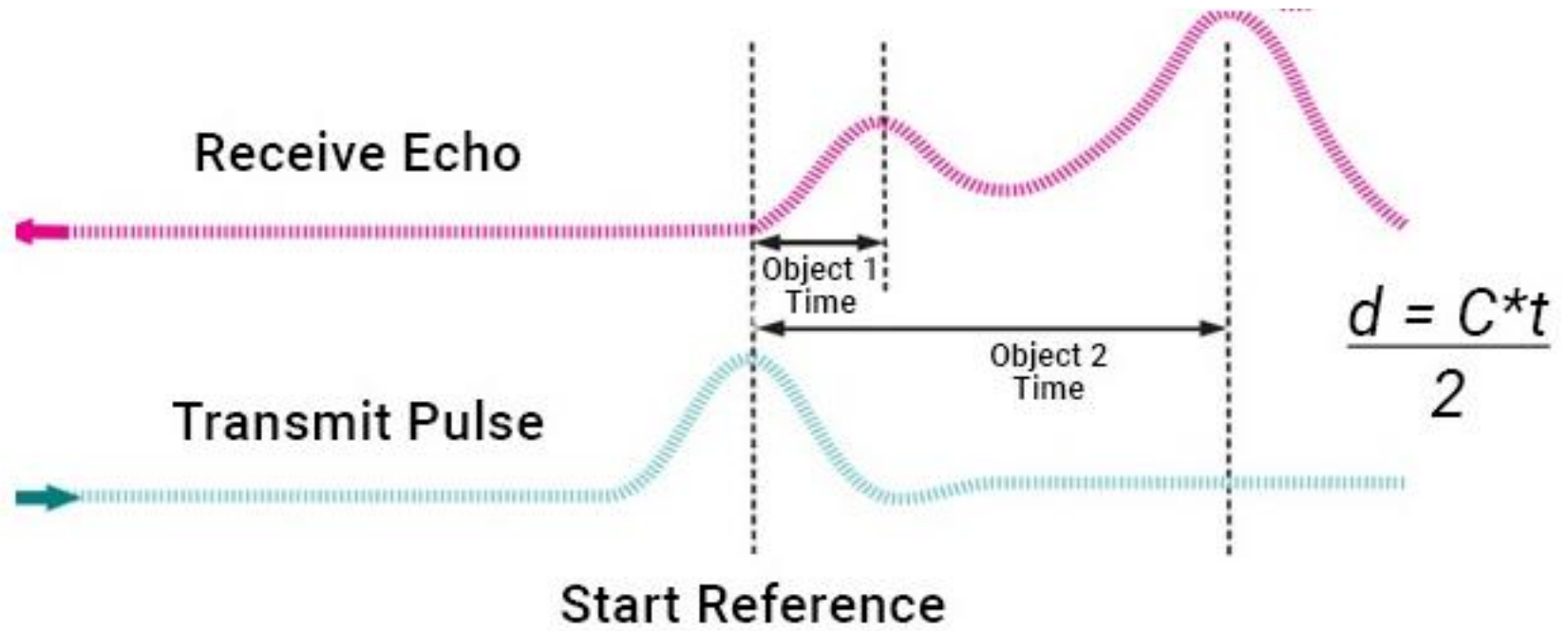
How to Use Laser to Measure Distance

- Phase shift detection: high precision, slow
- Pulse time-of-flight (ToF): real-time
- Triangulation

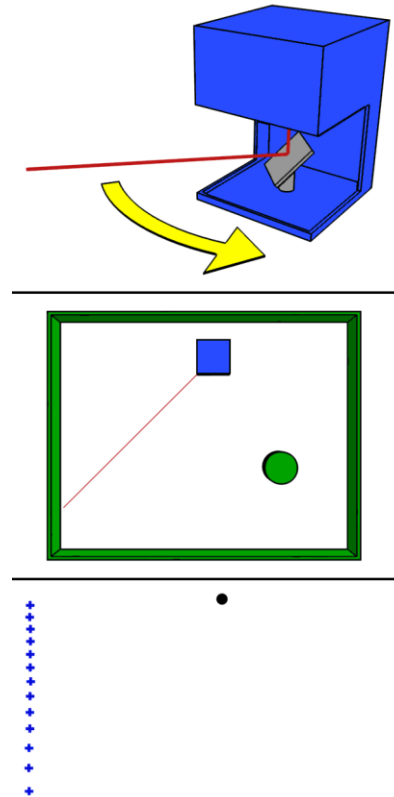
LiDAR: Phase Shift Detection



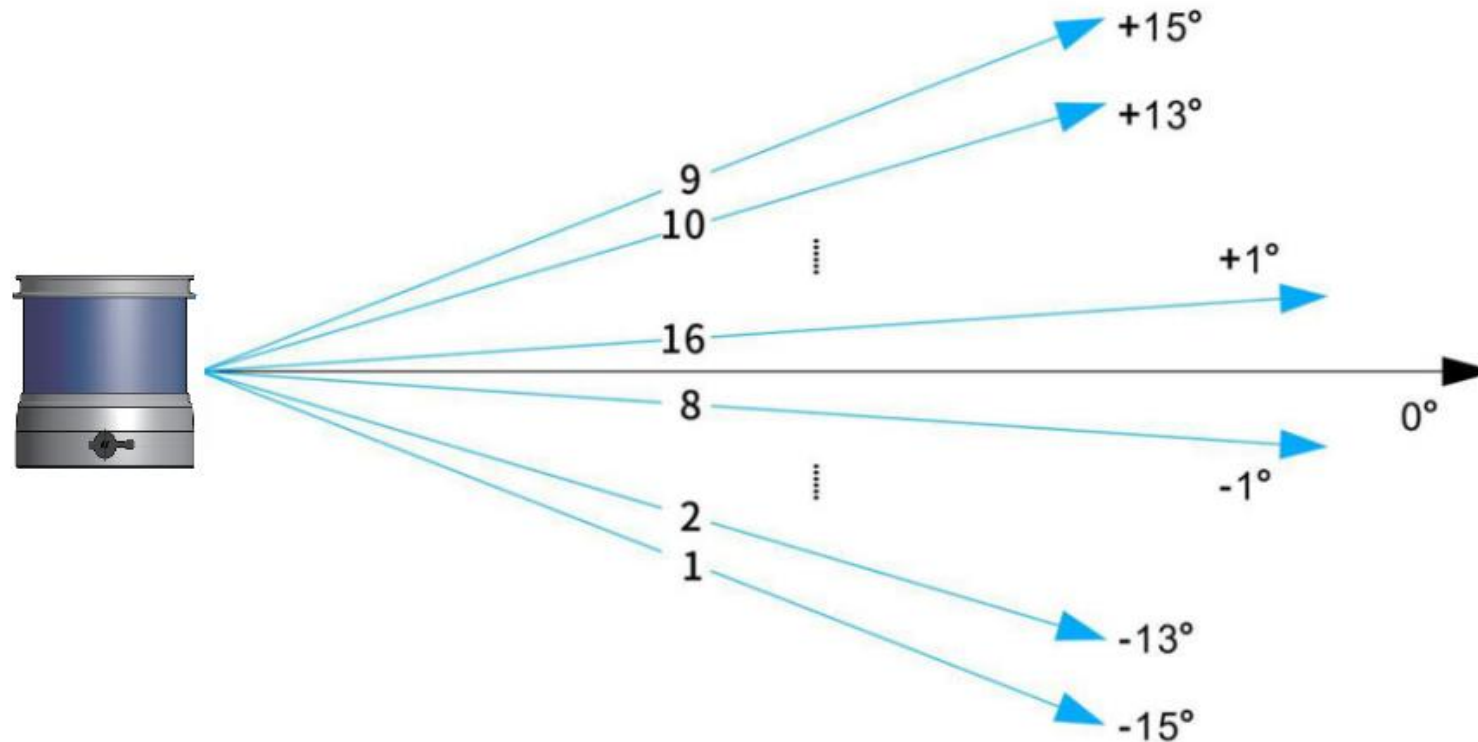
LiDAR: ToF



LiDAR for AGV: Conventional Implementation



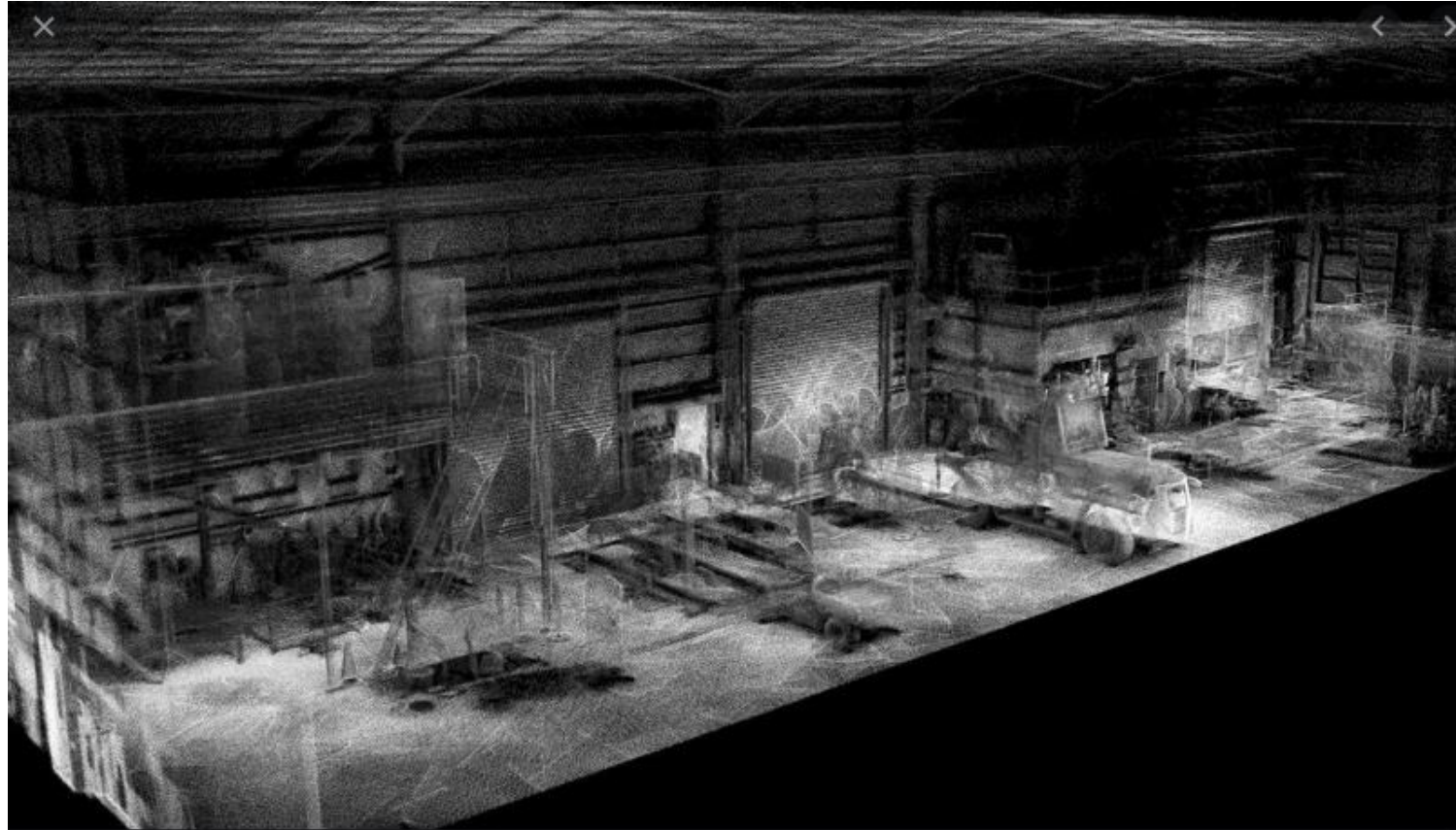
LiDAR: Multiple Channel Example



What is Difference Between Laser Scanner and LiDAR

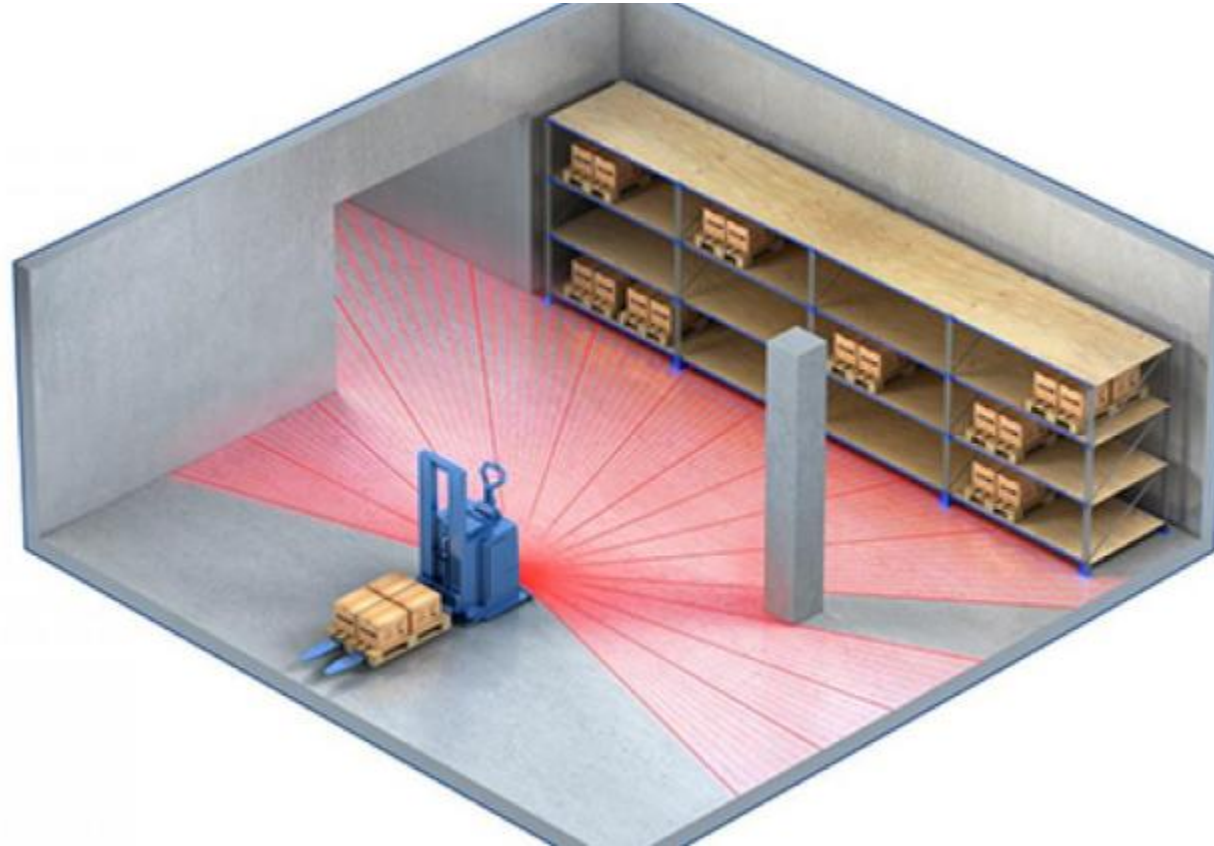


LiDAR for AGV: Digital Mapping



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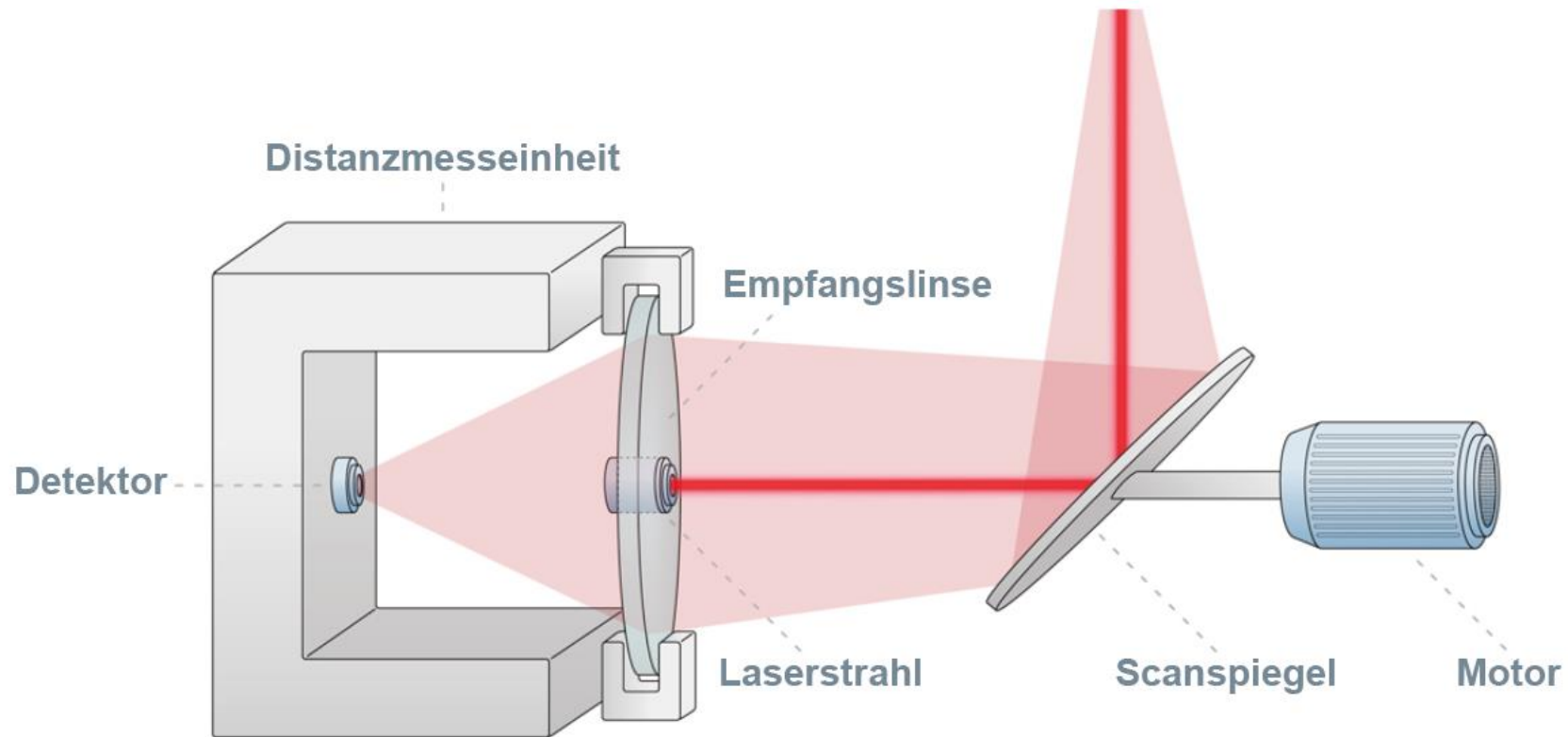
LiDAR for AGV: Navigation, Collision Avoidance



What Cannot LiDAR Do for AGV?

- Transparent object detection and avoidance
- Mirror or object with total reflective surface detection and avoidance
- Dusty environment
- Foggy, heavy rain and snow
- Very dark object

LiDAR: Basic Hardware



LiDAR for AGV: Basic Spec

- Distance
- Accuracy
- Field of View (FOV)
- Data rate
- Resolution
- Environment tolerance

LiDAR for AGV: Other Consideration

- Safety
- Quality consistency
- Customization
- Cost

LiDAR for AGV: Testing

- Distance measurement linearity
- Distance measurement for the targets with different reflectivity
- Angular or spatial resolution variation
- Temperature tolerance
- Mechanical vibration/shock tolerance
- Performance consistency from unit to unit

LiDAR for AGV: Commercial Availability

- 2D rotation LiDAR
- 3D rotation LiDAR
- MEMS LiDAR
- Flash LiDAR

LiDAR for AGV: 2D or 3D?

- Safety requirements
- Complexity of application environment
- Budgetary issue
- Excellency of software engineers
- Options of other sensors

Why is Mass Production of LiDAR Challenging

- LiDAR hardware manufacture:
 - Light source and sensor
 - Optical Alignment
 - Calibration
 - Cost control

Each product has its own personality

Why is Mass Production of LiDAR Challenging

- Firmware
 - Noise reduction
 - Multiple reflection
 - Real time processing

What Will Be the Next Generation

- Anything to replace laser to measure distance? Not yet
- Scanning mechanism innovation
- Massive application to drive the costs down
- LiDAR, LiDAR, LiDAR...

For more information:

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Thank You

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