

How Sensor Advancements are Addressing Higher Levels of Automation

DVN LIDAR Conference | SESSION 3: MARKET AND ECOSYSTEM

John Cooper
November 15, 2021

Agenda

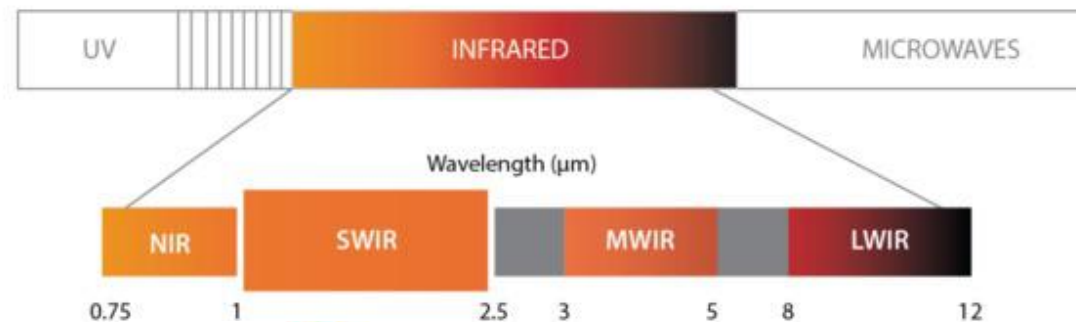
How Sensor Advancements are Addressing Higher Levels of Automation

- Camera
- Radar
- Lidar
- ADAS/AD Applications Enabled by Improved Sensors and Perception SW
- VSI Labs Applied Research



Sensor Performance Attributes: Camera

Performance Attributes	Camera	
	Passive Camera	Active Camera
2D Object Detection		
3D Object Detection	3D Perception SW	
Object Classification	3D Perception SW for 3D Object Classification	
Object Edge Precision		
Environment Analysis (Semantic Segmentation)	CV/DL Algorithms	
Angular Resolution		
Depth/Range Resolution	Stereoscopy/ 3D Perception SW	
Velocity Resolution		
Traffic Sign Reading		
(RGB) Color Recognition (Traffic Lights Recognition)		
Lane Detection		
Lane Tracking		
Living Object Detection	CV/DL Algorithms, Thermal FIR	
Dark Object Detection		
Adverse Weather		NIR Gated Vision, SWIR
Low-Light Performance	Adjustable Aperture	



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Clarity™ Reference Design

Design goals

- Range: 10 - 500+ meters
- Horizontal field-of-view: 32°
- Depth resolution: ~44 million points per second
- Angular resolution: down to 0.02°

Reference design details

- 3 identical cameras with overlapping field of view, working together
- Optimized for far-forward use cases
- Full field of view depth for every frame

Array Configuration

1 - Camera module

2 - 1000mm x 1000mm x 2.5mm

3 - 1000mm x 1000mm x 2.5mm

4 - 1000mm x 1000mm x 2.5mm

Note:

Green = High Ability

Yellow = Ability w/ Poor Performance

Red = Inability

Text = Method(s) to Improve



VSI Labs Applied Research

“Destination ACM” – Demonstrating Sensors Making the Unseen Visible

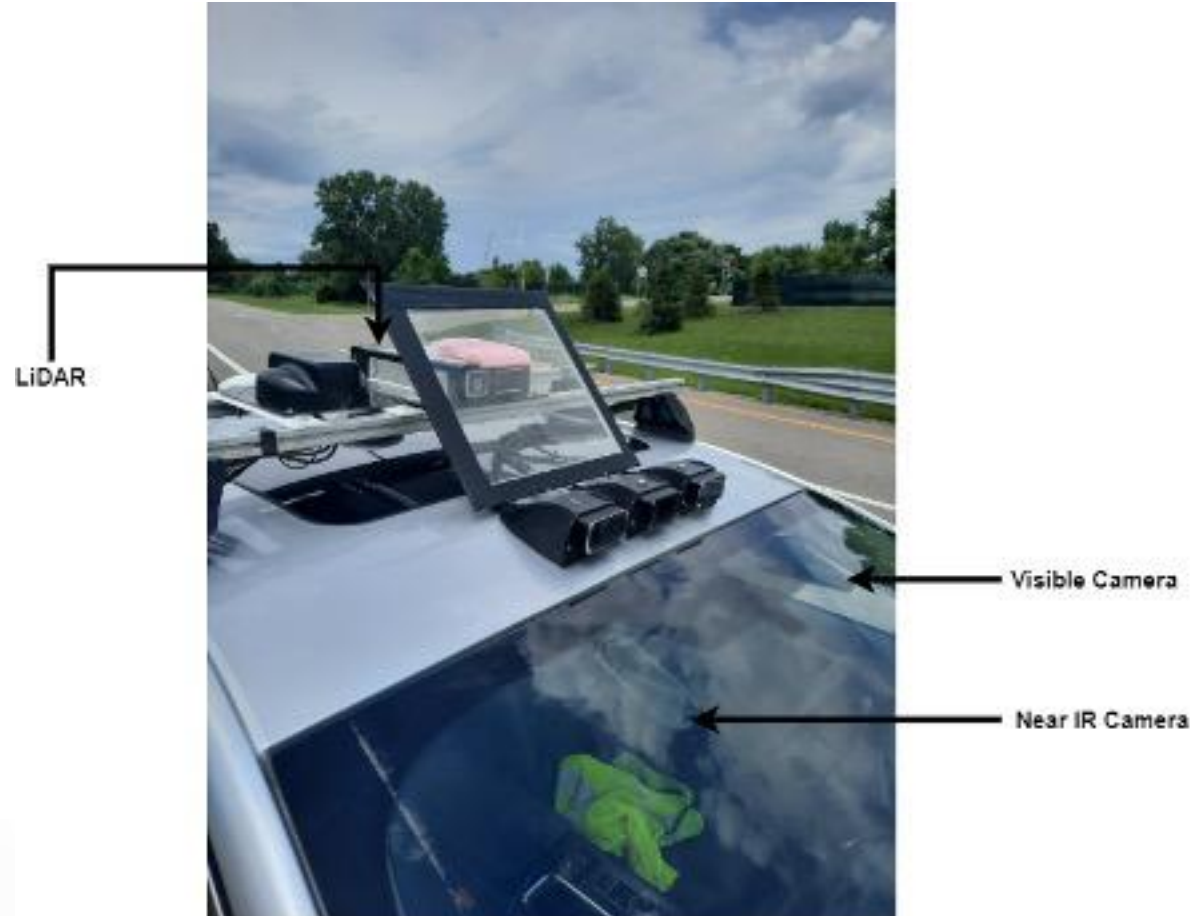
American Center for Mobility
near Detroit



VSI Labs Applied Research

“Destination ACM” – Demonstrating Sensors Making the Unseen Visible

- Sensor Placement



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“Destination ACM” – Demonstrating Sensors Making the Unseen Visible

- Target Placement



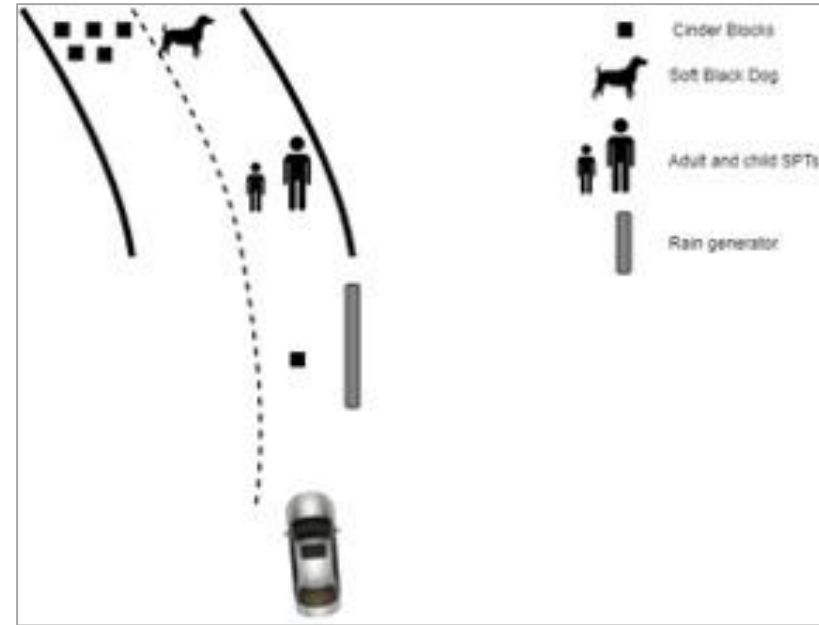
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- Sensor Perception

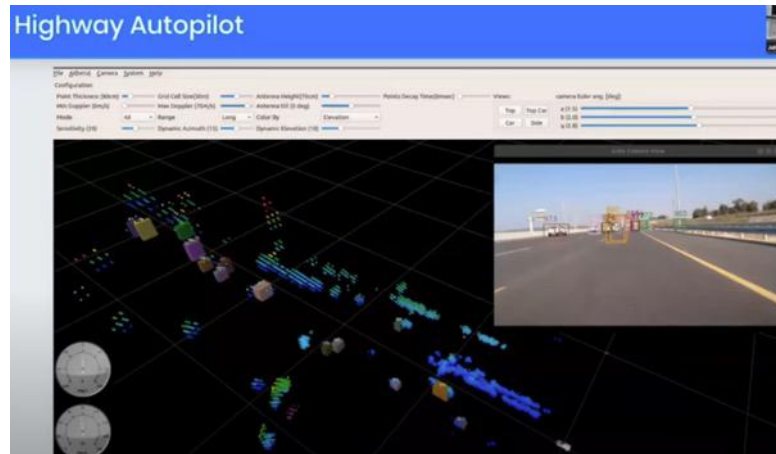


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Sensor Performance Attributes: Radar

Performance Attributes	Radar	
	Radar	Imaging Radar
2D Object Detection	Yellow	Imaging Radar SW, Radar DNN Processing
3D Object Detection	Yellow	
Object Classification	Red	
Object Edge Precision	Red	
Environment Analysis (Semantic Segmentation)	Red	
Angular Resolution	Yellow	Green
Depth/Range Resolution	Green	Green
Velocity Resolution	Green	Green
Traffic Sign Reading	Red	Red
(RGB) Color Recognition (Traffic Lights Recognition)	Red	Red
Lane Detection	Red	Red
Lane Tracking	Red	Red
Living Object Detection	Red	Red
Dark Object Detection	Green	Green
Adverse Weather	Green	Green
Low-Light Performance	Green	Green



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Sensor Performance Attributes: Lidar

Performance Attributes	Lidar	
	ToF LiDAR	FMCW LiDAR
2D Object Detection	Green	Green
3D Object Detection	Green	Green
Object Classification	Green	Green
Object Edge Precision	Green	Green
Environment Analysis (Semantic Segmentation)	Lidar Perception SW	
Angular Resolution	Green	Green
Depth/Range Resolution	Green	Green
Velocity Resolution	Yellow	Green
Traffic Sign Reading	Red	Red
(RGB) Color Recognition (Traffic Lights Recognition)	Red	Red
Lane Detection	Lidar Perception SW	
Lane Tracking	Lidar Perception SW	
Living Object Detection	Lidar Perception SW	
Dark Object Detection	Lidar HW design	
Adverse Weather	Lidar Perception SW, Lidar HW design	
Low-Light Performance	Green	Green



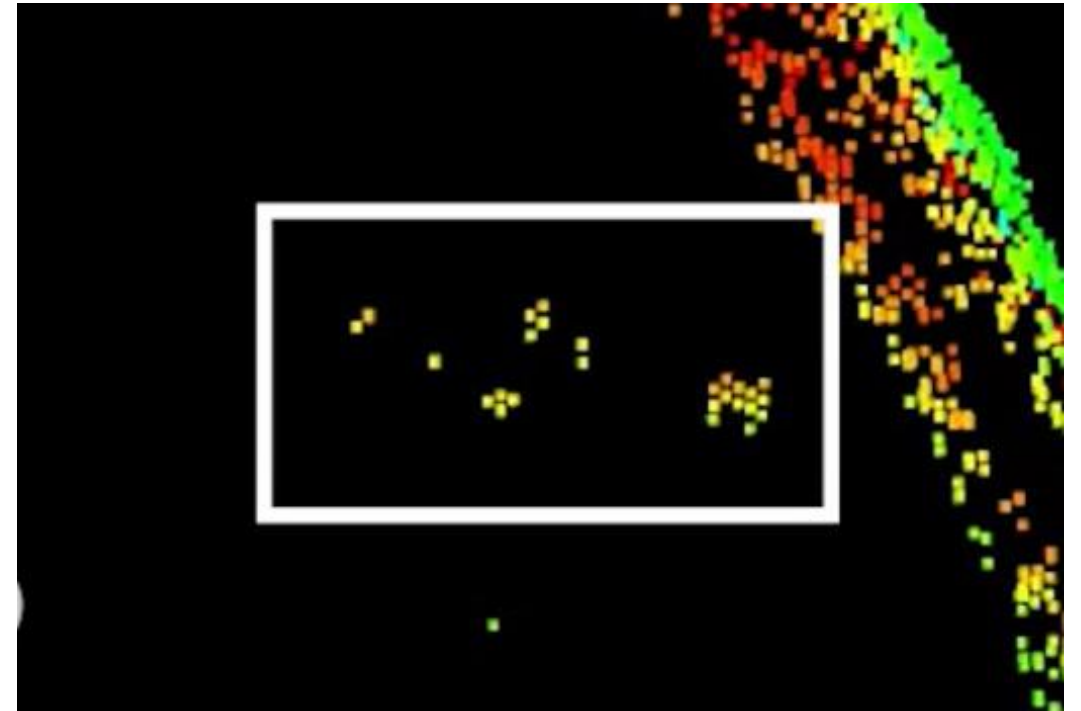
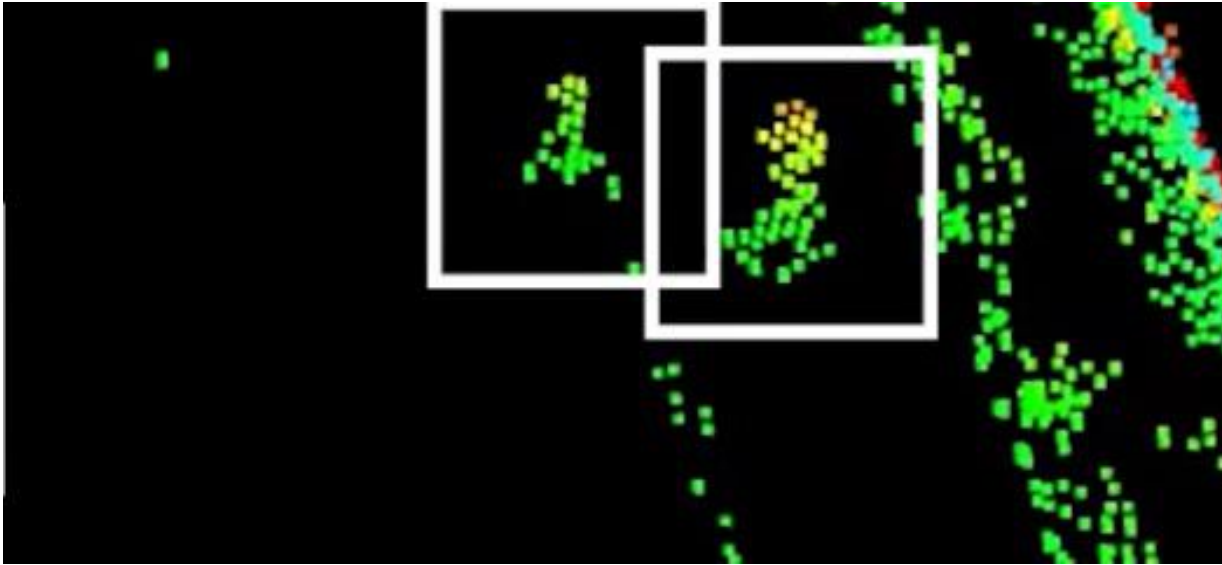
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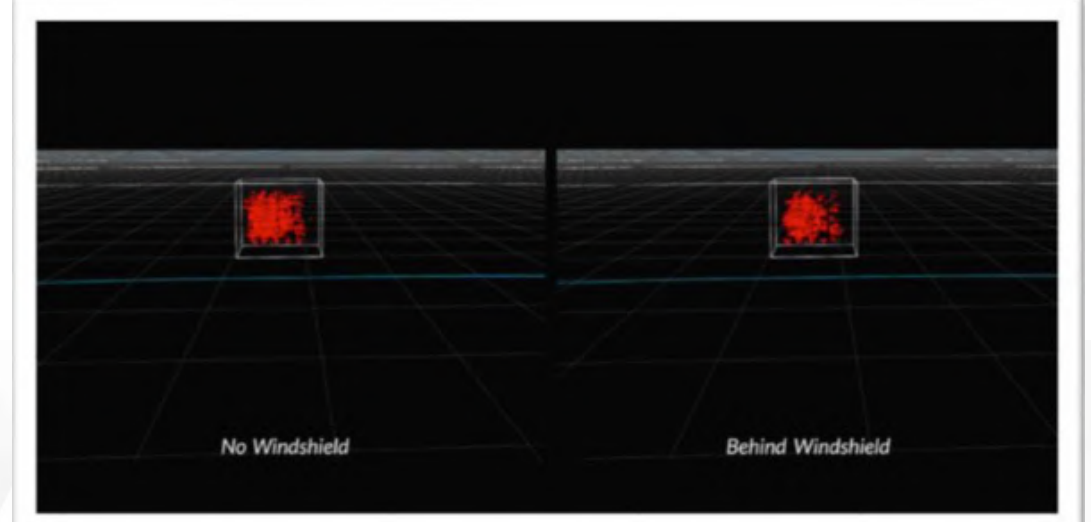
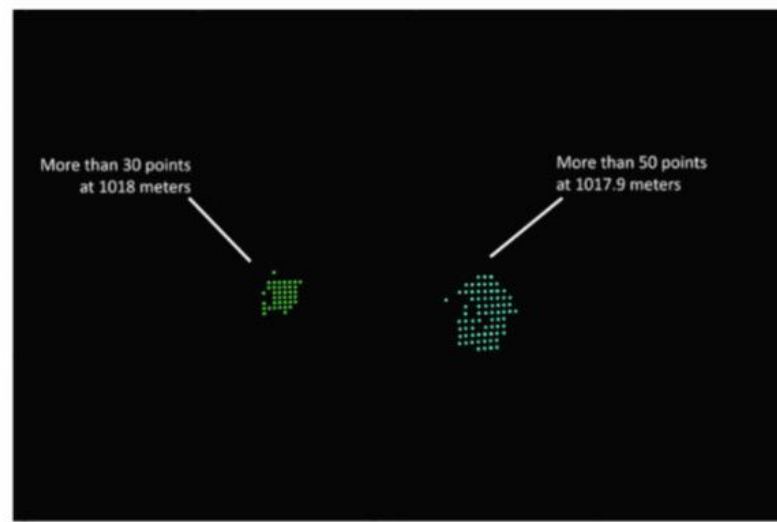
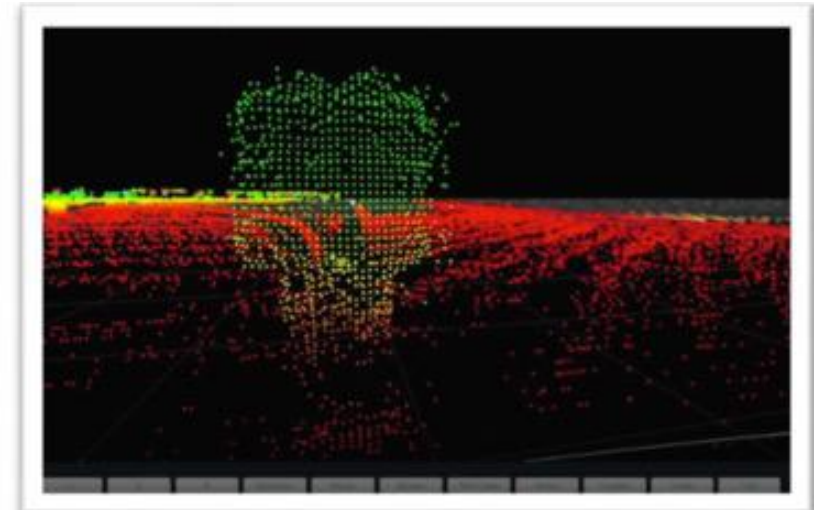
“Destination ACM” – Demonstrating Sensors Making the Unseen Visible

- Sensor Perception



VSI Labs Applied Research

VSI Labs Validation Report on AEye iDAR Lidar Sensor Performance



Sensor Performance Attributes and ADAS/AD Apps



Performance Attributes	Sensors						ADAS / AD Applications										
	Passive Camera	Active Camera	Radar	Imaging Radar	ToF LiDAR	FMCW LiDAR	AEB Inter-Urban	AEB City	AEB-P	ACC	LKA	TJA	Lane Change	TJP <60kph	HWP (Full speed)	Urban/City Pilot	
2D Object Detection							X	X	X	X	X	X	X	X	X	X	
3D Object Detection	3D Perception SW			Imaging Radar SW, Radar DNN Processing					X				X	X	X	X	
Object Classification	3D Perception SW for 3D Object Classification							X	X	X	X	X	X	X	X	X	X
Object Edge Precision										(X)				(X)	(X)	(X)	X
Environment Analysis (Semantic Segmentation)	CV/DL Algorithms					Lidar Perception SW								(X)	(X)	(X)	X
Angular Resolution										(X)	(X)	(X)	(X)	(X)	(X)	X	
Depth/Range Resolution	Stereoscopy/ 3D Perception SW						X	X	X	X		X	X	X	X	X	
Velocity Resolution							X	(X)	(X)	X		X	X	X	X	X	
Traffic Sign Reading										(X)		(X)	(X)	(X)	(X)	X	
(RGB) Color Recognition (Traffic Lights Recognition)																X	
Lane Detection											X	X	X	X	X	X	
Lane Tracking											X	X	X	X	X	X	
Living Object Detection	CV/DL Algorithms, Thermal FIR								X					X	X	X	
Dark Object Detection															(X)	X	
Adverse Weather		NIR Gated Vision, SWIR													(X)	X	
Low-Light Performance	Adjustable Aperture							(X)	(X)	(X)						(X)	X

Q&A



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