

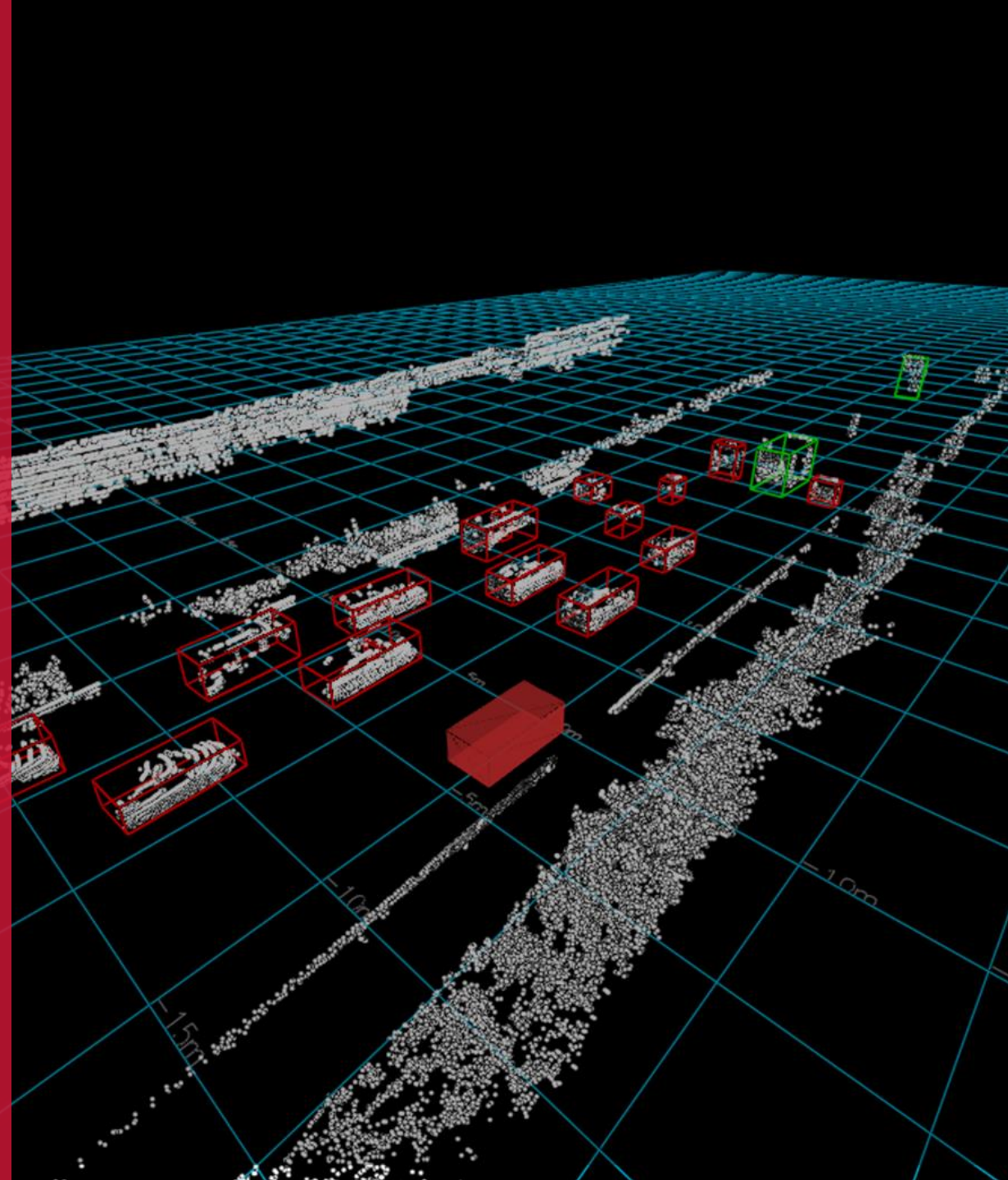
Confidential

VUERON

LiDAR Solution Provider for Automotive



June 20–22, 2023 | Santa Clara, CA



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Overview



Since 2019, Vueron has achieved milestones and built various business references, attracting over \$10 million in investments

Overview

Name	Vueron Technology Co., Ltd.
Foundation	October 10 th 2019
CEO	Joseph Kim
Office	HQ Seoul, South Korea San Jose office Munich office
Team	45 (32 engineers)
Key milestones	<ul style="list-style-type: none">• Obtain one LiDAR only self-driving permit in Korea / California / Nevada• Revealed smart Infra LiDAR solution• Revealed eco-friendly, self-driving truck

History

- **2023. 01** Release VueTruck – eco-friendly, self-driving truck
- 2022. 06** Obtained AV permit in US (CA / NV)
- **2021. 12** Pre-A Funding U\$10m (KDB, Bon Angels and more)
- 2021. 02** Obtained AV permit in Korea
- **2020. 11** Release VueTwo – Smart infra solution
- 2020. 07** Release VueOne – Automotive solution
- 2020. 05** Seed Funding(Naver, Bon Angels)
- **2019. 10** Vueron Technology Foundation



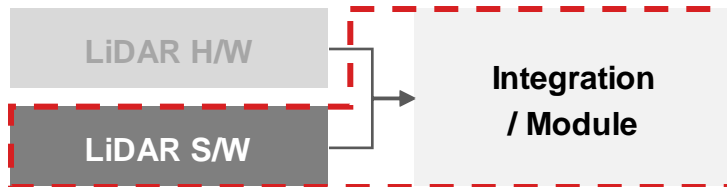
History

Driven by our mission to make people safer,
Vueron is dedicated to addressing the challenges of the autonomous driving industry and smart cities with Vueron LiDAR solution

Value

Mission **“To make people safer by providing the best LiDAR solution”**

Business



Product

- VueOne** • Autonomous Driving / ADAS
- VueTwo** • Smart infrastructure
- VueTruck** • Eco-friendly, self-driving truck

Global Networks



Vueron Product Description : Software

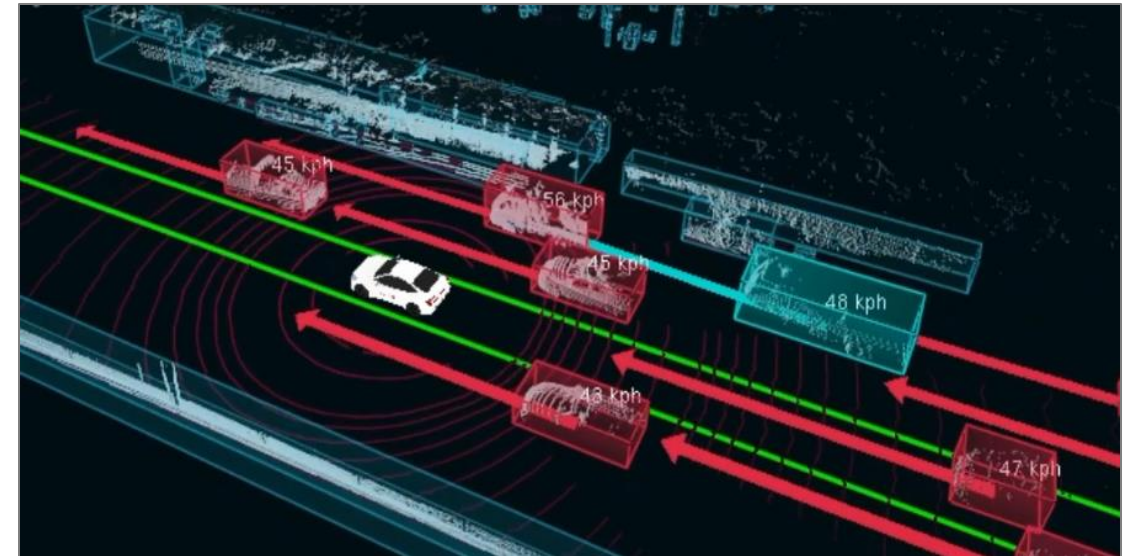
LiDAR software provides essential information for autonomous driving system by pre-processing millions of data points per second from LiDAR hardware

LiDAR Hardware



- **Hardware only provides point information**
 - Point X, Point Y, Point Z, and Point Intensity

LiDAR Software



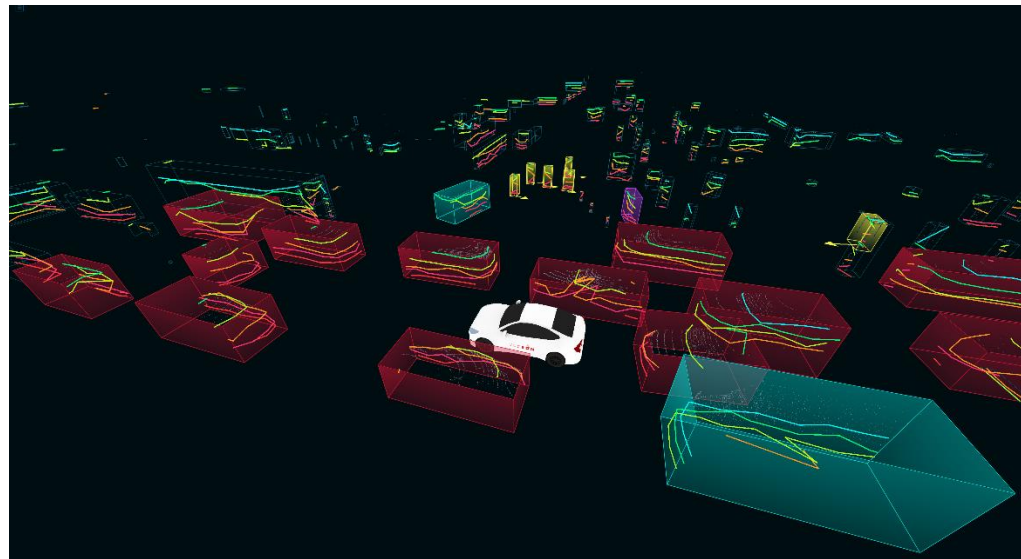
- **Software provides object information**
 - Position, Size, Direction, Velocity, and more

Vueron Product Description : VueOne



VueOne is a LiDAR perception software for autonomous driving and ADAS system

Basic output



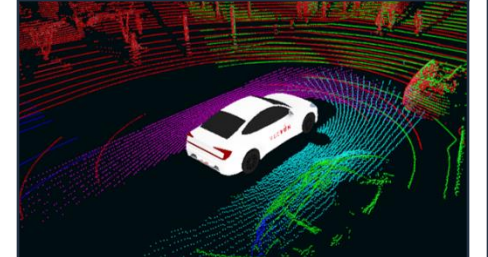
- Car
- Commercial Vehicle
- Pedestrian
- Cyclist
- Unknown object
- Velocity
- Object contour

Functions

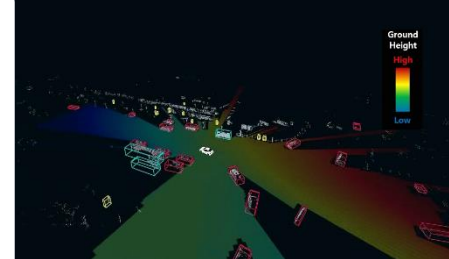
Lane Detection



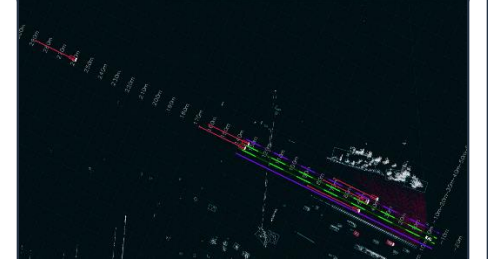
Multi-LiDAR Calibration



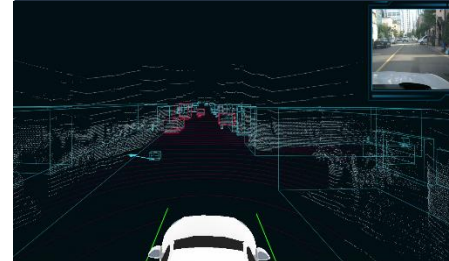
Ground Height Detection



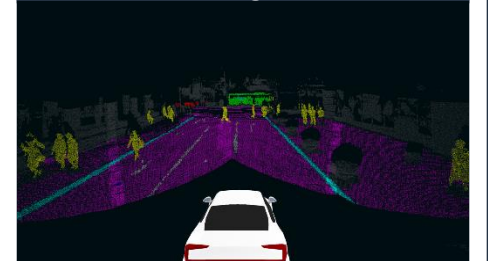
Long Range Detection



Road Obstacle Detection



Semantic Segmentation



Platforms

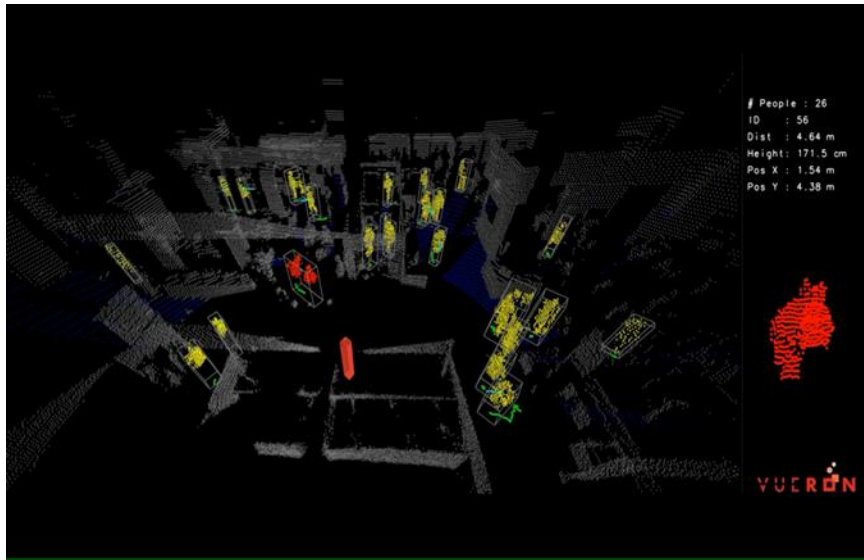


Vueron Product Description : VueTwo



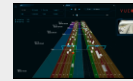
VueTwo is the best LiDAR perception software for smart infrastructure

Basic output



Object Class
(People, Car, and more*)

Distance



Height

Velocity

Direction

Trajectory

* More classes are available upon request.

Functions

People Counting



Danger Zone Alert



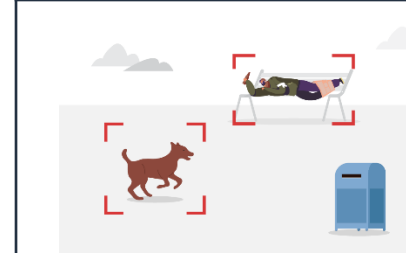
Heat Map



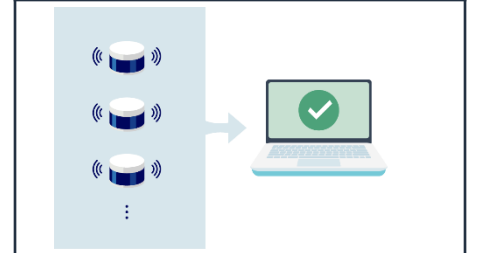
People Tracking



Moving Object Detection



Multi-LiDAR Processing



Platforms



Vueron Product Description : VueTruck



VueTruck is a specially designed Lv 4 autonomous trucking system for the delivery of fresh and frozen foods from hubs to customers



VueTruck - 001



System configurations



Operations



Key summary

1. Lv.4 autonomous trucks powered by our cutting-edge LiDAR solution, VueOne.
2. Sustainable delivery solution by utilizing electric trucks and refrigeration boxes
3. Providing highly reliable services through our partnership with 'TeamFresh', Korea's #1 cold-chain logistics company

VueOne's Competitiveness : Summary

VueOne enables the clients to deploy the best LiDAR solution with top level of safety and performance for autonomous driving to their current mass-produced vehicles

Core Competencies

- 1

High Safety & Performance

 - Due to insufficient S/W development ability, LiDAR H/W manufacturers try to build up ecosystem by securing S/W partnering companies
- 2

Applicability to Mass-Produced Vehicles

 - Competitors' LiDAR solutions require a large capacity database and processing ability; cannot with low performance/power MCU
→ Inevitable to equip high-performance GPU with high power consumption
- 3

Co-Work References in Automotive Sector

 - For AV Solution commercialization, accumulative collaboration with OEM / Tier 1 and related partnering companies is the main point

VueOne's competitiveness

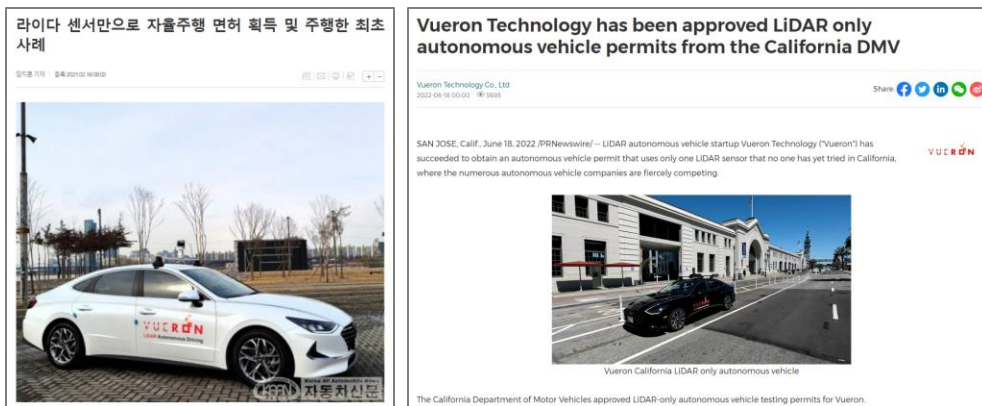
- World's first to obtain an autonomous driving license in Korea and US with only one LiDAR
- Continue to upgrade S/W performance with 8 test vehicles equipped with LiDAR
- 100% Compatible with every LiDAR in the world
- Available solution not only in GPU but also in low performance & power MCU
- Numerous POC projects and government tasks carried out for several years with automotive OEM and Tier 1
- Co-development experiences with global partners such as LiDAR H/W, Chipmaker, etc.

VueOne's Competitiveness : ① High Safety & Performance

Using test vehicles with autonomous driving license in Korea and US,
Vueron is constantly reviewing and upgrading its safety & performance level suitable for autonomous vehicles

Autonomous Driving License

**World's 1st company obtaining
AV permit with 1 LiDAR in Korea and USA^(CA / NV)**



- Feb '21, Obtained AV permit in Korea
- Jun '22, Obtained AV permit in CA, USA
- Jul '22, Obtained AV permit in NV, USA
- Dec '22, Prepare for obtaining AV permit in Germany

Autonomous Driving Test Vehicle

**Continuous review and upgrade of S/W performance with
8 test vehicles equipped with LiDAR Solution^(H/W + S/W)**



- Perform driving test with 4 cars^(Sedan, Truck, SUV) having AV permit in Korea and 2 cars in USA
- 2 LiDAR Solution Demo Vehicles (both in and outside of Korea)

VueOne's Competitiveness : ① High Safety & Performance

[Appendix] VueOne's Performance Benchmark

Challenge 1 3D Semantic Segmentation

Overview
Given one or more lidar range images and the associated camera images, produce a semantic class label for each lidar point.

Leaderboard
*disqualified from the 2022 Waymo Open Dataset Challenge

Method Name	Sensors	Frames [-p, +f]	mIoU	Class-wise Breakdown	Date (Pacific Daylight Time)
Cylinder3D*	All	[-undefined, +0]	0.718	MEAN_IoU	2022-05-23 23:54
LidarMultiNet		[-undefined, +0]	0.713	MEAN_IoU	2022-05-23 19:19
VUEION, Vueion.		[-undefined, +0]	0.7103	MEAN_IoU	2023-02-09 00:56
Offboard_SemSeg*		[-undefined, +0]	0.7061	MEAN_IoU	2022-05-23 11:03
MSeg3Dv2		[-undefined, +0]	0.7061	MEAN_IoU	2022-08-15 00:42
SegNet3Dv2		[-undefined, +0]	0.7048	MEAN_IoU	2022-05-23 15:27
SegNet3D		[-undefined, +0]	0.7026	MEAN_IoU	2022-05-22 03:02
MSeg3D		[-undefined, +0]	0.7008	MEAN_IoU	2022-08-07 20:09
HorizonSegExpert*		[-undefined, +0]	0.6944	MEAN_IoU	2022-05-23 20:07
WNet		[-undefined, +0]	0.6940	MEAN_IoU	2023-01-18 06:50

World **2nd** in Waymo Benchmark
(3D Semantic Segmentation)

Challenge 1 3D Detection

Overview
Given one or more lidar range images and the associated camera images, produce a set of 3D upright boxes for the objects in the scene. This is a simplified version of the 3D tracking challenge in that it ignores the temporal component. A baseline open source model is linked below for your reference.

Leaderboard

Method Name	Object Type	Sensors	Frames [-p, +f]	Latency (s)	AP / L1	APH / L1	AP / L2	APH / L2	Date (Pacific Daylight Time)
1 HRI_ADLAB_HZ	ALL_NS	L	[-3, +0]	Rank 1st	0.8701	0.8575	0.8257	0.8132	2022-11-19 00:54
3 MF-Net v2	ALL_NS	L	[-4, +0]	Rank 2nd	0.8599	0.8468	0.8137	0.8000	2022-11-24 02:37
5 LidarMultiNet-TTA	ALL_NS	L	[-2, +0]	Rank 3rd	0.8605	0.8472	0.8124	0.7994	2022-09-28 10:08
6 MIPNetEns-MMLab	ALL_NS	L	[-15, +0]	Rank 4th	0.8548	0.8444	0.8091	0.7960	2022-09-02 13:57
7 3DAM_Ens-Shanghai AI Lab	ALL_NS	L	[-4, +0]	Rank 5th	0.8528	0.8378	0.8065	0.7919	2022-07-19 01:40
8 LINUX_Detection	ALL_NS	L	[-4, +0]	Rank 6th	0.8482	0.8394	0.8022	0.7896	2022-05-10 21:18
9 MT3D	ALL_NS	L	[-3, +0]	Rank 7th	0.8503	0.8367	0.8006	0.7873	2022-06-15 05:31
10 MF-Net	ALL_NS	L	[-2, +0]	Rank 8th	0.8470	0.8322	0.7989	0.7845	2022-07-10 22:27
12 3dcl-ens	ALL_NS	L	[-4, +0]	Rank 9th	0.8463	0.8309	0.7968	0.7820	2022-07-02 02:08
13 VueionNet3D	ALL_NS	L	[-2, +0]	Rank 10th	0.8392	0.8246	0.7937	0.7795	2022-11-16 22:14

World **10th** in Waymo Benchmark
(3D Object Detection)

Vueron's Competitiveness : ② Applicability to mass-produced vehicles

VueOne is also a LiDAR software that can be 100% compatible with all types of LiDAR hardware and run with not only high-performance GPUs but also low-end MCUs

Applicability to LiDAR Hardware



- Regardless of manufacturer and product type, 100% compatible LiDAR S/W

Applicability to Processor



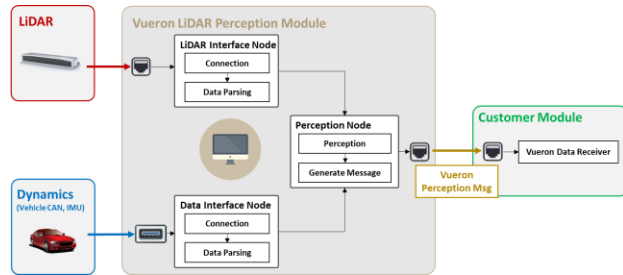
- LiDAR S/W available in not only with high-performance GPU, but also with MCU in mass-produced vehicles now using with low-power & low-performance

VueOne is the only one LiDAR software in the world that can immediately adapted to any LiDAR hardware and domain environment desired OEMs and Tier 1

VueOne's Competitiveness : ③ Co-Work References in Automotive Sector

Vueron has deep understanding of the automotive vehicles sector through numerous accumulated projects with Automotive OEMs and Tier 1

Global OEM



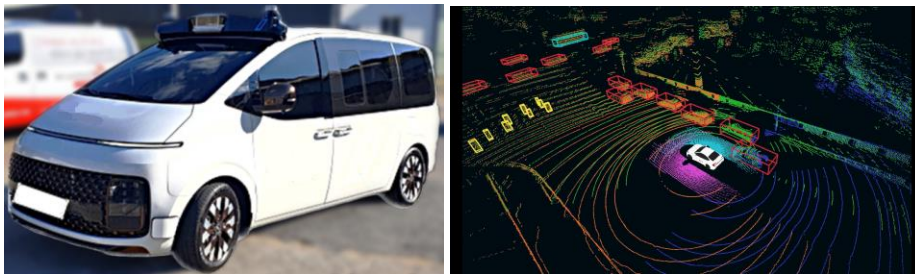
- PoC project to provide the perception s/w for LiDAR sensor that is considered mass production

Global OEM



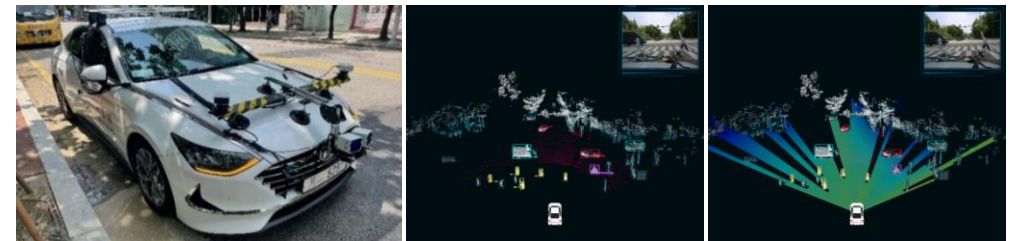
- PoC project to provide the sensor fusion software development (incl. LiDAR perception) for truck platooning system

Global Tier-1



- PoC project to provide the LiDAR perception s/w for autonomous shuttle

Global Tier-1



- PoC project to provide the LiDAR perception s/w for ADAS lamp system

Thank you

Contact : Noah Jang/ noah.jang@vueron.org