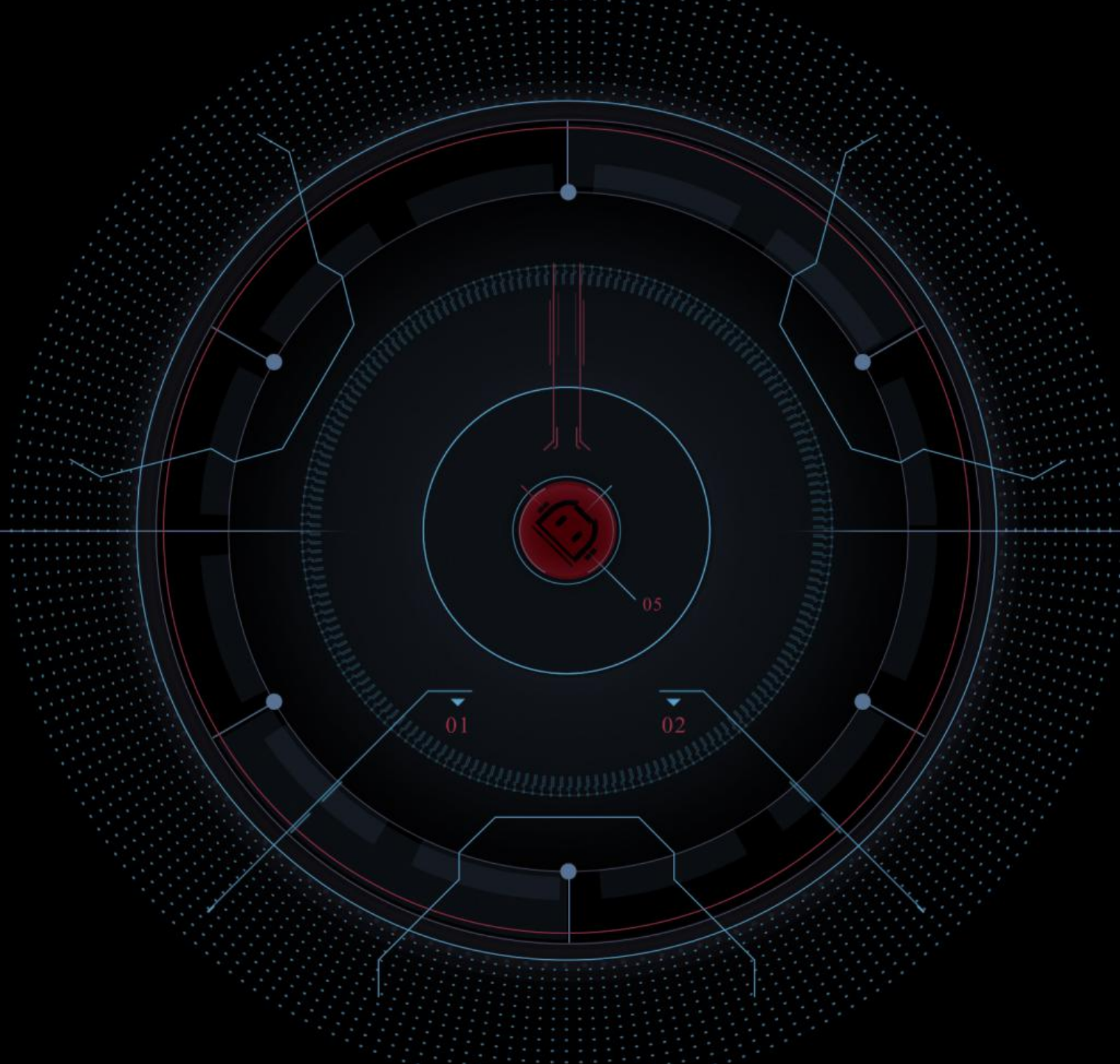
RoboSense（Suteng Innovation Technology）

More than what you see.

@robosenseLiDAR

Part 01

Who We Are



Our Vision

Taking LiDAR System as the Core Technology to

Bring Robots with Outstanding Environment Perception Capability that outperforms Human Eyes.

3 Dimensional

Long Range

All Weather

Core technology ：

LiDAR SYSTEMS

LiDAR is ushered in as the most potential sensor in this AI era. Compared with camera’s mimic on the vision mechanism of human eyes, LiDAR can give robots more. Insusceptible to ambient lighting, LiDAR is able to reconstruct 3D digital models with much higher precision than cameras. Taking all inclusive LiDAR solution as the core technology, RoboSense is dedicated to contribute its own share on the development of a modern smart city from each and every aspect.

Unmanned Vehicles
（eg: Waymo)

Robots
(eg. Boston Dynamics）

Security & Surveillance
(Migrant Virtual Wall)

UAV
(Power system Inspection)

Industrial
(eg. AGV)

Mapping & Surveying
(eg. Amap)

Smart City
Smart Transport

IoT

Project Highlights

World's Leading Autonomous Driving LiDAR Environment Perception System Provider: Delivers Complete Autonomous Driving LiDAR Hardware + Algorithm Solutions.

Strong Technology Accumulation:

- Multi-beam LiDAR Technology: Launched a line of mass production multi-beam LiDAR products: RS-LiDAR-16, RS-LiDAR-32A, RS-LiDAR-32B;
- MEMS LiDAR Technology——Live demonstrated RS-LiDAR-M1pre at CES2018 ;
- More than 20 months R&D efforts on OPA Technolgy, with multiple key technical barriers conquered.
- Multi-LiDAR Coupling Technology, LiDAR and Camera data fusion technology;
- LiDAR based autonomous driving environment perception Algorithms——LiDAR based localization, obstacles recognition/classification/tracking;
- MEMS LiDAR and Camera Data Fusion Technology (LCDF)
- HD map based comprehensive LiDAR perception system(strategic partnership with AMAP)

- Worldwide research, production and marketing strategy staffed with top level talents.
- Growing patent protection (more than 200 key patens)
- A large group of cooperative partners including: JD.com Inc, Cainiao, Baidu, SAIC, BAIC, TuSimple, Shenzhen Bus Group, SF Express, Deepmap, AutoX, Amap, etc.

Operation Footprints

Beijing
R&D Office

Shenzhen
R&D Headquarter
Research Base of Automated Production
Production Base

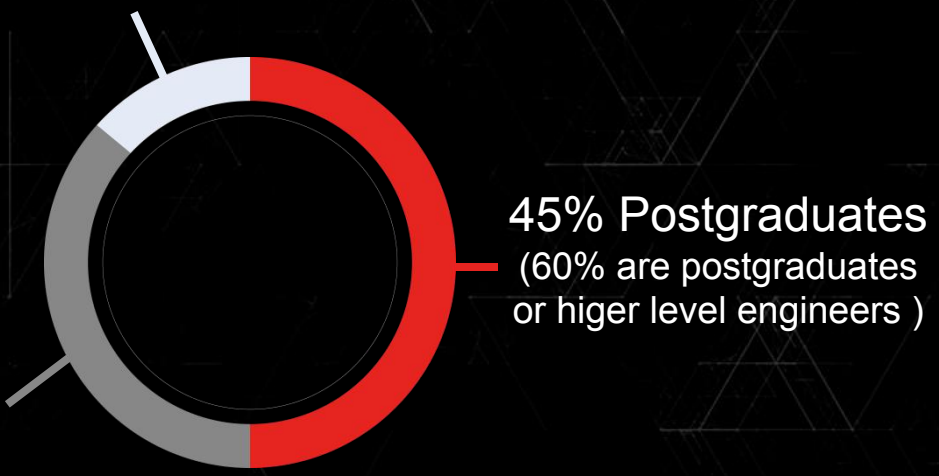
Silicon Valley
R&D Office

Our Team

15% PhDs
(40+ PhDs)

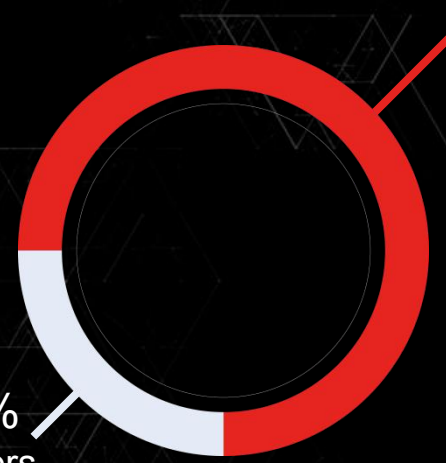
45% Postgraduates
(60% are postgraduates or higer level engineers)

40% Others



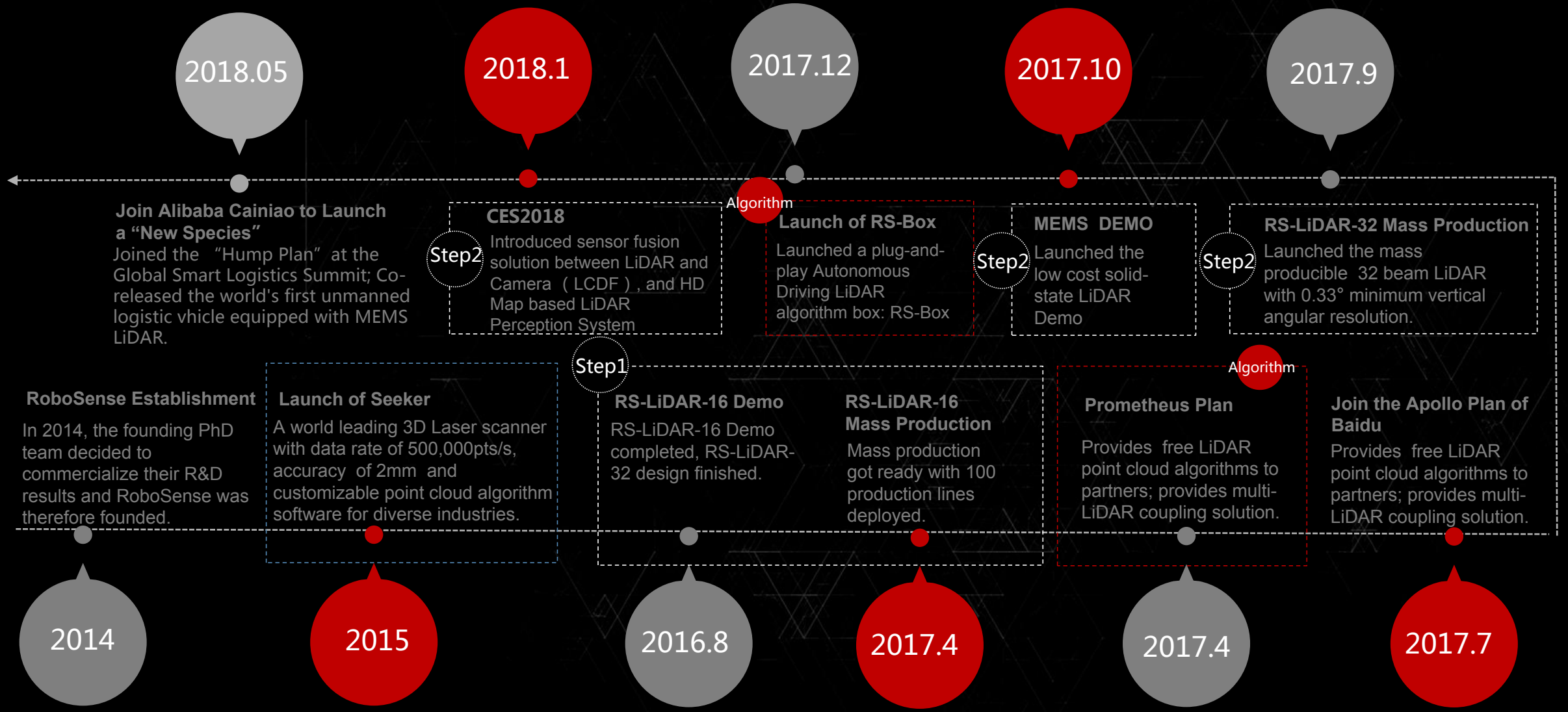
80% Research Engineers
(Core members from top universities, eg: Standford, UC Berkeley, University of Waterloo, Tsinghua University, Peking University, Harbin Institute of Technology, etc.

20%
Others



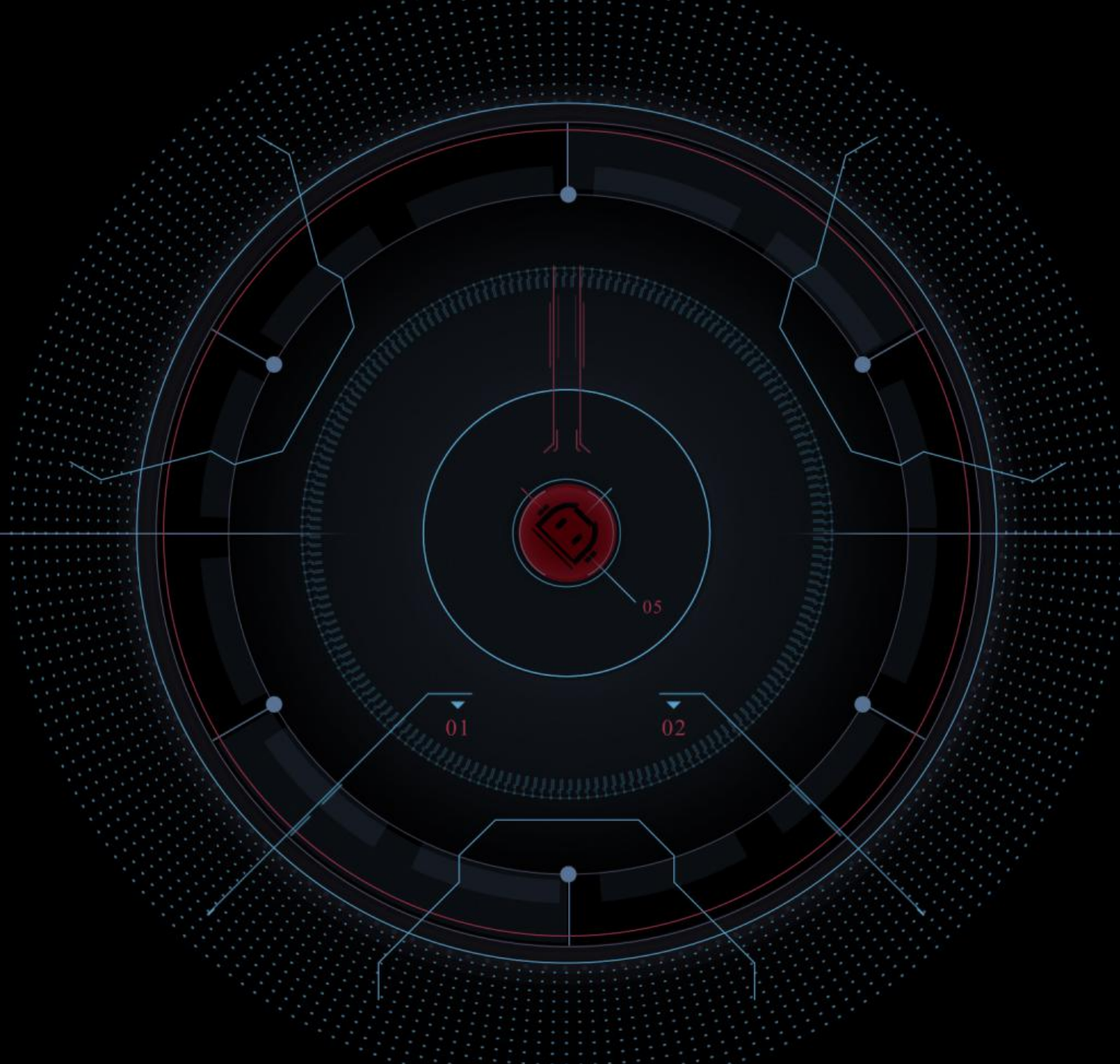
- The team is joined by members from the China Thousand Talents Program, China Peacock Talent Program, Linghang Leader Program, MIT TR35, Forbes Asia30U30, etc.
- Some members of the team have served prestigious enterprises including DJI, Lucent Bell LABS, Qualcomm,OmniVision, Intel, CNSI, Innovative, AltoBeam, Marvell, Huawei, ZTE, Mindray, etc.
- The team is also joined by members who have been evaluation experts or committee members of top level technology award panels including: IEEE, ETH Silver Medal, RGC and ICVS.

Development Path

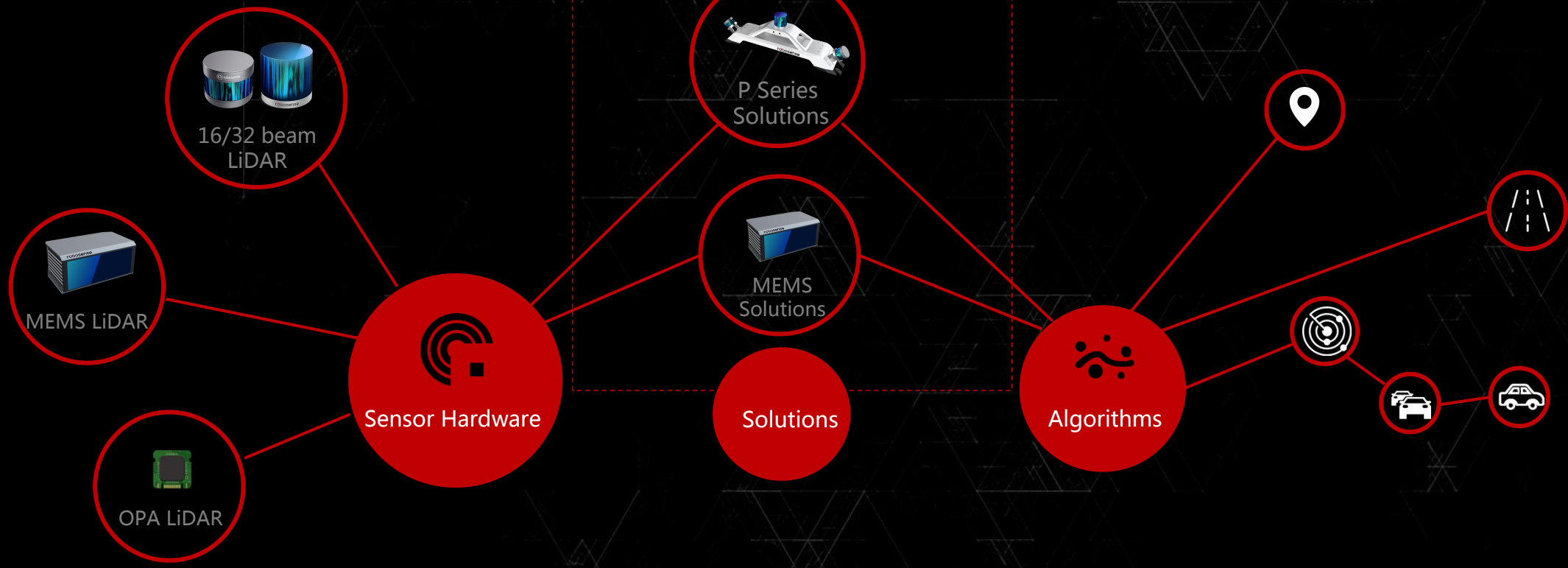


Part 02

Product Introduction



Products and Solutions

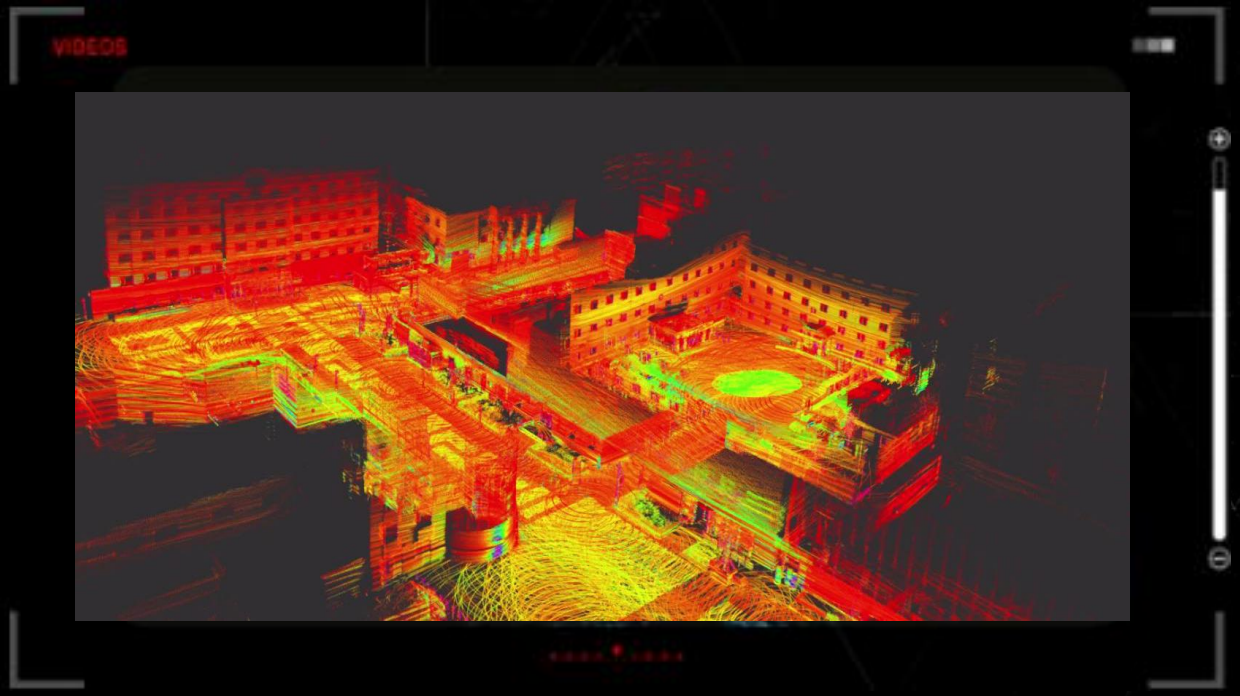


RoboSense combines hardware and solfware to provide full-stack LiDAR environment perception solutions for autonomous driving.

Sensor Hardware

- Mass Production Solid-state Hybrid LiDAR: RS-LiDAR-16
- Mass Production Solid-state Hybrid LiDAR: RS-LiDAR-32
- MEMS Solid-state LiDAR: RS-LiDAR-M1^{pre}
- NEXT：RS-LiDAR-M1 & OPA LiDAR

- Laser: 16 channels
- Wavelength: 905nm
- Laser class: class 1
- Accuracy: ±2cm(typical)
- Range: 20cm to 150m(20% object reflective intensity)
- Data rate: 320,000pts/s
- FOV: 360° × 30°
- Angular resolution（vertical): 2.0°
- FOV（horizontal）:360°
- Angular resolution(horizontal): 0.09°-0.36°（5Hz-20Hz)
- RPM: 300-1200rpm (5-20Hz)
- Input voltage: 9-32VDC
- Power: 9W(typical)
- Sensor protection: IP67
- Operation temperature: -10℃ to 60℃
- Dimension: 82.7mm*φ109mm
- Weight: 0.84kg(without cabling)
- Data: 3D space coordinates/reflective intensity



Real-Time, High Data Rate

RS-LiDAR-16 is designed with 16 powerful laser beams capable of continuous fast-speed scanning on an amazingly high data rate of 320,000 points/second.

Long Range, Higher Resolution

RS-LiDAR-16 excels on the global market with proved longest detection range. Amazing detection performance of 150m@20% reflectivity enables vehicles to clearly “see” the road conditions even a hundred meters ahead.

Ultraprecision Catches the Last Detail

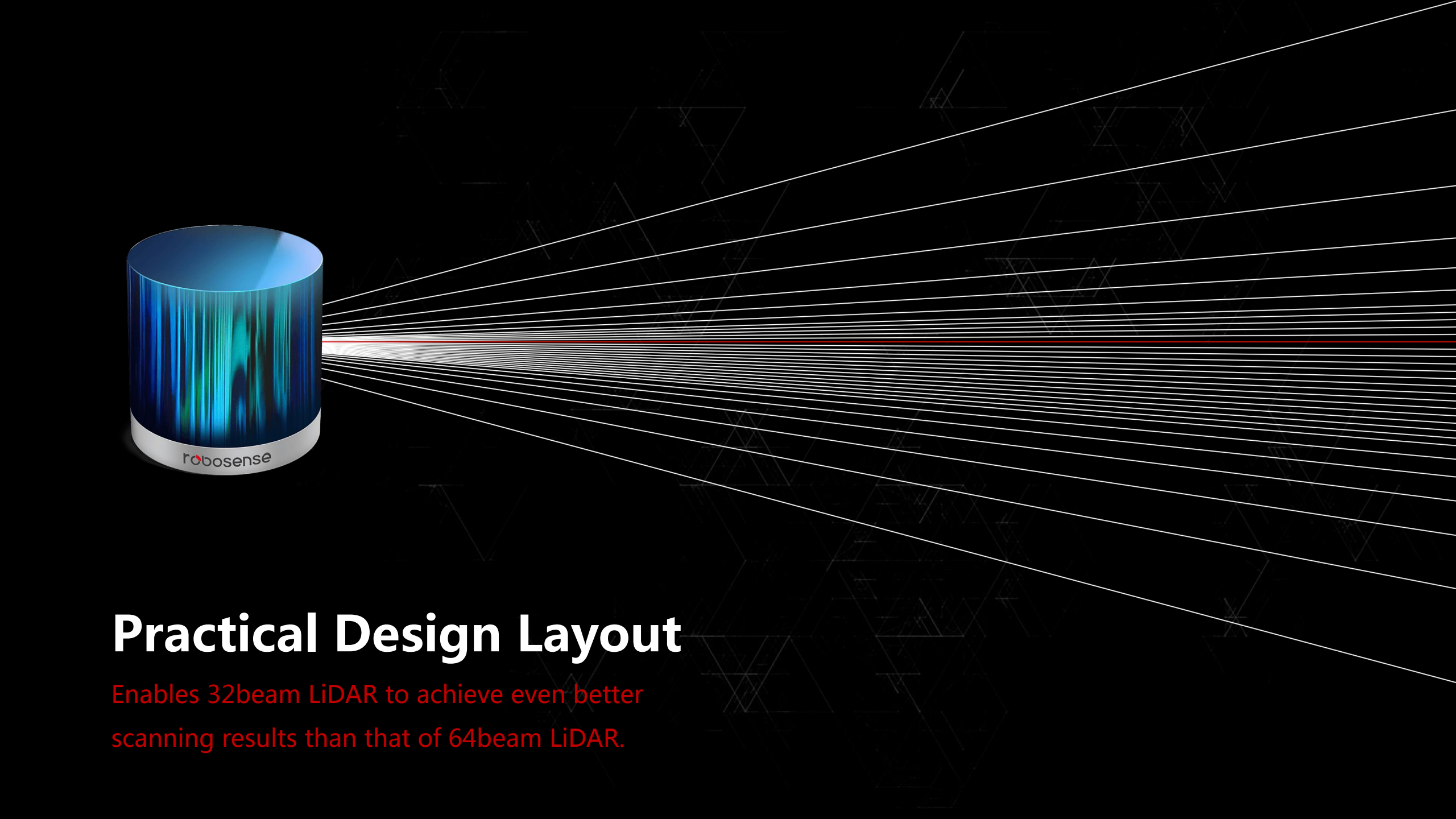
RS-LiDAR-16 adopts cutting-edge digital signal processing technology and ranging algorithms, successfully reaches the world's top level range accuracy of 2 centimeters.

Sensor Hardware

- Mass Production Solid-state Hybrid LiDAR: RS-LiDAR-16
- **Mass Production Solid-state Hybrid LiDAR: RS-LiDAR-32**
- MEMS Solid-state LiDAR: RS-LiDAR-M1^{pre}
- NEXT：RS-LiDAR-M1 & OPA LiDAR

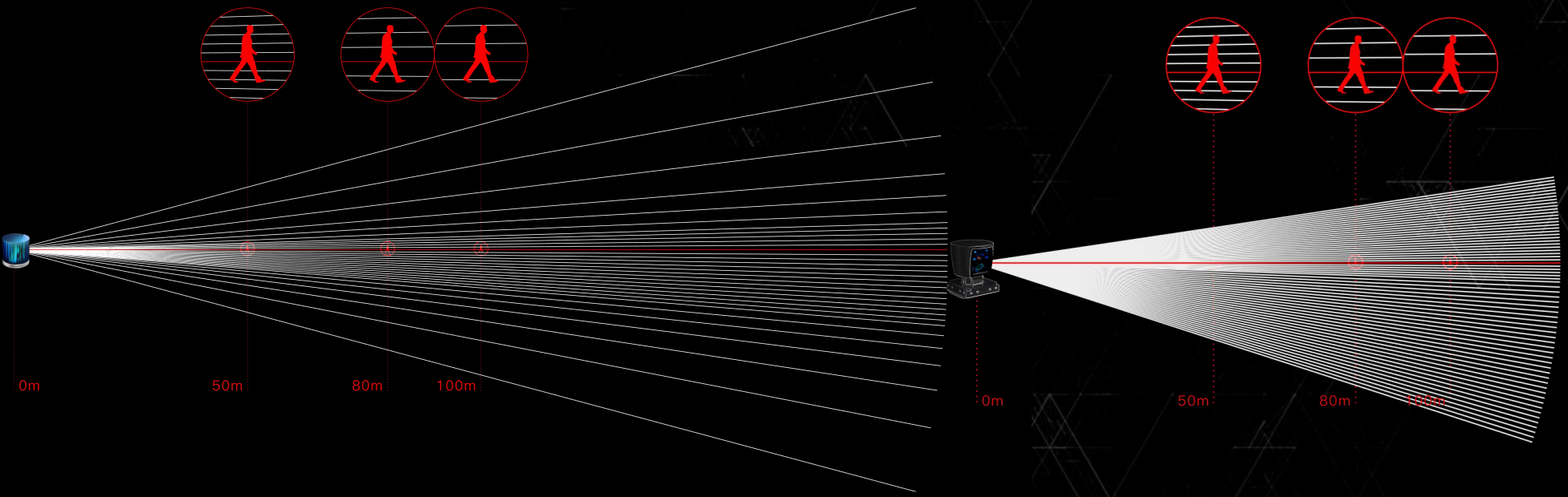
robosense

- Laser: 32 channels
- Wavelength: 905nm
- Laser class: class 1(typical)
- Range: 20cm~200m(20% object reflective intensity)
- Data rate: 640,000pts/s
- FOV: 360° × 40°
- Angular resolution（vertical): minimum 0.33°
- Angular resolution(horizontal): 0.09º-0.36º（5Hz-20Hz)
- Input voltage: 9-32VDC
- Power: 13.5W
- Sensor protection: IP67
- Operation temperature: -10℃ to 60℃
- Dimension: RS-LiDAR-32B: 110.5mm* φ115mm
- Weight: 1.0kg
- Data: 3D space coordinates/reflective intensity



Practical Design Layout

Enables 32beam LiDAR to achieve even better scanning results than that of 64beam LiDAR.



50m / 80m / 100m
Number of laser lines cast on obstacles.
* Pedestrian height：1.70cm

	32beam (left)	64beam (right)
50m	7	7
80m	4	4
100m	3-4	3

■ 0.33° vertical angular resolution, steers detection region of interest to the driving space.

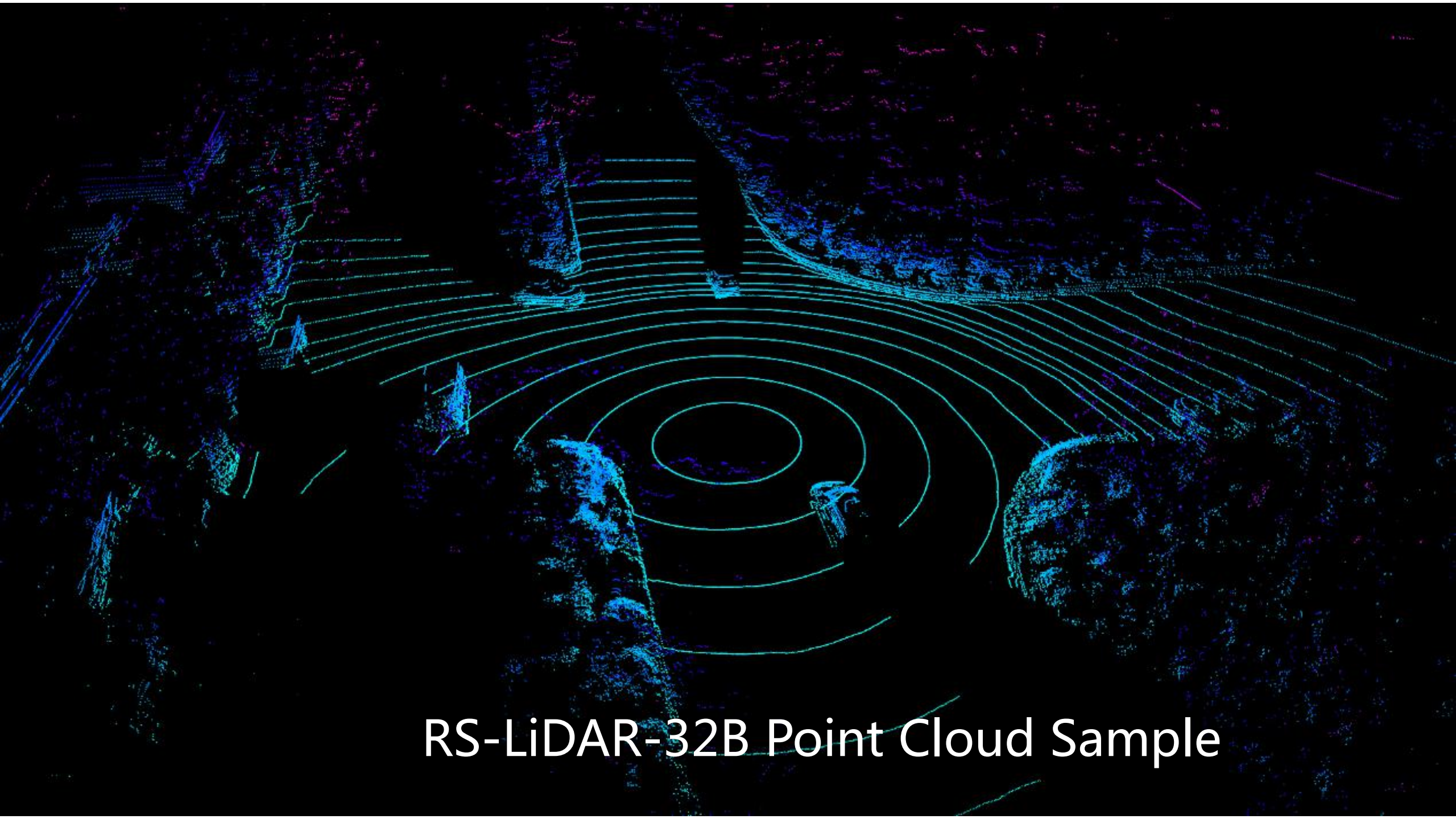
The laser heads of RS-LiDAR-32B, with higher angular resolution in the middle part, steer the scanning region of interest to the driving space on road. 20 laser beams with an idenitical 0.33° vertical angular resolution brings the RS-LiDAR32B stronger obstacle detection abality than 64 beam LiDAR products(0.4 °)

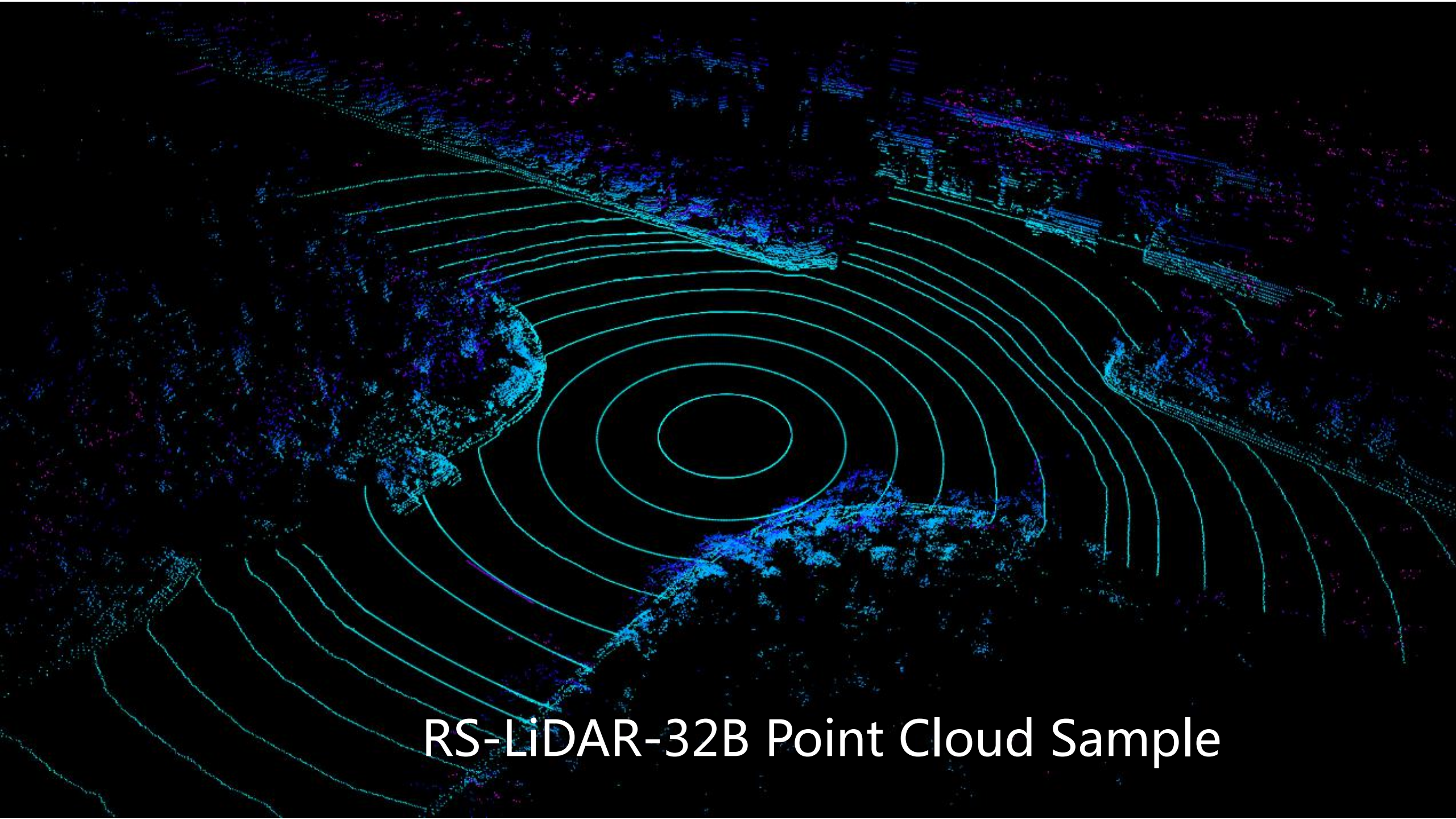
■ 200m detection range

RS-LiDAR-32 can detects as far as 200m to leave more reaction time for the fast driving autonomous vehicles.

40 ° vertical FOV, best design to eliminate blind spots.

The RS-LiDAR-32B is designed with a wide vertical field of view of 40° with 25° arranged below the horizon. This generous design ultimately optimizes the detection of blind spots that cannot be spotted by conventional designs.


RS-LiDAR-32B Point Cloud Sample


RS-LiDAR-32B Point Cloud Sample

Sensor Hardware

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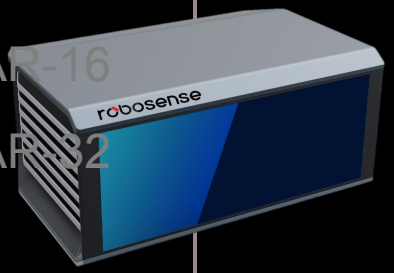
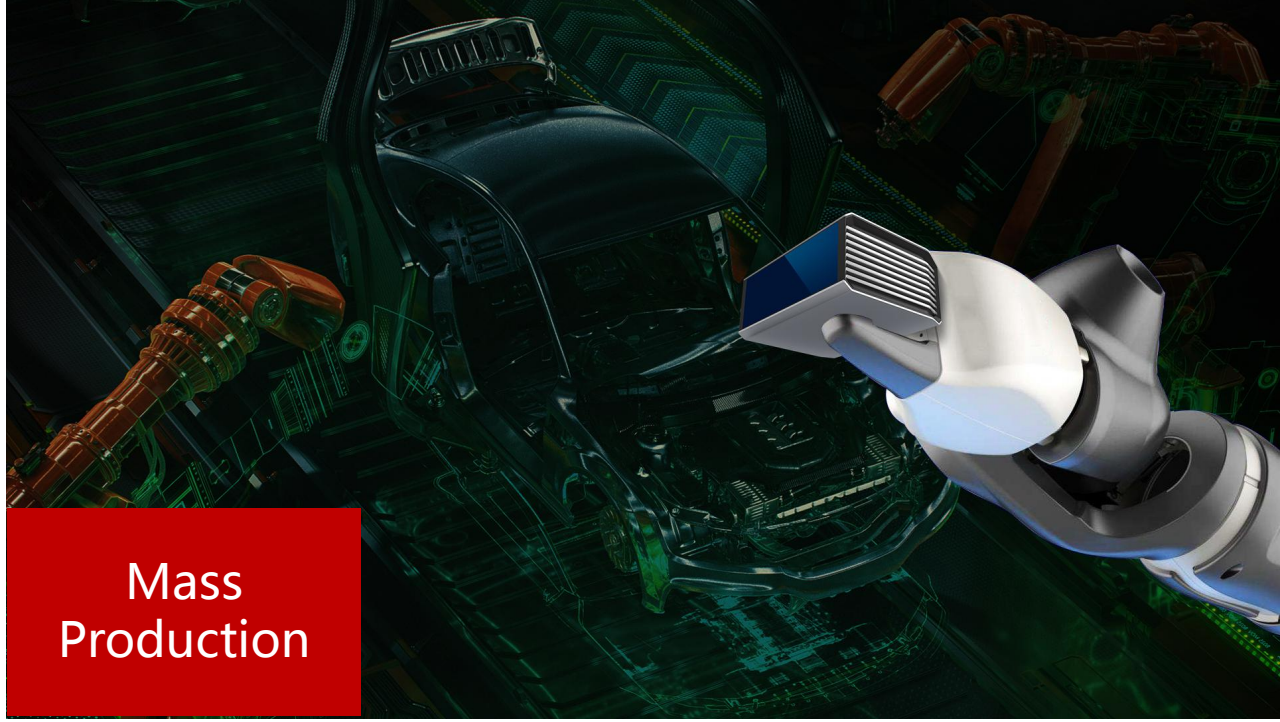
- Mass Production Solid-state Hybrid LiDAR: RS-LiDAR-32
- MEMS Solid-state LiDAR: RS-LiDAR-M1pre
- NEXT：RS-LiDAR-M1 & OPA LiDAR

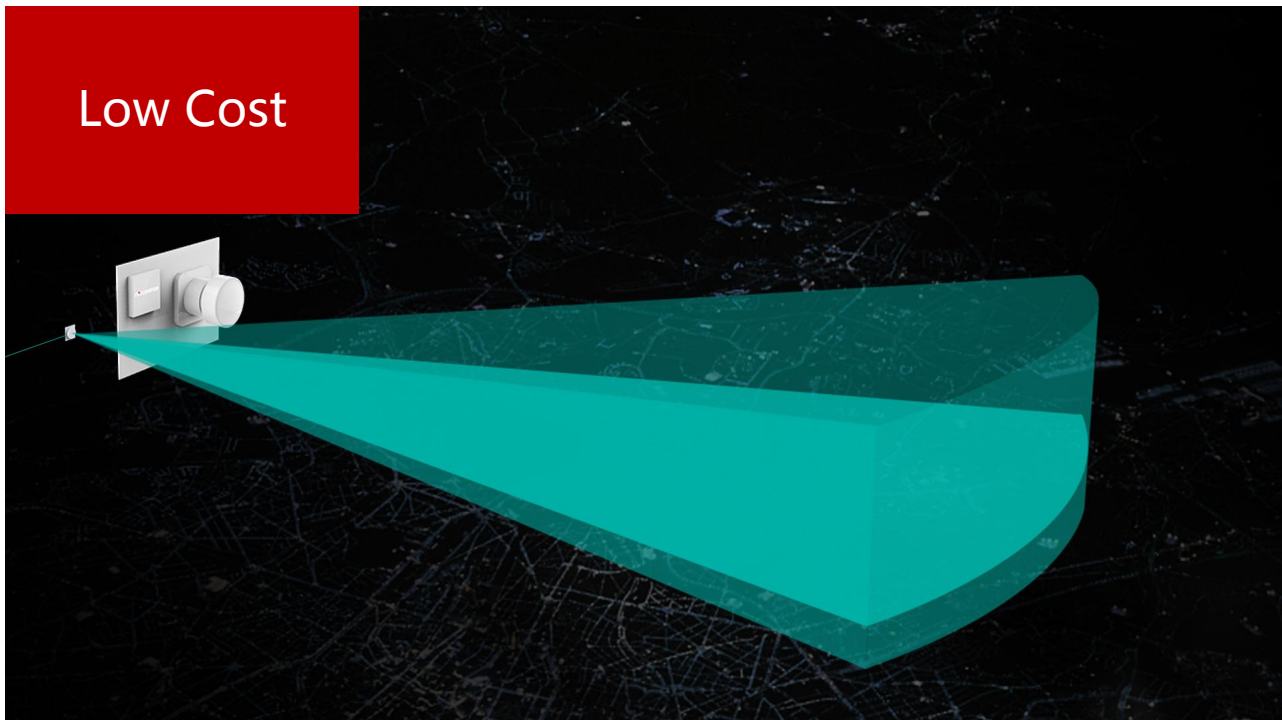


Automotive Grade



Mass Production

High Resolution



Low Cost

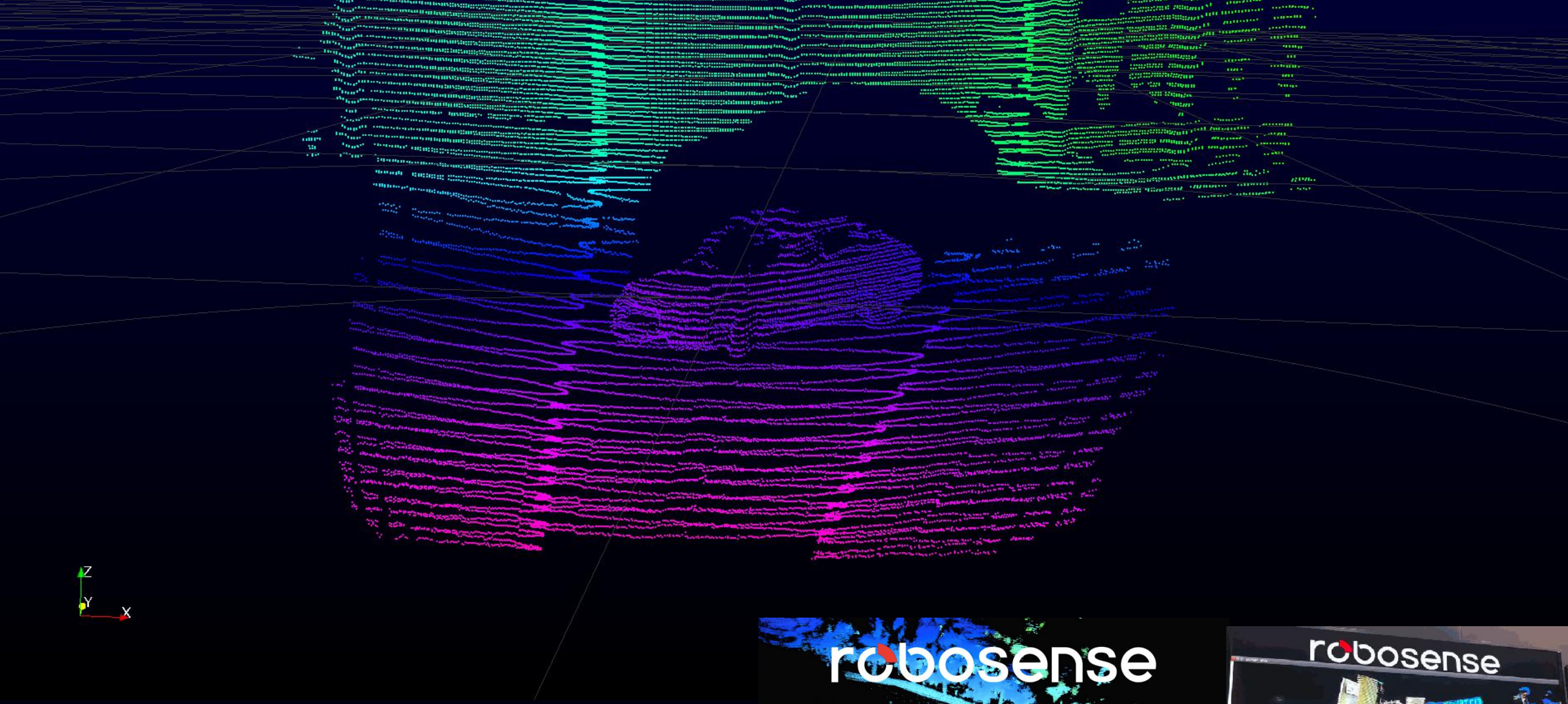
Up to 200m
Range

IP67
Sensor Protection

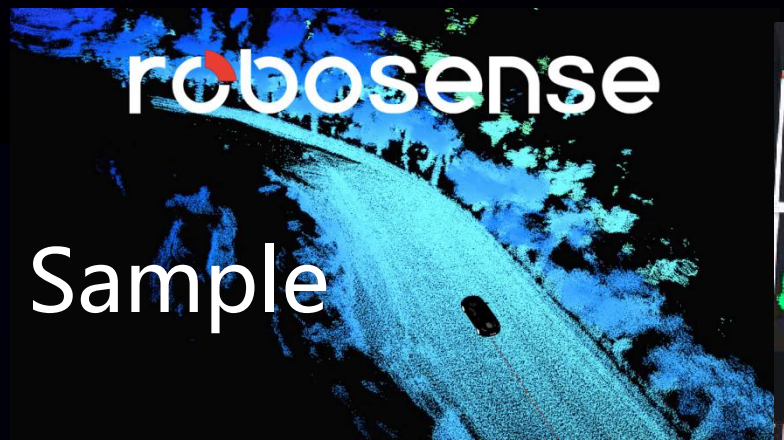
63° x 20°
FOV

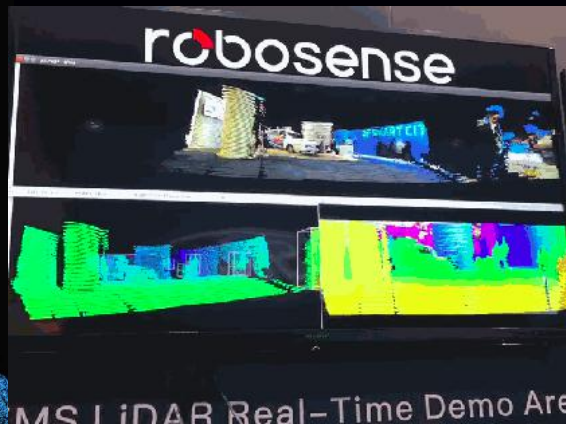
0.09° x 0.2°
Resolution

20fps
Frame Rate



RS-LiDAR-M1^{pre} Point Cloud Sample





RS-LiDAR-M1^{pre} Landmark Moments

2018, RS-LiDAR-M1^{pre} Real-time Demonstration at CES2018

RS-LiDAR-M1^{pre} Landmark Moments

June, 2018, Alibaba Cainiao&RoboSense jointly released the world's first unmanned logistic vehicle mounted with MEMS solid-state LiDAR

Sensor Hardware

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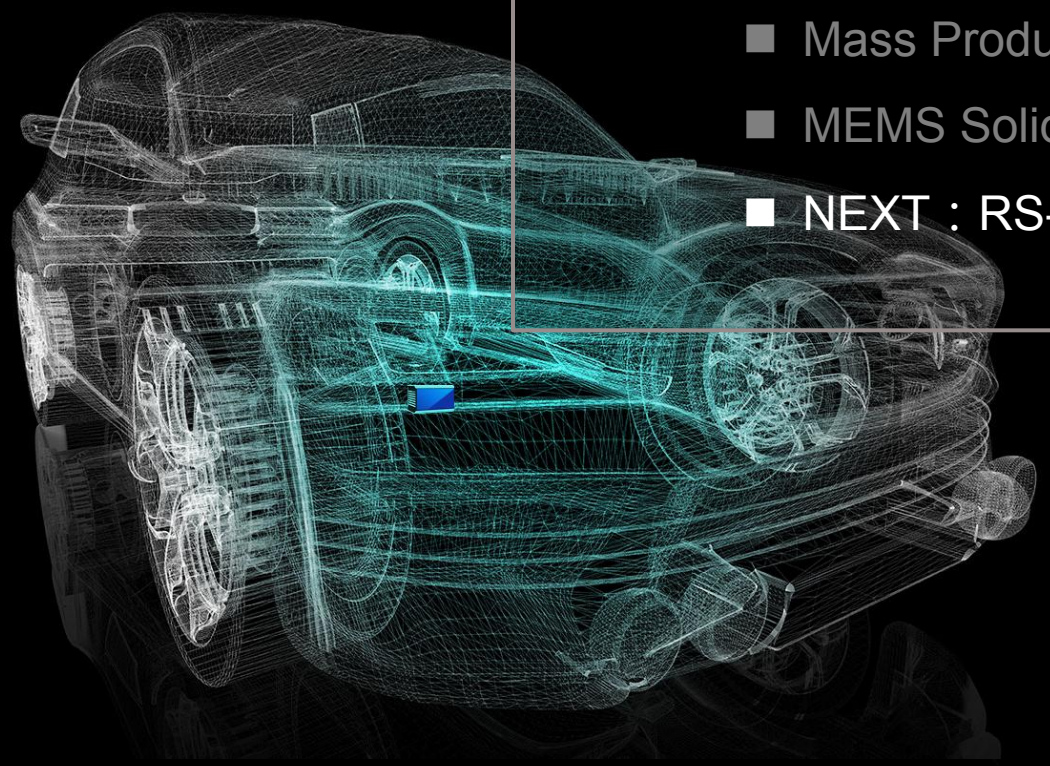

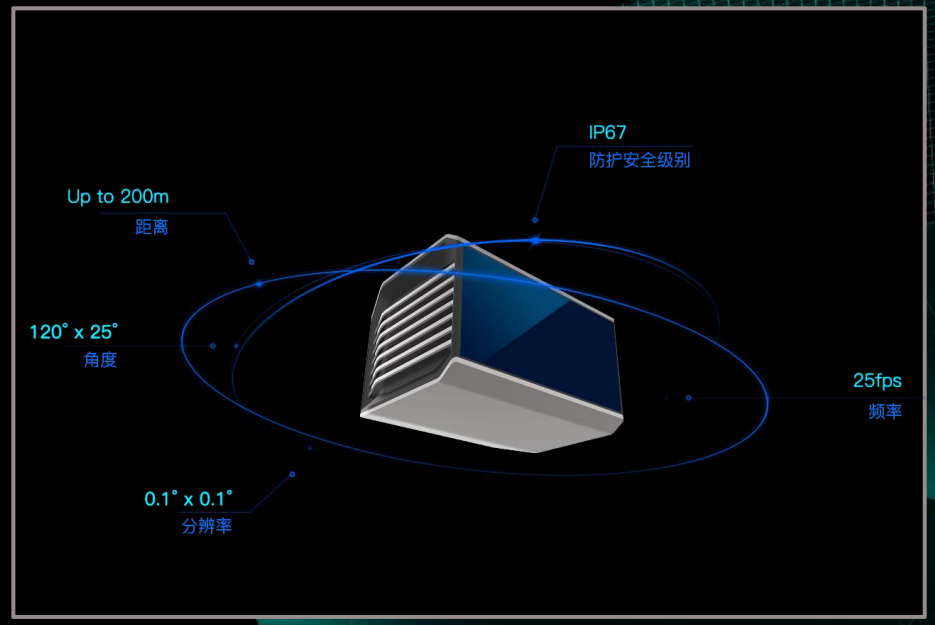
IP67
防护安全级别
Up to 200m
距离
120° x 25°
角度
25fps
频率
0.1° x 0.1°
分辨率


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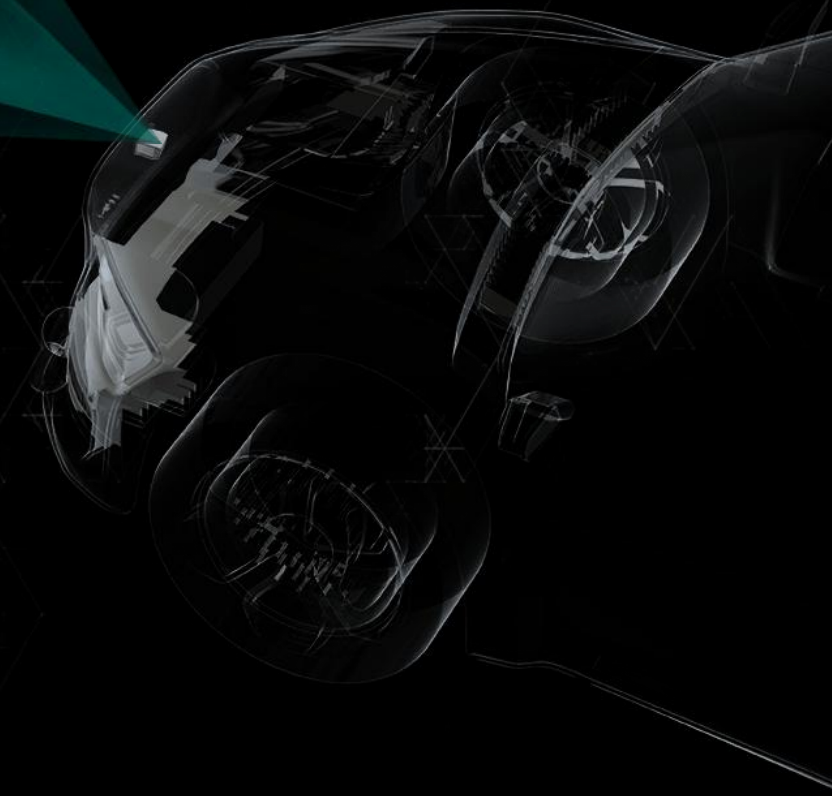


Algorithms and Solutions

RS-LiDAR-Algorithms is a SDK that RoboSense specially developed for Autonomous Driving Applications. Packed in the SDK are algorithm modules including localization, road curbs/driving area detection, lane markings detection, obstacles detection/classification, and moving objects tracking, etc. The purpose is to facilitate client's secondary development and speed up their autonomous driving projects.

Localization

- Multi Sensor Fusion
- HD Map
- cm Accuracy
- ...

Lane Marks Detection

- Lane Marks
- Road Signs
- Road Cross
- ...

Road Curbs Detection

- Road Curbs
- Driving Space
- ...

Obstacles Detection

- Location
- Distance
- Posture
- Size
- Shape
- ...

Obstacles Classification /recognition

- Pedestrian
- Bicycles
- Cars
- Trucks
- ...

Moving Objects Tracking

- Moving Objects Information
- Speed, Size, Direction, Angular Speed
- ...

P1

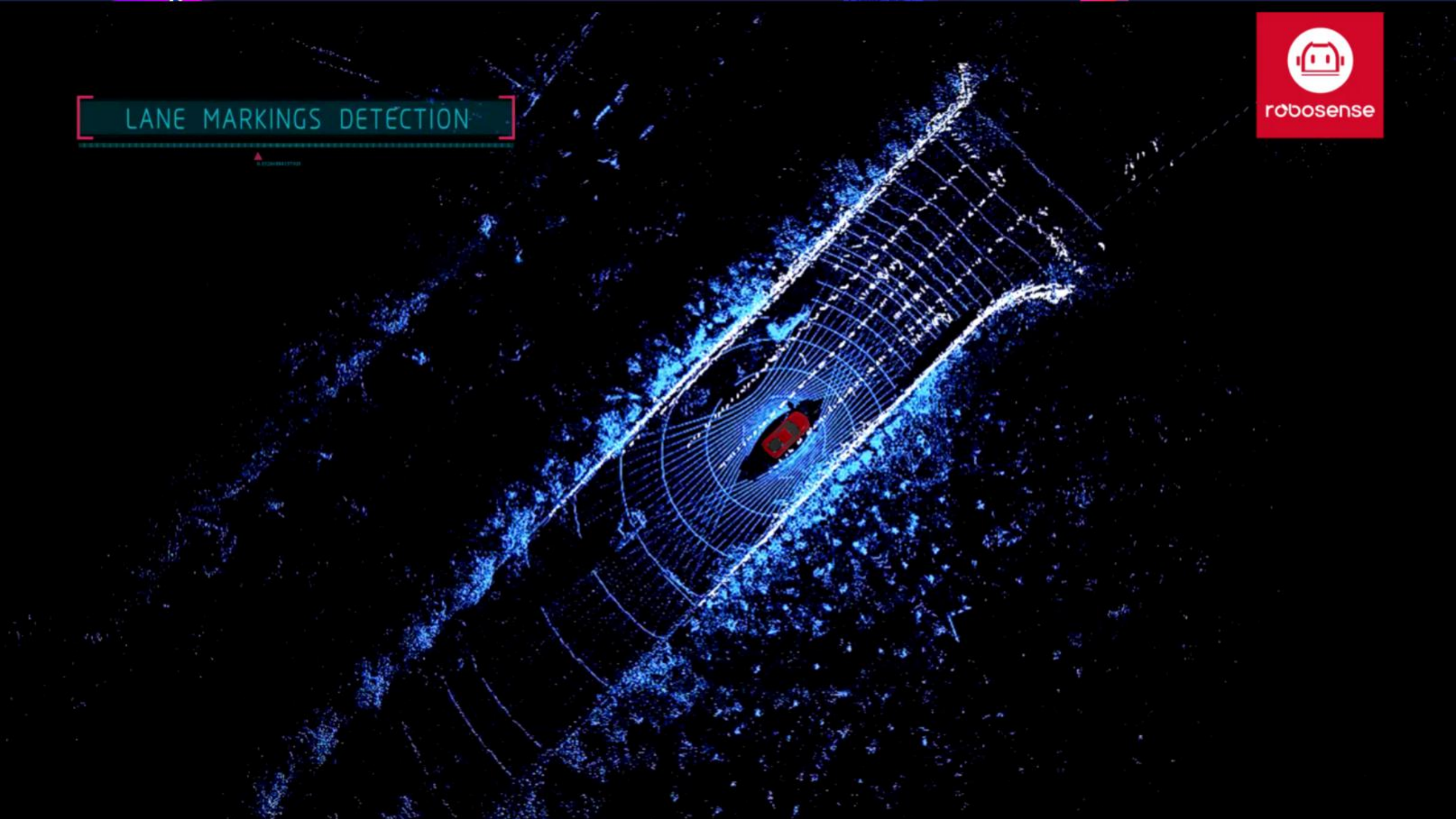
- RS-LiDAR-16*1
- RS-Box
- LiDAR perception modules for low speed autonomous driving

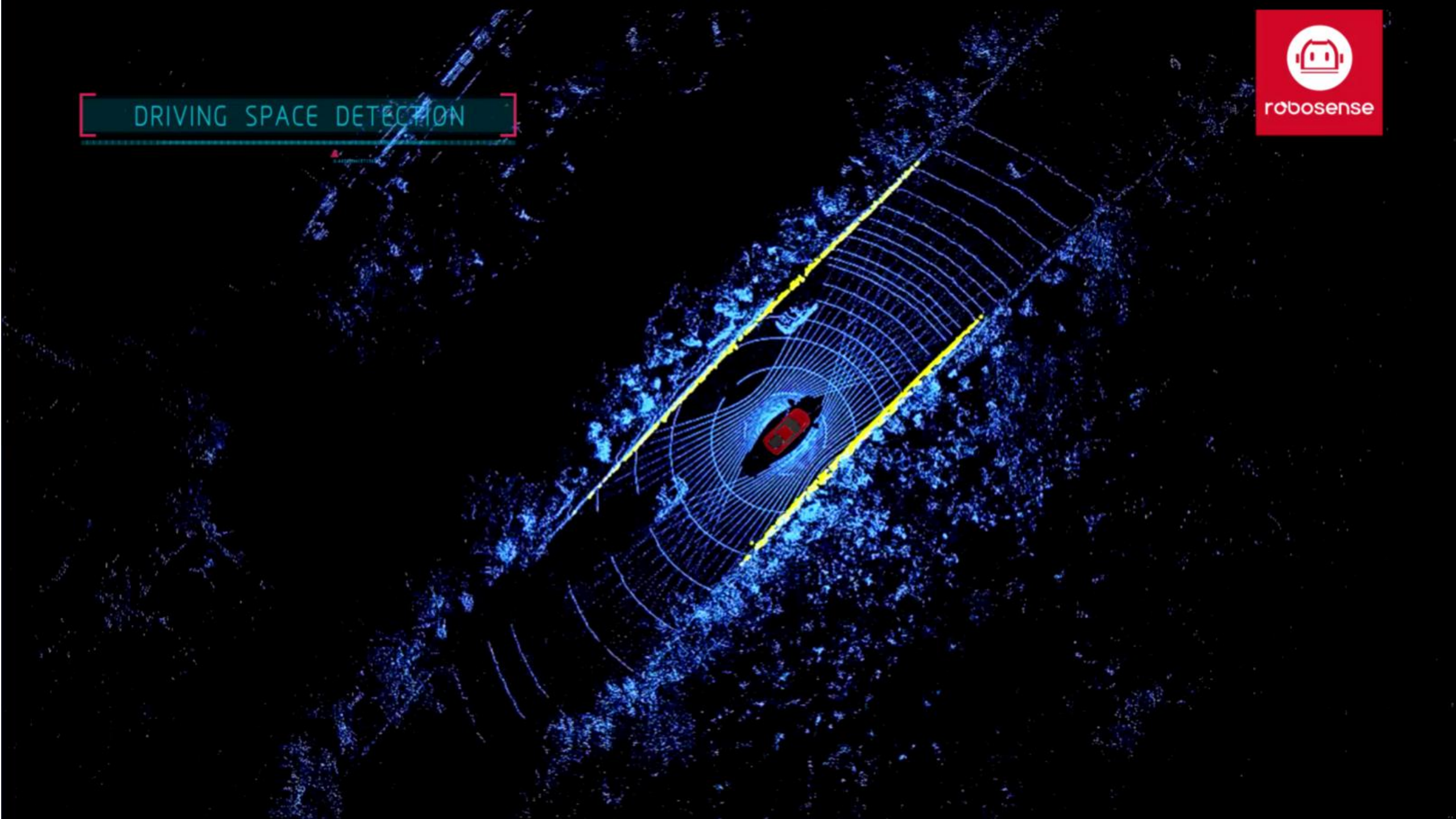
P2

- RS-LiDAR-32*1
- System Hardware
- Training System
- Provide full-stack LiDAR localization and perception solution for high-speed autonomous driving

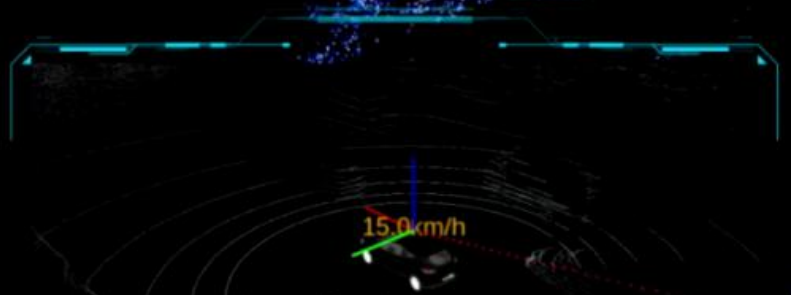
P3

- RS-LiDAR-32*1
- RS-LiDAR-16*2
- System hardware
- Training system
- Full-stack LiDAR localization& perception solution for L3-L5 high-speed autonomous driving

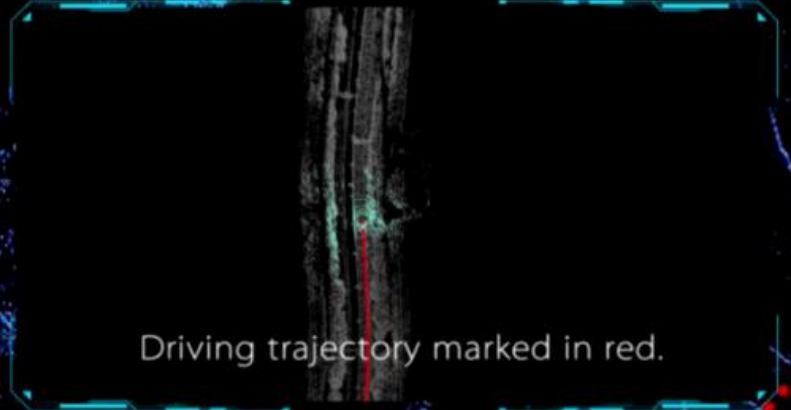

LANE MARKINGS DETECTION
robosense


DRIVING SPACE DETECTION
robosense

HIGH PRECISION LOCALIZATION

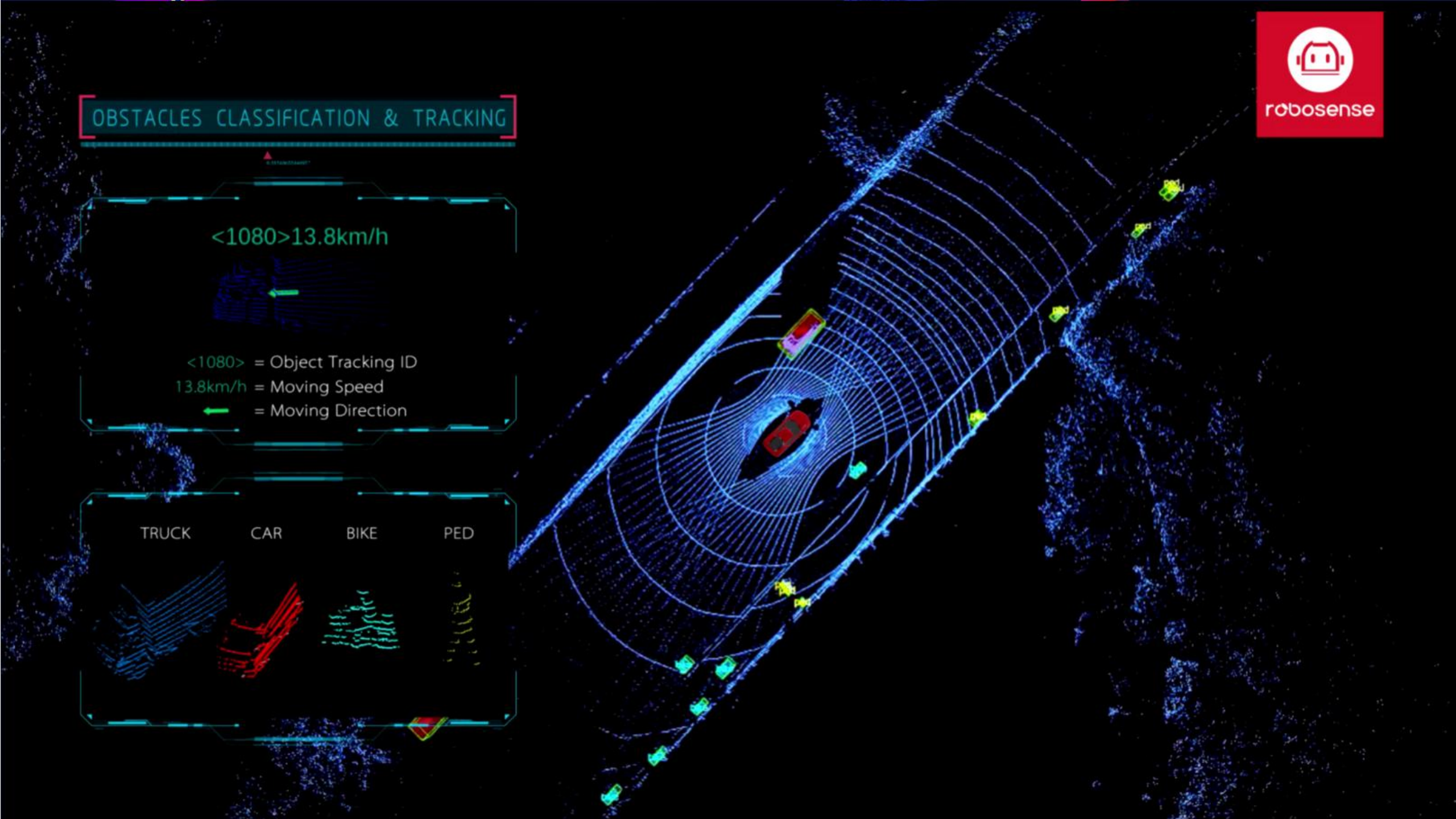


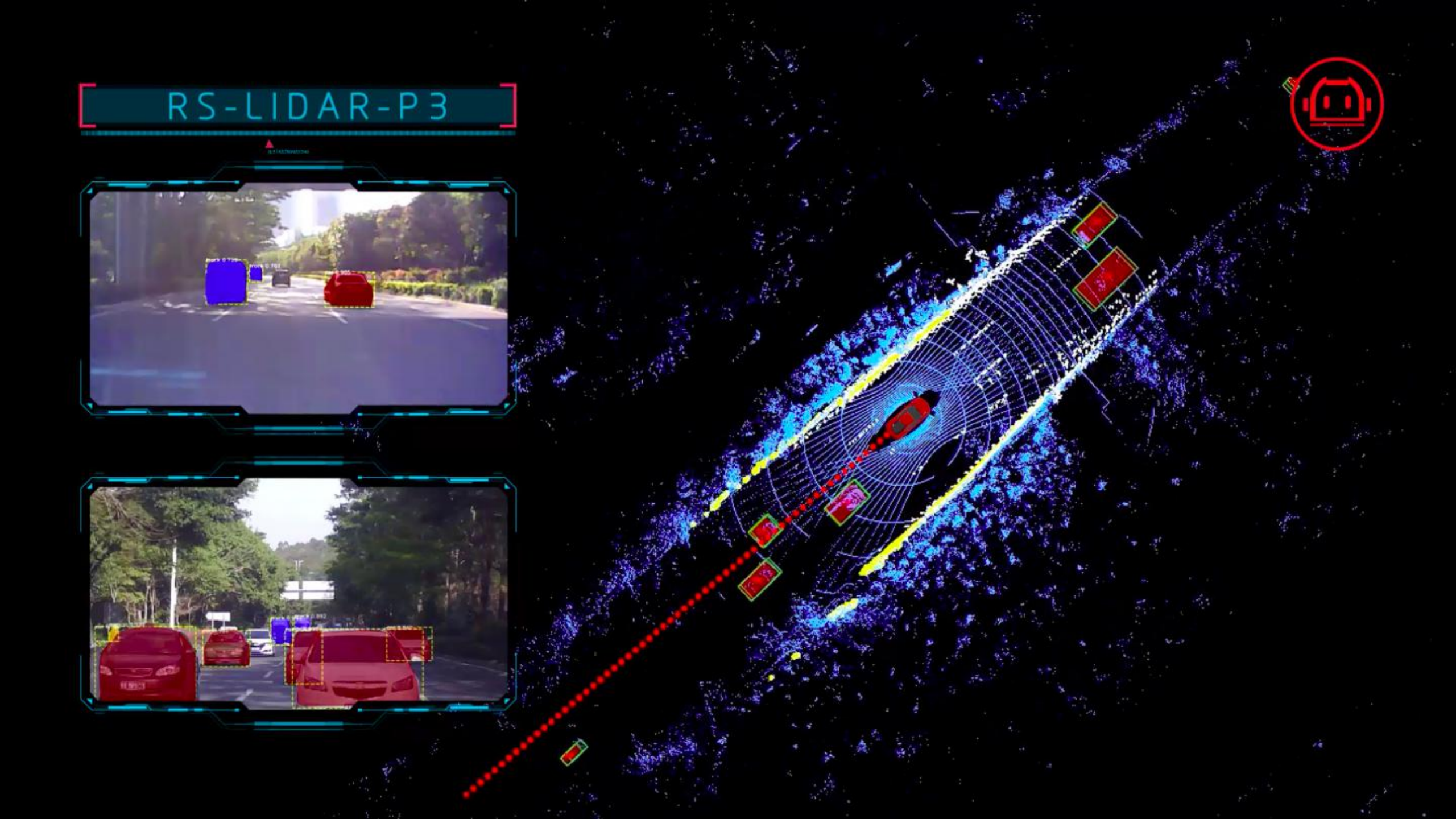
Localization output
=
latitude and longtitude at globalCS.
XYZ at local CS based on the map origin.



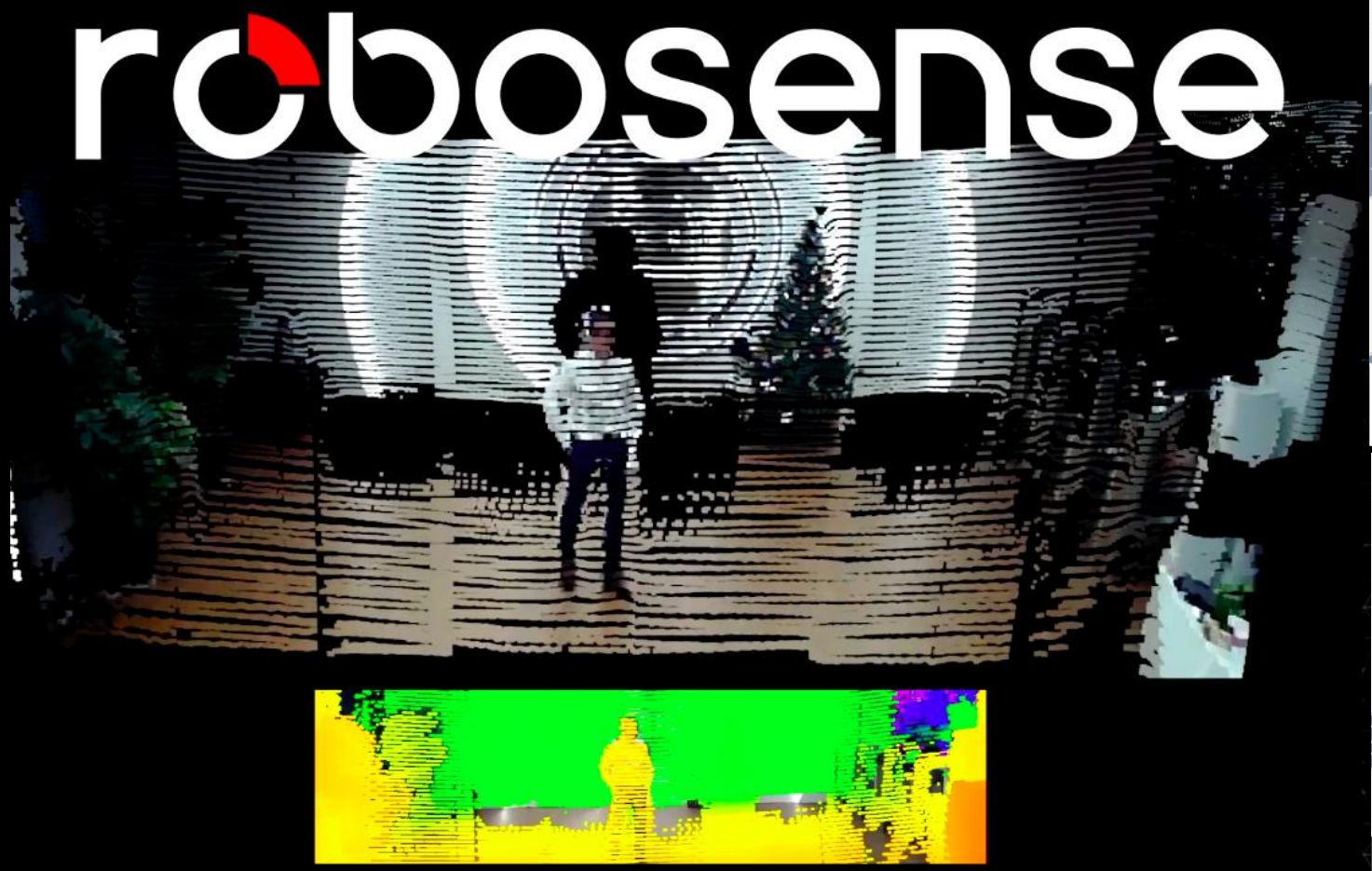
Driving trajectory marked in red.

robosense

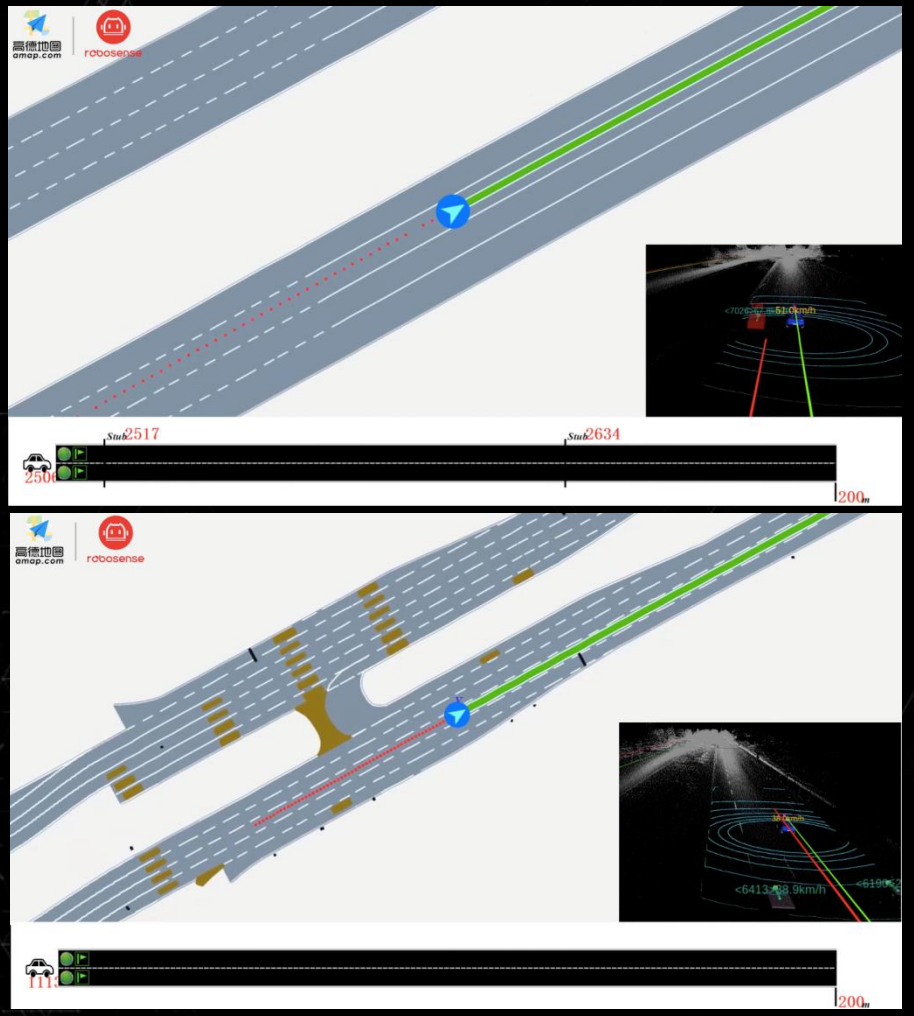

OBSTACLES CLASSIFICATION & TRACKING
<1080>13.8km/h
<1080> = Object Tracking ID
13.8km/h = Moving Speed
= Moving Direction
TRUCK
CAR
BIKE
PED
robosense


RS-LIDAR-P3

Technology Solutions



LiDAR and Camera Data Fusion Technology (LCDF)



HD Map based complete LiDAR Perception System(Partners with Amap)

Competitive Edge

	LiDAR Hardware			LiDAR Algorithm	Other LiDAR Technology
	Multi-beam LiDAR	MEMS LiDAR	OPA LiDAR	Perception Algorithms	
RoboSense	16 beam: 150m@20%, Vertical Angular Resolution 2° 32 beam: 200m@20%, Vertical Angular Resolution 0.33°	RS-LiDAR-M1^{pre} Resolution: 0.1°*0.2° >200m.	20 months R&D, 3 design tape-outs, multiple critical technical barriers conquared	3D algorithms: localization, obstacle recognition, classification, tracking	• Multi-LiDAR coupling solution • LiDAR and camera fusion technology (LCDF); • HD map based complete LiDAR perception system (strategic partnership with Amap)
velodyne	16 beam: 100m@80%, Vertical Angular Resolution 2° 32 beam: 200m@20%, Vertical Angular Resolution 0.33° 64 beam: 150m@80%, Vertical Angular Resolution 0.4° 128 beam: 200m@15%, Vertical Angular Resolution 0.17°	——	——	——	Velarry LiDAR
innoviz		innovizPRO： Resolution: 0.15°*0.3° 150m；	——	——	——
Quanergy	M8：150m@80%，8beam；	——	S3	——	——
Ibeo	4 beam, 8 beam(0.8° vertical angular resolution)	——	——	2D Algorithms	——

Focused on Autonomous Driving LiDAR System Development, RoboSense is a world leading full-stack system solution provider.

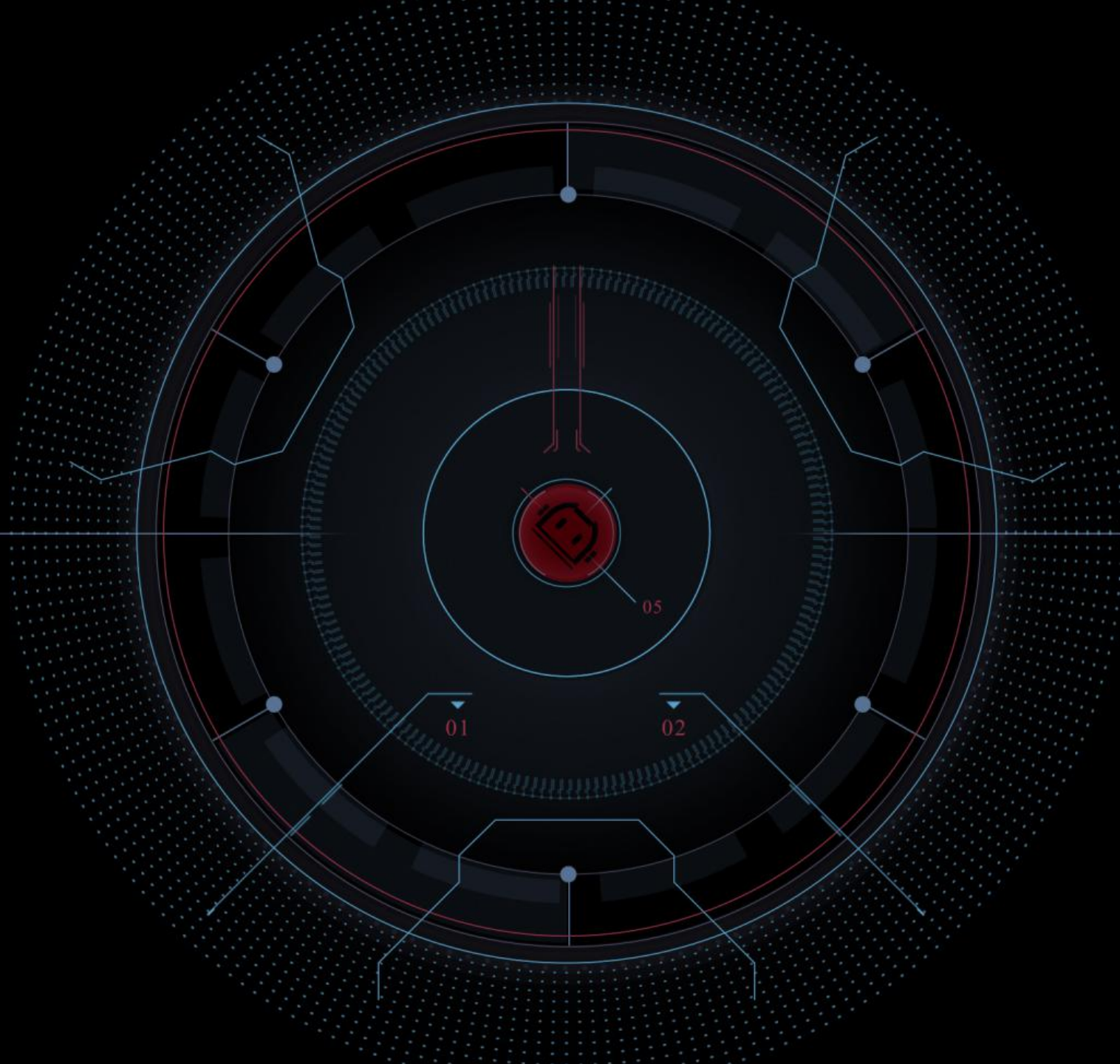
•Multi-beam LiDAR: Except MEMS LiDAR to substitute 128 beam mechanical LiDAR, RoboSense boasts the 16 beam and 32 beam LiDAR that with performance and parameters especially accuracy and effective measurement range reached global leading standard.

•MEMS LiDAR: Angular resolution and range reached global prominence.

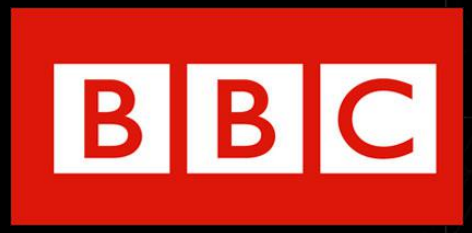
•Launched 3D algorithm SDK and RS-Box.

Part 03

Honors & Reports



Media That Have Reported Us



Corporate Honors

01 From Government

- 2016 Nanshan Start-ups Award(First Prize from 3672 projects)
- 2016 Start-ups Grant from Science and Innovation Committee(97 projects approved with RMB1 million top grant)
- 2016 National High-tech Enterprise Certificate

02 From Industries

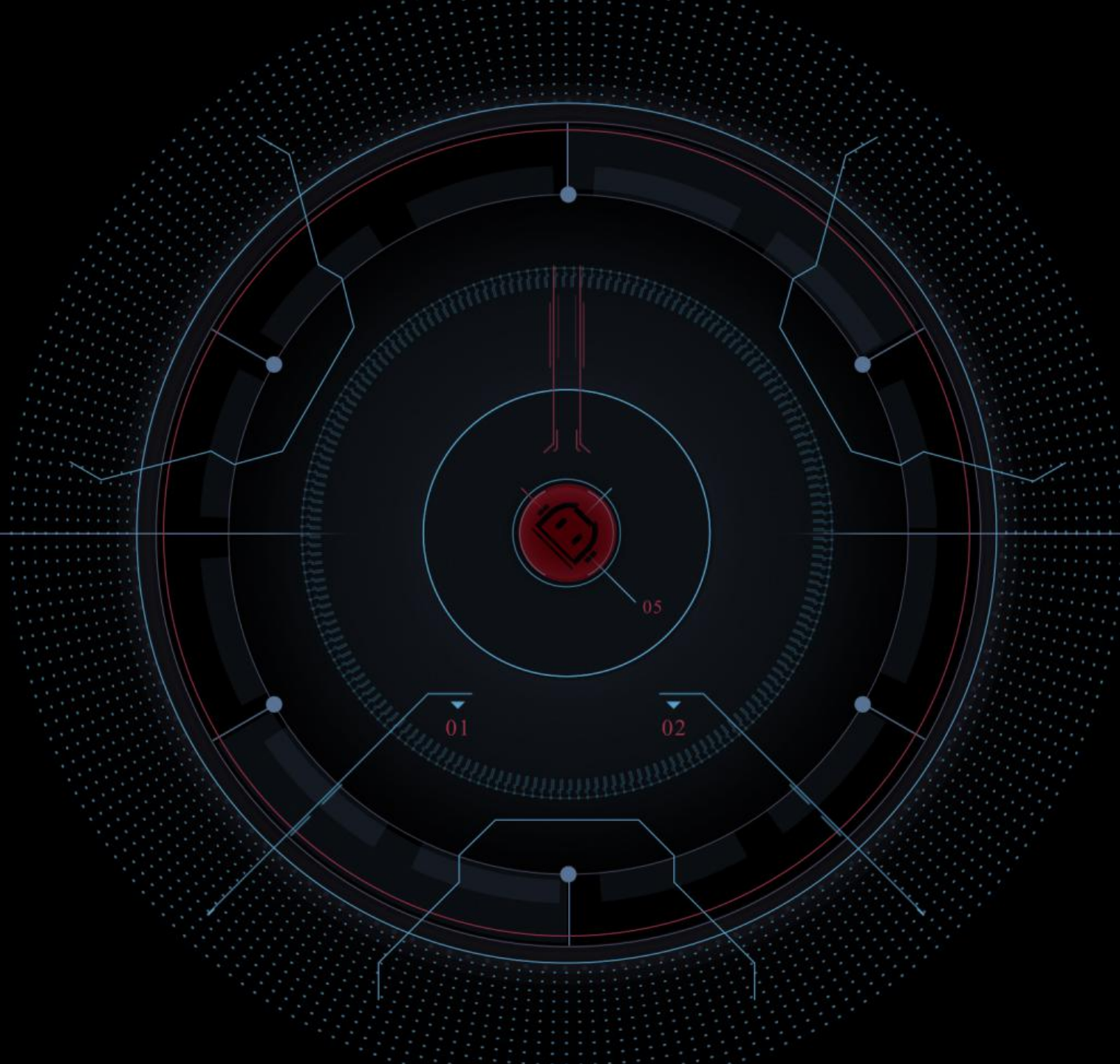
- Champion of the Audi Innovation Lab2017
- First Place at the Second International New Energy and Intelligent Car Global Challenge.
- GAIR 2017 Pioneer Enterprise
- 2016, 2017 Zero2IPO Enterprise of the Most Investment Value (First Place, Top50)
- Second Place at the 2016 LINC(Live in Unlimited Creation) Car Venture Competition(0.1 point lost to the First Place)
- NBI New Enterprise Top5.

03 Others

- lieyunwang.com 2017 Top20 Enterprise of Best Investment Value.
- Global Science-Boss Zhipin-AI Technology Review. The Top50 most wanted employer in 2017.
- LeiPhone.com Most Potential Enterprise at GAIR in 2016；
- iyiou.com Top 50 AI Start-ups in China 2016

Part 04

Application Cases



Application Cases

Low Speed Logistics Vehicles

Alibaba's Cainiao Unmanned Delivery Robot G1 and G2 installed with RS-LiDAR-16

JD.com's Delivery Robot with RS-LiDAR-16

2018, Chinese New Year Gala, AV fleet and RS-LiDAR

Zhen Robotics' Delivery Robot with RS-LiDAR

Plus AI's Delivery Robot with RS-LiDAR

Application Cases

Commercial Vehicles


2017, Shenzhen Autonomous Bus with RS-LiDAR

April, 2018, Autowise Autonomous Street Swppers with RS-LiDAR


April, 2018, Autonomous Bus mounted with RS-LiDAR, tests in Beijign Garden Expo Park

2017-2018, TuSimple's Autonomous Trucks and RS-LiDAR.

Application Cases

Passenger Cars

Chery's Autonomous Driving Test Car with RS-LiDAR

Academic Autonomous Driving Solutions with RS-LiDAR

In-Driving Autonomous Driving Test Car with RS-LiDAR

roadstar.ai Autonomous Test Car with RS-LiDAR

Application Cases

UISEE Autonomous Park Shuttles with RS-LiDAR-16

2017, FSAC Autonomous Racing Cars with RS-LiDAR

Magride Autonomous Bus with RS-LiDAR-16 tests in Snow

Falcon 4th Generation Park Shuttle with RS-LiDAR-16

2017 Tianjin Intelligent Vehicle Grand Challenge with RS-LiDAR-16

THANKS !

robosense