From Technologies to Markets

LIDAR technology oadmaps: trends, developments, and opportunities November 15th, 2021

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AUTOMOTIVE APPLICATION AND MARKET

From simple to complex ADAS applications



Increasing need of sensors and computing



AUTOMOTIVE APPLICATION AND MARKET

2020 volume: 174k units

How technological innovations are implemented

F segment is where technological innovations are implemented

Average ASP: $100k \rightarrow ADAS$ content about 3%=3000

New functionalities using state of the art sensors and computing are implemented in this segment.

The F segment is where most of innovations are firstly implemented due to a higher car ASP.



A strong work on the cost/performance ratio has to be done to implement innovations into lower segments



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AUTOMOTIVE APPLICATION AND MARKET

Adoption of LiDAR in ADAS vehicles

LiDAR is penetrating the ADAS market in the Fsegment. As the price decreases, it will be implemented in lower segments.

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LIDAR TECHNOLOGY SEGMENTATION



*FMCW: Frequency Modulated Continuous Wave

TEARDOWN OF THE ROBOSENSE RS-LIDAR-MI



It operates 905 nm lasers with direct time of flight (dToF) for range evaluation.

The maximum range is 150 m with a 10% reflectivity target.

Interface board Analog to digital board **Opening the RS-LiDAR-**MI reveals a MEMS scanner and five optical modules containing one laser diode and one SiPM each. The Robosense MI is one of the first automotive MEMS LiDAR. It is MEMS mirror module using SiPM as receivers and shows higher complexity compared to mechanical LiDARs. MEMS mirror module bracket

Processing board

Evolution of LiDAR volume





Position of sensors today

As of today, a car can monitor objects ahead and behind it but is not able to detect anything on its sides.



- As of today, most of the sensors are implemented either at the front or at the rear side of cars. They are used for sensing applications. These applications can take control of the car in some cases.
- Few sensors are placed on the side of the vehicle. Only surround cameras are placed on these sides of the vehicle. They are used only for viewing applications.



New places to integrate sensors – Opportunities linked to lighting and EVs













LiDAR integration roadmap



TECHNOLOGY ROADMAP

Supply chain analysis – Known design wins





*Total number of design wins known to date (29).

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TECHNOLOGY ROADMAP

Automotive LiDAR technology roadmap



LIDAR AUTOMOTIVE MARKET

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Automotive LiDAR revenue forecast



- The automotive LiDAR market is expected to follow a similar pattern to shipments. Revenue will increase modestly until 2024 followed by a large increase with increased adoption in the ADAS segment.
- The LiDAR market is expected to reach \$2.3B in 2026, growing at a CAGR₂₁₋₂₆ of 93.6%.

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OUTLOOK

How OEMs can reach (full) autonomy

Larger OEMs

Will develop their software for advanced automated driving features through partnerships or acquisitions.



Will develop basic automated driving features using Tier-1s. To do so, Tier-1s will partner or acquire start-ups to bring them the knowledge.

Semiconductor companies

🖬 mobileye[.]

Companies are positioning themselves (maybe through acquisitions) to be at the center of automated driving systems.

Qualcoww

Acquisition

veoneer

NVIDIA





Partnerships?

Companies are also entering the automotive market by developing self-driving features or their own car.

Consumer companies



Smaller OEMs

OUTLOOK

Consumer AV

• With the entry of new players such as Huawei, Xiaomi, Oppo, (potentially Sony), and Apple in the automotive market, a new market could appear that would be different when compared to ADAS and Robotic vehicles.



Reliability

Serviceability

A new market with a new type of sensor? Such cars would bring more sensors and more computing power than can be found in traditional ADAS cars.

OUTLOOK

Consumer AV – The example of Arcfox

• The Arcfox Alpha S is the first move of Huawei in partnering with the BAIC group to manufacture a new car.

Much more computing power than a Tesla (140 TOPS).



- Collaboration between Huawei
 and the BAIC group
- Up to 708 km (NEDC cycle)
- 94kWh battery
- Up to 800 TOPS computing power (~x6 more than in a Tesla)
- 3 LiDARs
- 6 radars
- 9 cameras
- full-stack solution for L4-L2+ autonomous driving
- ~€55,000

Arcfox Alpha S

KEY TAKEAWAYS

- The combination of multiple ADAS applications is needed to reach high levels of autonomy. It requires an always increasing need of sensors and computing power.
- There is still a large diversity of players involved in the automotive LiDAR, each at different level of maturity. Mechanical LiDAR at 905nm still dominates the market.
- The use case has a direct impact on the position of the LiDAR(s) and on its specifications. There is not one LiDAR that fits all applications.
- The location of LiDAR is evolving, positioned into the grill at first to other locations such as the roof, the windshield, headlamps, the bumpers, or the fenders.
- The LiDAR market is expected to grow fast, especially after 2023 to reach \$2.3B in 2026.





Thank you for your attention !

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