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LiDAR Market Continues To Percolate

Are cheaper LiDAR devices on the way?

SEPTEMBER 13TH, 2017 - BY: JEFF DORSCH (HTTPS://SEMIENGINEERING.COM/AUTHOR/JEFF-DORSCH/)

Light imaging, detection, and ranging (LiDAR) sensors are still dazzling investors and technologists. They are chasing after the technology for automotive applications, while also keeping an eye on LiDAR for drones, industrial automation, mapping, and robotics, among other uses.

It's too early to tell how market share for automotive LiDAR is shaping up, as the bigger vendors are still working to make sensors cost-efficient for use in advanced driver-assistance systems and automated driving. And startups continue to pop up around the world, in Silicon Valley and elsewhere, some of which could emerge as industry leaders, given enough time and money.

Case in point: Israel's Oryx Vision recently wrapped up a Series B round of funding for $50 million, bringing its total funding to $67 million in 15 months. Third PointVentures and WRV led the new round, joined by Union Tech Ventures. Bessemer Venture Partners, Maniv Mobility, and Trucks VC, all existing investors, participated in the Series B financing. Another Israeli LiDAR startup, Innoviz Technologies, just raised $65 million in Series B funding from investors that include Delphi Automotive, Magna International, 360 Capital Partners, Glory Ventures, and Naver. The new round brings the company's total funding to about $74 million; Like Oryx, Innoviz was founded last year.

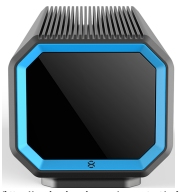

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Fig. 1: Oryx Vision's flash automotive LiDAR unit. Source: Oryx Vision

Market research firms are issuing hockey-stick analyses on the LiDAR market's potential growth. Grand View Research forecasts the worldwide automotive LiDAR market will be worth $223.2 million by 2024. MarketsandMarkets, looking at the broader LiDAR applications market (cartography, corridor mapping, exploration, meteorology, and urban planning, in addition to automotive), predicts a global market valued at more than $5.2 billion by 2022, with a compound annual growth rate of 25.8% from 2017 to 2022.

BIS Research estimates the automotive LiDAR market was worth $65 million last year. It will show double-digit compound annual growth over the next decade, according to the firm. Global Market Insights looked at other applications of LiDAR technology (civil engineering, corridor mapping, government, military and defense, topographical surveys) and said the market for those applications will increase from $365.5 million in 2015 to more than $1.1 billion by 2023.

On a geographic basis, Mordor Intelligence forecasts the North American market for LiDAR technology will reach $880 million by 2020, up from $550 million in 2015, for a 9.63% CAGR.

Amin Kashi, director of ADAS & AD at **Mentor, a Siemens Business (https://semiengineering.com/kc/entity.php?eid=22017)**, said there is progress in the size and reliability of LiDAR sensors. These devices should have no moving parts, unlike the mechanical LiDAR systems that Google used, for example, with its earliest driverless cars.

"There are now about 16 LiDAR companies trying to solve this issue," said Kashi. "The roadmaps for these companies aren't to the point where we would say this year we have a final solution that could go into production. They are still a year or two away from components that we are used to in the automotive market with all the tests and reliability testing and standards testing that has to be done for these modules."

LiDAR is not a single chip, and creating a solution is a non-trivial problem. The sensor chips need to work in the harsh environment of automotive electronics. That could be integrated into one component or contained in a module.

"Reliability is very important in this case," Kashi said, and there are questions about how many LiDAR sensors an autonomous vehicle will need. "Not everyone will have the same number of LiDARs," he noted, estimating the highest level of autonomous driving will require two to five LiDARs in the vehicle.

While some market observers say LiDAR isn't necessary for autonomous driving, Kashi challenges that assertion, saying LiDAR will work in a complementary fashion with advanced camera and with radar sensing.

"There is a lot of movement," he said. "Tier 1s are trying to get into that space, trying to get partnerships with these startups. A lot of startup activities, a lot of new concepts coming out. If this is going to happen, if autonomous vehicles who everyone is promising in the next couple of years, these types of providers need to go from prototypes to production capability fairly soon. And that's a fact. I see that the number of companies involved in this is growing, but I can't say there are really breakthroughs in terms of seeing things go a lot further than a couple of months ago."

Different starting points

The lack of breakthroughs certainly isn't for lack of trying, though. Startups are approaching LiDAR from a number of different directions.

Consider Cepton Technologies, for example, a Silicon Valley startup founded last year.

"Our core technology is in a proprietary lasers emission and sensing array that delivers very high resolution," said Wei Wei, Cepton's director of business development. "We're talking about 0.2-degree resolution in both horizontal and vertical directions. The vertical direction is the weakness for many technologies, especially for the rotating LiDAR sensors. For us, we are four times or five times the resolution of those sensors."

Cepton has been shipping LiDARs since February to customers in Silicon Valley, Asia, and Germany, according to Wei. The Cepton team is 30 people and growing. The company introduced its long-range and wide-angle LiDAR products at Nvidia's GPU Technology Conference in May.

"Our LiDAR functions more like a camera or the human vision system, concentrating your pixels into a forward-looking view, which distinguishes itself from many of the other LiDARs that are currently on the market that spin around with a 360-degree view," said Mark McCord, vice president of engineering at Cepton. "Our take on the market is that this will be a better match to future automotive requirements, because people won't want to

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have a spinning sensor on the top of the car. For a variety of reasons, the sensors will be integrated in other places in the car where you don't get a 360-degree field of view."

Cepton is using off-the-shelf components for its solution, and doing its manufacturing in-house. But the challenge for all of these companies is commercializing their products, so Cepton is in discussions with partners to help with the manufacturing. That could be Tier 1 suppliers or contract manufacturers.

The company plans to ruggedize its automotive LiDAR sensor by next year, and will do joint system validation with OEMs in 2019. "At the same time, we are looking at different industrial markets," Wei said. There are also discussions with mapping companies.

Price wars ahead?
Quanergy Systems, another Silicon Valley startup, claims to be winning the LiDAR war on price. Quanergy's solid-state sensor chip, priced at $250, should go into volume production by the end of September for applications other than automotive. Quanergy and Sensata Technologies handle the manufacturing of Quanergy products. Automotive-grade LiDAR chips will be available in September of 2018, according to CEO Louay Eldada.

"LiDAR is arguably the most capable sensor for automation in a variety of industries, and it's a good place to invest," Eldada said. "But there will be a shakeup. Some companies will ramp up, some will falter when they want to ramp up."

He noted that the goal is a sub-$100 solution, which will be critical for LiDAR to migrate into new markets such as smart homes, smart sites, and smart cities—even wall-less border security. "You hear some people here saying, 'Who cares about cost? Well, everyone cares about cost. You hear some people saying, 'I have a system that fills the trunk of a car and it's initially $400,000, eventually going to $20,000, but who cares about all that? I can give you a beautiful picture.' And that happens to be a MEMS-based system, a mirror-based system. Well, none of it is good."

Velodyne LiDAR, which spun off from its parent company last year, stands out as the company that is shipping LiDAR sensors to customers now and has true proof-of-concept, while LiDAR startups are trying to make their bones with automotive manufacturers and Tier 1 suppliers. The company is filling up a factory in San Jose and has a research and development branch, Velodyne Labs, in Alameda, Calif.

Anand Gopalan, the company's chief technology officer, noted that Velodyne has more than 10 years of experience with LiDAR technology and "reasonable production volumes." Velodyne LiDAR just signed a perception system contract with Mercedes-Benz Research & Development.

"The challenges for LiDAR in general, across the board, are achieving the longest range in terms of being able to see at distance, achieving the highest resolution in terms of being able to see in fine buckets across the field of view, and then, of course, high reliability associated with the automotive environment, and then cost," Gopalan said. "We have a long track record. We see a tremendous demand from the market for autonomous [technology], so demand for LiDAR has been growing exponentially, year over year. We are continuing to scale up our production to build these products at high volumes, going from tens of thousands of units to hundreds of thousands of units to millions of units."

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Fig. 2: Velodyne's longest-range unit. Source: Velodyne.

In addition to automotive electronics, Velodyne LiDAR is looking toward applications in high-definition mapping, drones, robotics, and industrial equipment, according to the CTO. "The autonomous vehicle space is the fastest growing," he noted.

The company's new device is a fixed-laser, solid-state LiDAR sensor. It is in prototype, with volume production set for the late 2018 and 2019 time frame, Gopalan said. The system is based on Velodyne's proprietary ASIC technology, with chips made by an unidentified foundry. While it is aimed at Level 4/5 autonomy in vehicles, it has more immediate applications in ADAS functions, he noted.

"LiDAR is bringing back to life some silicon technologies," Gopalan observed. also looking toward photonics, with "optics technologies finding a new home," he added. LiDAR is "a new driver for silicon," and with standard CMOS processes, LiDAR chips "are bringing down the price points," the CTO said.

The San Jose factory is producing Velodyne LiDAR's flagship products, using robotics on the factory floor. The company's goal is for "a lights-out factory," with the robots handling automated assembly, Golapan said.

LiDAR leaders are shaping up in the market. The push for autonomy in multiple industries will pay off for some vendors, and it will test the capabilities of others.

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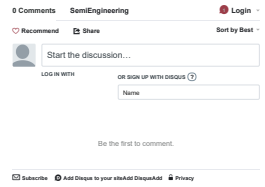

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