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Automotive sensors

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Feature

Breakthrough sensor technologies bring self-driving cars a step closer

By Kim Moore

Cheaper and more powerful lidar and technologies that can augment it are getting investor attention

In USAA's San Antonio office in the southern US state of Texas, one of the earliest airbags from the late 1970s is on display. The insurer was an early advocate and lobbyist for installing the now ubiquitous safety feature in cars.

Fast forward 50 years and USAA is investing in the very latest car safety technology for autonomous vehicles, a key element of their commercialisation. In January USAA's venture team took part in a $13m funding round for Lumotive, a developer of 3D sensor chips. The capital raise, led by Samsung Ventures, will finance the development of optical semiconductor devices that enable the next generation of lidar sensors.

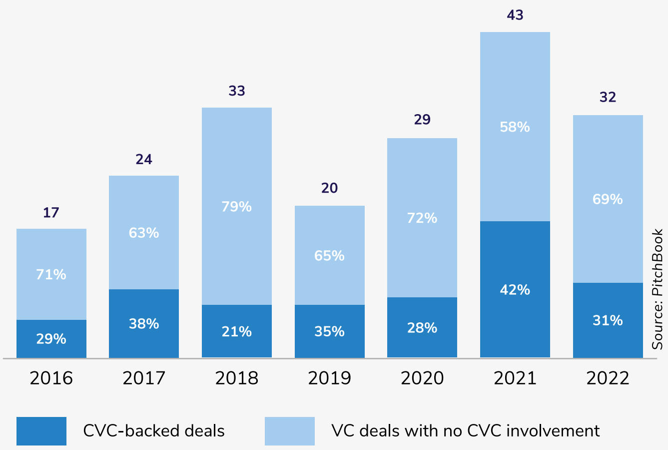
Ensuring safety is a barrier that makers of autonomous vehicles must overcome before self-driving cars can be made widely available. Part of the reason that autonomous vehicles have been slower to be developed than many hoped is because lidar technology has been expensive and its capabilities still limited. But a new generation of lidar and other sensors is emerging, which could overcome these challenges.

Lidar, which stands for light detection and ranging, is a remote sensing method that uses pulses of laser light to measure distances. It enables autonomous cars to detect objects around them, so that they can avoid collision. Typical lidar is a mechanical device that creates a 360-degree view of what is going on around the vehicle. New technologies are taking this application a step further to increase detection performance and make it cheaper to produce.

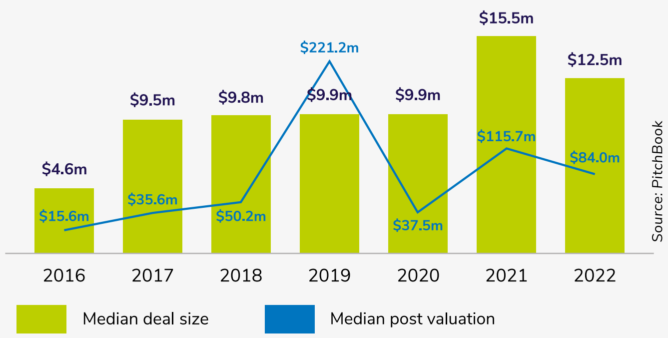
US-based Lumotive is developing a silicon-based semiconductor that uses software to steer a beam to detect a vehicle's surroundings. The chips address perception and safety requirements across

Dashboard

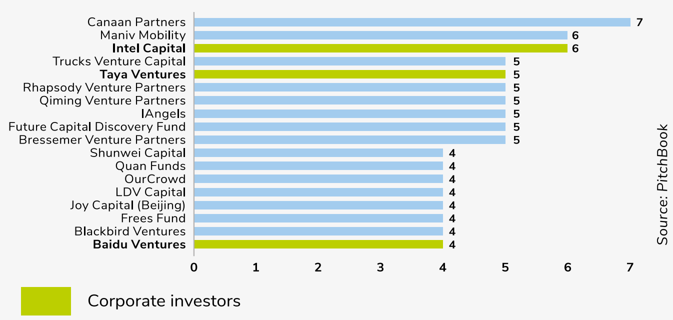
Automotive lidar & sensor tech deals 2016-22



Median deal size & post-money valuation in the lidar and sensor tech space 2016-22



Top investors in automotive lidar & sensor tech 2016-22



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industries, not just in automotive but also in industrial and consumer sectors, says CEO Sam Heidari.

Lumotive's technology can play a role in making lidar applications cheaper because it can be easily scaled, says Michael Smith, assistant vice president of corporate development at USAA. This is especially important for commercialisation in the automotive sector where safety systems have increased the cost of cars by 50% in the past decade.

"If Lumotive can help increase the prevalence of the safety systems whilst also reducing cost, it will have a nice market opportunity," says Smith.

Lumotive's sensors can be integrated into the existing car manufacturing supply chain, helping to reduce costs further. "Lumotive can provide a new and better technology to the existing lidar manufacturers. They go in tier one manufacturers and OEMs [original equipment manufacturers]. That was an attraction that they could improve the existing value chain," says Smith.

Other startups have invented sensors that use materials which are extra sensitive to detecting surrounding objects. Phlux Technology, a spinout from the University of Sheffield, in the UK, uses antimony, a metallic element, to make infrared sensors that improve the performance of lidar systems.

The startup's product is 10 times more sensitive and has 50 times more range compared with equivalent sensors, according to a release. In December last year it raised £4m ($4.93m) in seed funding, led by UK investment firm Octopus Ventures. The round included Northern Gritstone, an investor of startups in the north of England, Foresight Williams Technology Funds and Innovation Fund.

A unique feature of the technology is that it can operate at high energy in poor visibility while not damaging human eyesight.

"We are getting to this point in the adoption of lidar in autonomous vehicles where, to have good visibility in bad weather and darkness, you need to have a certain amount of power that is emitted and reflected off these lidar devices. There is a compromise between our safety and the wavelength of light that can be used for lidar devices," says Amy Nommeots-Nomm, deep tech investor at Octopus Ventures.

"One thesis we have of where lidar will go is the energy, or wavelength of light, that will be used for mainstream lidar will transition away from visible wavelengths of light to infrared," she says.

Phlux Technology's sensors can emit more than 1,000 times more photons than silicon-based emitters, enabling its antimony sensors to see further and with greater pixel density.

"Industry will never achieve full autonomy with lidar if it relies on silicon-based sensors, so our approach will reshape the sensor market for robotics and self-driving machines," says Ben White, CEO and co-founder of Phlux Technology, in a release.

The startup's sensors can be mass produced and retrofitted into existing lidar systems, which is a big attraction for investors. The sensors can also be applied to other sectors such as satellite communications, fibre telecommunications and gas sensing.

"We back technologies that can serve a lot of markets. It gives them space to move and grow as they move towards commercialisation," says Nommeots-Nomm.

The deep tech investor also predicts innovations in background computing that process the data that sensors collect. "We are seeing growth in optimised algorithms for these applications, which are progressing in tandem with this cheaper, more accurate lidar," she says.

Unsurprisingly, carmakers are eyeing up new lidar technology. GM Ventures, the corporate venture arm of General Motors, recently invested in UK startup Focal Point, a developer of next generation global positioning system (GPS) technology. The company is trying to solve the so-called canyon problem with GPS, in which tall buildings in urban settings disrupt satellite signals from reaching ground level.

Focal Point has developed computer chip software that stops reflections from satellites bouncing off buildings and more accurately pinpoints vehicles using GPS. This makes navigation and positioning more accurate in dense urban environments. It is partnering with General Motors on applying its technology to the carmaker's driver assistance systems and autonomous vehicle technologies.

"Lidar, radar, GPS-type technologies are going to be a focus for us," says Stefon Crawford, principal at GM Ventures.

While fully autonomous vehicles may still be years away, lidar 2.0 will be a critical part of that journey.

Investor and startup quotes

Anooj Shah, **senior director of investment and strategy, BlackBerry**

One of the areas that we've found has resonated with automakers is how to use software to create virtual sensors that replace small physical sensors in the car. The reasons why automakers are interested in this is twofold: The first is it makes vehicles more resilient to supply chain disruptions. The second is it also reduces the overall materials cost of the vehicle.

Blackberry has invested in Germany-based company dubbed Compredict, whose software purports to predict failures, thus enabling lightweight design of automotive components. This kind of software could be used for stress-testing of vehicles and thus help improve safety.

Amy Nommeots-Nomm, **deep tech investor, Octopus Ventures**

We are getting to this point in the adoption of lidar in autonomous vehicles that, to have good visibility in bad weather and darkness, you need to have a certain amount of power that is emitted and reflected off these lidar devices. There is a compromise between our safety and the wavelength of light that can be used for lidar devices.

One thesis we have of where lidar will go is the energy, or wavelength of light, that will be used for mainstream lidar will transition away from visible wavelengths of light to infrared.

We are seeing a lot of innovation in background computing and processing of the data. I think innovation will happen in both areas.

Paul Drysch, **chief executive and co-founder, PreAct Technologies**

It seems now that venture capitalists are scared of the market. These particular venture capitalists were effectively burnt out as they were investing billions of dollars in long range lidar projects that went nowhere. The environment as a whole in the technology sector to has become harder with regards to receiving funding, so in order to stand out you need to create something that can hit the markets soon in order to receive investment.

Startups to watch

Baraja

Based in: Australia
Founded: 2016
Funding to date: $63.9m

Baraja is an Australia-based developer of the autonomous lidar technology Spectrum-Scan. The technology solves many issues in lidar systems, such as blurring by scanning with wavelengths and tuneable lasers that instantaneously hop from one point to another without inertia, resulting in a blur-free point cloud and reliable information.

Founded in 2016 by Federico Collarte and Cibby Pulikkaseril, the telecommunications experts could use optical fibre and photonics technology to resolve the various setbacks affecting lidar, including generating long range perception accuracy.

The startup has raised a total of $63.9m in total funding, most recently a $31m round in 2021. Hitachi Construction Machinery, a subsidiary of Hitachi and the Sweden-based automaker Veoneer, have backed the company, alongside Sequoia and Blackbird Ventures.

Lunewave

Based in: US
Founded: 2017
Funding to date: $14.1m

Lunewave, a spinout of the University of Arizona, has created the Luneberg lens radar technology that provides long-range and high-resolution detection for autonomous vehicles. Luneberg offers a strong 360-degree field of view and a 250+ metre range, meaning that two of these radars can replace up to eight conventional radars on the market.

Launched in 2017 by its three co-founders and University of Arizona alumni Min Liang, Hao Xin and John Xin, who are all experts in engineering, millimetre wave frequency and microwaves.

The US-based spinout announced its $7m series A funding round in 2020, which was led by the asset manager FM Capital and saw participation from Intact Ventures, the corporate venture arm of the Canada-based insurance company Intact Financial. The company has also received support from the multinational technology corporation IBM.

Metawave Corporation

Based in: US
Founded: 2017
Funding to date: $30m

Metawave is a US-based producer of sensing perception solutions for terrestrial and aerospace mobility. Through wireless technologies, the company builds intelligent automotive Specktra radars through metamaterials and AI that are capable of classifying and labelling potential challenging weather conditions.

Founded in 2017 by Maha Achour, the company seeks to improve eVTOL safety, as well as further advance the driverless vehicle sector through its Perception Engine Aware. The company utilises 5G telecommunications applications that produce low costing results.

The startup raised $26m in a series B funding round in 2022, bringing its total funding to $30m. Its series B investors were left undisclosed, however, other corporations have previously invested including Hyundai Motor Company, NTT Docomo, Denso and Toyota's corporate venture arm, Toyota Ventures.

Neural Propulsion Systems

Based in: US
Founded: 2017
Funding to date: $31.5m

Neural Propulsion Systems (NPS) is a US-based artificial intelligence company developing a multi-modal sensor system, including a solid-state lidar, radar and cameras, allowing a car to see around corners and up to 1,000 metres away. It promises to be cheaper and to consume less energy than rival systems.

Founded in 2017 by serial entrepreneur Behrooz Rezvani, NPS' technology resolves several challenges lidars have including seeing obstacles that are blocked by other objects and continuing to function throughout bad weather such as rain or fog.

Since then, the startup has raised a total of $31.5m, with its two key investors being the technology firm Cota Capital and Blue Lagoon Capital. NPS was also recently named as CES 2023 Innovation Awards Honoree for its ground-breaking sensors technology.

Nodar

Based in: US
Founded: 2018
Funding to date: $14.3m

Nodar is creating 3D sensor technology using off-the-shelf cameras that deliver long range and precise depth sensing. The US-based startup manufactures its Hammerhead product which can be used on L3 and L4 autonomous vehicle applications such as passenger vehicles.

Leaf Jiang, the company's chief executive, founded Nodar back in 2018, after spending over 12 years at MIT Lincoln Laboratory studying and building laser ranging systems for the military. Through this, Nodar has been able to develop 3D sensing products that maintain high performances through strong winds, vibrations and water exposure.

In April 2022, the startup raised $12m in a series A round with New Enterprise Associates leading the round and Rhapsody Venture Partners also participating. Previous investors also include venture capital firms such as MassChallenge, Plug & Play and Small Business Innovation Research.

Opsys Tech

Based in: Israel
Founded: 2016
Funding to date: $36.5m

Based in Holon, Israel, Opsys Tech is a developer of optic sensor technology that provides high resolution and fast scanning capabilities across a cars full field of view. The company is also working with other companies to incorporate this technology into cars windscreens.

Founded in 2016 by Rafi Harel, Eitan Gertel, Mark Donovan and Guy Gertel, the company's innovative technology allows for multiple base sensors to be constructed as an aggregated package or spread across the entire vehicle, providing imaging from all angles.

Earlier this year, Opsys Tech closed its $51.5m series C funding round with investors ranging from Osage University Partners, Translink Capital and Saban Ventures, the corporate arm of the US-based entertainment company Saban Capital Group.

PreAct Technologies
Based in: Australia
Founded: 2016
Funding to date: $63.9m

PreAct: software-based short-range lidar with uses beyond cars

By Roshini Bains

Oregon-based startup PreAct Technologies has developed a near-field software definable flash lidar technology for self-driving cars to help quickly and accurately map various surroundings.

Making lidar less costly and thinking beyond just the autonomous driving market are two ways a startup can stand out, says Paul Drysch, the chief executive and co-founder of PreAct Technologies, the US-based lidar software developer.

"Most lidar companies focus on long-range sensing for autonomous vehicles, and coming out of the autonomous vehicle space I knew the market was not going anywhere anytime soon. Whereas short range sensing, a $30bn industry, is continually innovating and developing results," he says.

PreAct has developed a near-field lidar technology, TrueSense, which detects up to 20 metres — compared with around 200 metres for long-range lidar. And it is based on software to keep costs down.

"To compete in this market, we knew we had to build a lidar unit similar to those existing units but significantly less expensive," says Drysch, "And the only way that could be achieved was through software, as other lidar companies have sophisticated and expensive hardware components to them which require vast amounts of spending. So, we took off-the-shelf components and developed a flash lidar which does not use lasers and through software, we can make it perform equal to anything already out there."

PreAct's near-field software-definable flash lidar technology combines continuous wave time of flight technology and a high-resolution RBG camera. It can be used in driving settings such as pre-crash detection to self-parking guidance, but can also be applied to sectors such as agriculture and healthcare.

"We consider ourselves a software company and produce lidar units for the automotive and trucking sectors, in particular, but our software can be applied to many industries such as robotics and security too," says Drysch.

Drysch has a 20-year history in the transport and automotive sector, beginning his career as a territory manager for American Honda Motor Company's Latin America region. He was global director of Cisco Jasper's connected car division and was the vice president of business development and general manager of the APAC region for RideCell, a US-based fleet operations software developer.

The Tesla model

Drysch says software-defined vehicles are a strong current trend. "I believe everyone is now chasing the Tesla Model. Current vehicles have around 47 ECUs (electronic control units) that control one aspect of a car, whereas Tesla has created one computer to control all components such as brakes, air conditioning and the stereo," he says.

"Tesla models are connected through their cloud platform and the model offers a software-as-a-service model to improve safety and performance. Therefore, all the OEMs are headed toward this example. With regards to PreAct Technologies, we have also adopted this, by developing software that is fully definable, meaning we can change every aspect of a sensor over the air and allow OEMs to keep their safety systems leading edge over time."

Investor "scared" of the market

Though the number of funding deals for sensor startups has been growing over the past few years, Drysch believes that finding investment has become a greater challenge. "I believe it is much harder to receive lidar investments compared to two years ago," he says, "It's not uncommon to see many lidar companies go out of business or merge because they are too weak on their own," he says.

Several lidar companies, including Quanergy, a Silicon Valley maker of solid state lidar and Germany's Ibeo, filed for insolvency at the end of 2022.

"It seems now that venture capitalists are scared of the market. These particular venture capitalists were effectively burnt out as they were investing billions of dollars in long-range lidar projects that went nowhere. The environment as a whole in the technology sector to has become harder with regards to receiving funding, so in order to stand out you need to create something that can hit the markets soon in order to receive investment.

"PreAct Technologies has been able to get the necessary funding, compared to these other companies, because we have a clear path to profitability that has been mapped until next year," says Drysch, "We have designed software that can fit into many markets, not solely automotive, which will garner investment from those non-automotive projects too."

Investment from State Farm

Founded in 2018, PreAct Technology has so far raised a total of $41m, including a $14m series B round led by the US-based private equity firm Squared Capital, with participation from State Farm Ventures, the corporate venture arm of State Farm, one of the world's largest auto insurance companies.

"After PreAct Technologies attended the TechCrunch Startup Battlefield ceremony and won, we were approached by State Farm. All the companies within the automotive industry tend to generate billions of dollars in revenue, so they are unlikely to invest in a little startup because of the risk involved in that," says Drysch.

"Having a company like State Farm invest in you and work with you provides a way into the market whilst providing additional credibility and once State Farm showed interest, it almost incentivised other insurance companies to want to knock on the door and talk with us."

The latest raise will allow the company to double its engineering staff, says Drysch. "We have also acquired a small computer vision company in Barcelona which will help us further bring forward our products to market over the next few months. I hope we can also attract new customers through this, especially as we have a couple of products in our pipeline too."

The company's leadership consists of five individuals; Keith Brendley, the co-founder and chairman; Kurt Brendley, the co-founder and chief operating officer; James Dawson, vice president of customer solutions; David Class, vice president of engineering and Drysch.

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Startups to watch (cont.)

Phlux Technology

Based in: United Kingdom
Founded: 2020
Funding to date: $4.8m

Most lidar sensors rely on silicon, but Phlux Technology, the UK-based infrared lidar sensor developer and spinout of the University of Sheffield, uses a chemical element called antimony which is capable of enhancing the ranging system for driverless cars more effectively.

Established in 2020, the company claims it makes sensors 10 times more sensitive than traditional counterparts and has the potential to bring down the cost of lidar manufacturing. Sheffield University Alumni's Ben White, Joe Shien Ng and Chee Hing Tan founded the company based on their research into novel semiconductor materials and infrared detection devices.

Since its launch, Phlux Technology has raised a total of $4.8m through its seed funding round in 2022, which saw investors from venture firms such as Octopus Ventures, Northern Gritstone, Foresight Williams Technology and Innovate UK.

PreAct Technologies

Based in: US
Founded: 2018
Funding to date: $41m

PreAct Technologies is a US-based developer of near-field software definable lidar technology. The company aims to bridge the gap between collision avoidance systems and active safety technology by producing high quality 3D data that can be tailored to users' needs.

The company was founded in 2018 by chief executive, Paul Drysch, who previously worked as Cisco Jasper's global director of their connected car division and was the vice president of sales and marketing at WirelessCar.

Since its launch, the company has raised a total of $41m, with its most recent funding round occurring this year where it raised $14m in a series B round, with the insurance corporation State Farm Life Insurance providing an investment through its venture arm, State Farm Ventures.

Red Leader

Based in: US
Founded: 2018
Funding to date: $13m

Red Leader is a US-based startup creating a new form of mathematics for lidar technology. Red Leader's software is focused on fine-tuning lidar images for low-range sensors, with the potential of becoming an iPhone camera for laser technology.

Jake Hillard and Rebecca Wong co-founded the startup back in 2018 with the aim of transforming and bringing light to the future of sensor technology. Hillard himself had previously worked as a hardware engineer at the US-based rocket manufacturer SpaceX.

To date, Red Leader has raised a total of $13m in funding, with its latest funding round in 2022, where it raised a $10m series A round. The round saw participation from Micron's corporate venture capital, Micron Ventures and the US-based venture capital firm, NextView Ventures.

Repli5

Based in: Australia
Founded: 2016
Funding to date: $63.9m

Repli5 is a Sweden-headquartered company that creates lidar software tools that simplify the development of autonomous vehicles. The company's 3D simulation environment can helps auto makers cut some of the time and cost of development.

Launched in 2018, the company is part of the Chalmers Ventures portfolio, an incubator for Chalmers University. Repli5's chief executive, Stefan Svahn, has 15 years' worth of experience working with startups and multinational corporations.

So far, Repli5 has received an undisclosed investment during its seed funding round from Chalmers ventures and from Wallenberg Investments subsidiary, Navigare Ventures. The software has the potential to also expand into other fields including the mining and urban planning industry.

Scantinel

Based in: Germany
Founded: 2019
Funding to date: $18.7m

Lidar sensors can operate on a variety of transition frequencies and one of the most effective yet niche is frequency-modulated continuous waves (FMCW) which are known to improve dynamic range and multiple closely spaced surfaces. Enter Scantinel Photonics, a German startup that uses FMCW photonic chips to make lidar cheaper, faster and easier to mass produce.

Scantinel Photonics was launched in 2019 by the ex-employees of the optical systems manufacturing company Zeiss, Andy Zott, Vladimir Davydenko and Jan Horn. Daydenko is the company's chief architect and integration of the FMCW silicon photonics and laser integration, using his long experience in developing micro-optical components to help launch this company.

The startup has raised a total of $18.7m in funding, with support from three key investors, the Netherlands-based photonic chip developer PhotonDelta, Scania Growth Capital and Zeiss.

Voyant Photonics

Based in: US
Founded: 2018
Funding to date: $19.7m

As an industry first, Voyant Photonics, is a US-based startup that develops 4D lidar on a single semiconductor chip. The technology accurately locates people and objects whilst identifying moving objects for a highly cheaper cost.

The company was launched in 2018, by lidar chip experts Chris Phare and Steven Miller, who also are part of Colombia University's Lipson Nanophotonics Group. Their experience sets them apart and has allowed them to mass produce a lidar system similar to computer chips that are ubiquitous for all machine technology perception.

The startup has raised a total of $19.7m in financing, with its most recent occurring in 2021 where they raised $15.4m in a series A funding round, that saw participation from the US-based government agency Darpa and the robotics and technology focused venture capital firm LDV Capital.

Market overview

By Kaloyan Andonov

How many sensors does a modern-day car have? It is a simple question with a surprisingly tricky answer. The number can vary greatly anywhere from as little as 30 in somewhat dated vehicles to well over 200 in high-end modern ones.

While cars have had sensors for some time, they are coming into a new prominence now, with the quest for smarter and safer vehicles pushing demand for sophisticated sensor technologies.

The automotive sensor market was estimated at $27.5bn in 2021, according to a recent report by Mordor Intelligence. The report forecasts that the market will see a compound annual growth rate of 13.6% until 2027, driven by the rise of electric vehicles (EVs) and autonomous driving as well as the proliferation of advanced driver-assistance systems (ADAS) in most conventional internal combustion engine vehicles.

Making sense of sensors

Automotive sensors can be categorised in different ways, in terms of type (pressure, position, temperature, speed, level, gas, inertial etc.) or application (vehicle security, telematics, powertrain and so on).

Pressure, position, temperature and speed sensors command the largest market share according to the Mordor Intelligence report.

The number of pressure and magnetic sensors is expected to increase as the mass market for electric vehicles grows, the report says. Batteries are the backbone of EVs, and there will be growing demand for the magnetic sensors used for their monitoring and management.

Driver assistance and automotive systems, meanwhile, will increase the need for position sensors that detect people, vehicles or other objects in motion.

Wrong turn for autonomous driving?

Self-driving cars are one of the big drivers for sensors in vehicles. The project to create truly driverless cars, however, has been slower than originally anticipated, with major automakers taking a step back from the technology.

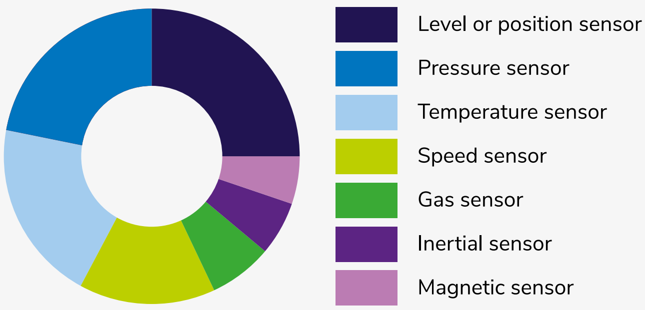
Volkswagen (VW) and Ford's autonomous vehicle unit, Argo AI, for example, was shut down last year, with Ford reporting in its Q3 2022 earnings call that it had taken a "$2.7bn non-cash, pre-tax impairment on its investment in Argo AI, resulting in an $827m net loss [for the quarter]."

Ford said that it would focus on advanced driver assistance (so called Level 2 and Level 3 autonomy), rather than the Level 4 and 5 autonomy (essentially driverless cars) that Argo AI was pursuing.

Meanwhile, a former Tesla engineer testified in court that one of the company's driverless car promoting videos from 2016 was staged, as reported by TechCrunch. Tesla has privately admitted, according to released documents, that its Autopilot system is only a Level 2 autonomy despite hype generated by Elon Musk.

All these developments are casting certain doubt about the feasibility of fully autonomous vehicles, but this does not necessarily change the market for sensors, as the majority of new vehicles being commercialised today are equipped with ADAS and need to be laden with sensors.

Automotive sensor market, revenue (%), by type, 2021



Source: Mordor Intelligence

Driver assistance coming — whether drivers like it or not

Consumer enthusiasm for advanced driver assistance systems has been muted in some markets, like Europe.

One study, conducted by Siemens, demonstrated a lack of enthusiasm about ADAS among consumers in Europe and the US, where only 56% of Europeans and 57% of Americans claimed to be interested in purchasing ADAS features, as opposed to 83% in China.

Another one, conducted by software developer CCC IS, found that more than half of drivers claim to seek a long list of safety features. However, most not only lack deeper understanding of ADAS but also as many as 70% actually disable such features in their vehicles.

However, consumer preferences might not be the deciding factor. With many regulatory bodies setting safety standards around the globe, driver assistance systems may be implemented regardless.

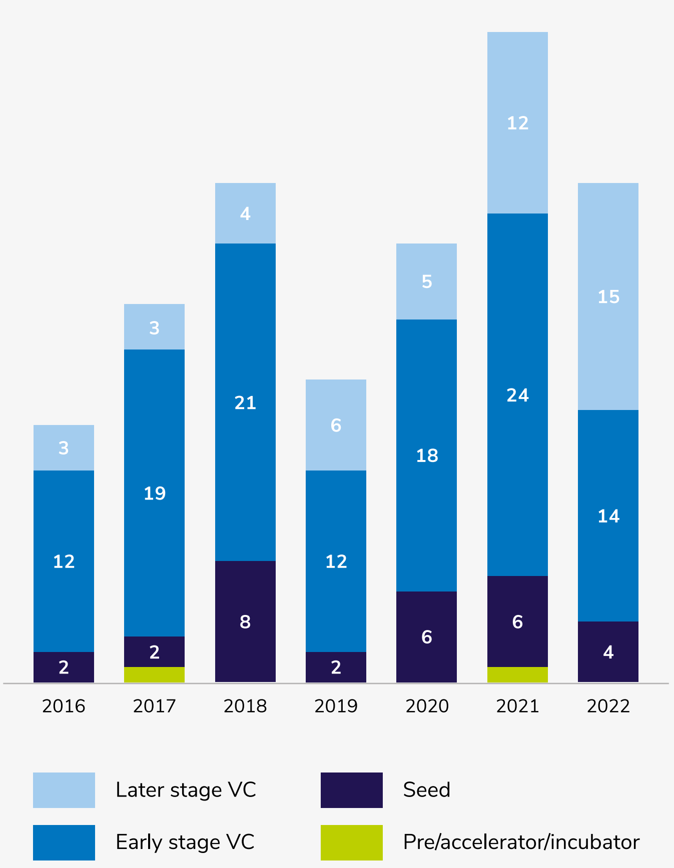
The EU, for example, already adopted its revised General Safety Regulation, which introduced a range of mandatory ADAS to improve road safety — although it is worth noting that the US Federal Motor Vehicle Safety Standards (FMVSS) do not mandate or regulate any particular ADAS to date, according to the American Bar Association.

Coveted high-value sensors

Much of the excitement about this market revolves around high-value sensors, which help to improve safety, fuel efficiency and environmental impact of a vehicle.

The most-talked about such technology has been, undoubtedly, light detection and ranging (lidar), sometimes also referred to as "3D scanning" or "laser scanning". That is precisely what this tech does – it creates an accurate 3D image of surrounding surveyed areas.

Automotive lidar & sensor tech 2016-22 by round types



Source: PitchBook

However, like most innovative tech, it is somewhat controversial. In addition to natural technical difficulties of measuring accurately under adverse conditions, the biggest drawback of lidar has to do with its cost. Lidar systems can vary in price from $4000 to $80,000 and beyond, according to Neuvition.

Lidar technology can be categorised into mechanical, pure solid-state and semi-solid lidar. The price tag of mechanical lidar is generally high, which is why it is primarily used in test vehicles. While pure solid-state technology is not fully mature, semi-solid lidar has become the most commonly used in motor vehicles today because of their lower relative cost. The average price of vehicle-mounted semi-solid lidar system stands at about $1,000.

According to Mordor Intelligence, lidar sensors tend to be more expensive compared to radar sensors because of the rare earth metals required to produce them. From the manufacturers' standpoint, this also makes them more susceptible to supply chain disruptions. Elon Musk had famously dubbed lidar "a fool's errand".

Lower cost alternatives to lidar

There are alternatives to the pricey lidar tech, though. The most commonly found one is computer vision. This technology uses inexpensive cameras and an array of sensors bult into the vehicle to detect obstacles, other vehicles, pedestrians etc. Its biggest drawback is the unreliable detection of objects at a distance beyond 50 metres (164 ft).

It is already employed for a variety of purposes by manufacturers like Tesla and Toyota, including collision avoidance, automated braking, driver's behavioural analysis and even in assembly automation by carmakers, according to AIMultiple.com.

Another alternative to lidar are the high resolution automotive radars, also known as 4D imaging radars. This technology is reportedly able to provide and draw a detailed image within a range of over 300m (1000 ft).

Such radars can also detect objects on the side of the road as well as specific targets (e.g. a person or a bike), even if those are partially hidden by a large object, like a truck or a tree.

It is no surprise that high resolution radars, for that reason, are believed to be potentially the next step to Level 4 and Level 5 autonomy.

In fact, vehicle manufacturers are already taking an active interest in this space. In 2021, automaker General Motors, for example, invested in radar software company Oculii. The startup aims to improve the spatial resolution of radar sensors by up to 100-fold, according to TechCrunch.

Automotive component manufacturer Denso has backed across multiple rounds California-based Metawave, alongside Hyundai, Toyota and Saic Motors, among other investors. The company is developing advanced vehicle and aerial imaging radar technology. It claims to be the first company to demonstrate realisable analogue beamforming and steering radar solutions for the mobility and autonomy markets.

The price of the hardware required for lidar and other sensor technologies has made some entrepreneurs and investors seek solutions with virtual or software-based sensors.

There are also other innovative startups whose technologies simply aim to better adapt lidar. For example, UK-based Phlux Technologies lidar uses antimony rather than silicon. The company works with robotics, industrial automation, and autonomous vehicle companies to help their systems navigate better.

Similarly, Neural Propulsion Systems offers a multi-modal sensor system which blends intelligently solid-state lidar, radar and cameras.

VC and CVC involvement in the space

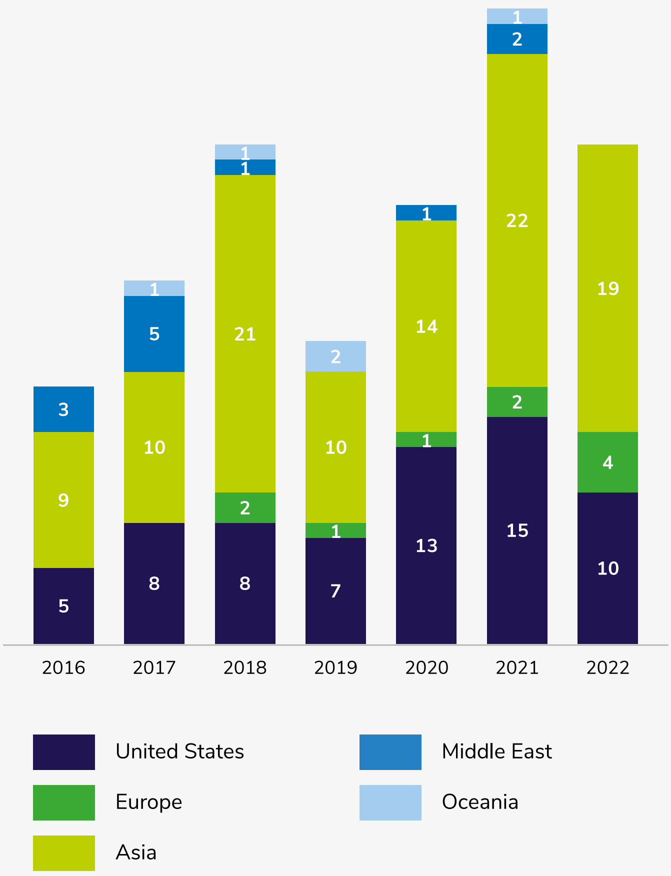
Venture capital investors have backed a few dozen lidar and sensor startup funding rounds each year for the last few years, with deal numbers in 2022 down from a high in 2021. About a third of deals have had a corporate backer.

The median size of those has stood for the most part at or above $9m per round. Similarly, median post-money valuations ranged mostly below $100m from 2016 onward, suggesting that such rounds are likely early-stage and thus reflecting the relative infancy of the technology.

In fact, if we look at the round type breakdown, most rounds in this space were indeed early stage or seed. Geographically speaking, most VC deals in specialised businesses in this space were concentrated in the US and Asia (both East Asia and Israel).

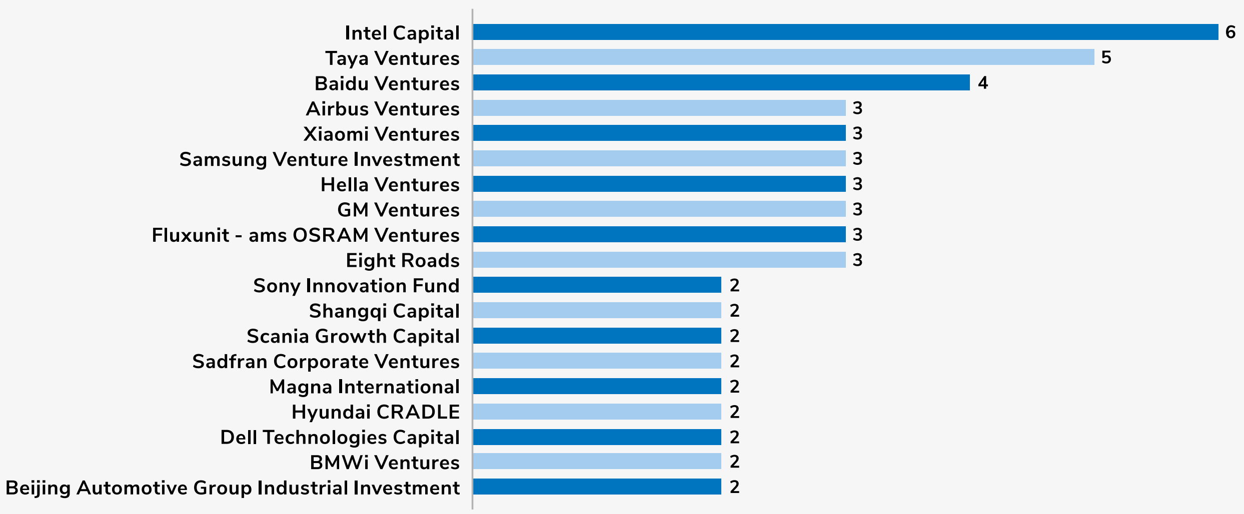
The automotive sensors space has proven attractive to traditional VC and CVC investors alike. The top corporate investors by deal count between 2016 and 2022, according to PitchBook´s data, were Intel Capital, Taya Ventures, part of Israel's Taya Media Group, and Baidu Ventures.

Automotive lidar & sensor tech 2016-22 by region



Source: PitchBook

Top corporate investors in automotive lidar & sensor tech 2016-22



Source: PitchBook