

Intelligence at the Speed of Light

Silicon Valley lidar start-up enjoys automotive investment



L *IDAR Magazine* last visited Cepton Technologies in San José at the end of 2017, just as the firm was preparing to move into its new facility¹. The build-out, designed by CEO Dr. Jun Pei, was under construction. The company's Sora™ sensor had attracted interest in the UAV-lidar

market. Dr. Pei recommended we talk to his customer May Mobility, which was making autonomous vehicles for use in limited, geofenced areas, so we visited its headquarters in Ann Arbor, Michigan, and its operations center in Detroit². Cepton has become a familiar presence at geospatial trade shows

and the products have been used by several UAV-lidar integrators. We asked if we could re-visit for an update. Managing editor Stewart Walker and publisher Allen Cheves were welcomed by marketing & communications manager Faithy Li, CEO Dr. Jun Pei (Jun) and EVP of Marketing Dr. T.R. Ramachandran (TR). Unable to cast aside our fascination with Silicon Valley's secrets, we tried to focus on the firm and the people rather than the technology. Here is what we learned.

We toured the new building. There were cubes full of parts, systems and

¹ Walker, A.S., 2018. Cepton Technologies: the Silicon Valley approach to lidar sensor development, *LIDAR Magazine*, 8(2): 34-44, March/April.

² Walker, A.S., 2018. Autonomous vehicles operational thanks to lidar, *LIDAR Magazine*, 8(5): 20-26, September/October.

BY DR. A. STEWART WALKER



Dr. Jun Pei, co-founder and CEO, in the machine shop

instruments. We saw an area for calibration and Jun emphasized that Cepton does outdoor testing in bright sunlight, which can be tough for lidar. We returned inside, to an open area for production and testing. There was a mechanical lab, with a sensor under development, then an electrical lab, also for testing. But Jun showed his real joy—the machine shop. All the equipment and cabinets used to be in his garage in Saratoga, except for some new machines. We saw test vehicles, then a production area, on a small scale, with people using their hands, on different stations for different parts of assembly. Behind this was optical alignment. And a ping pong table! On the way back to the conference room, there was a sensor mounted on a wall, with results on a monitor, where we could see people moving. Jun added that the takeaway was not so much the lidar image itself but the box around it and the tail behind each person, i.e. the tracking mechanism. The software could find people and track them anonymously. The user could define a zone and



Bob Brown, CFO

count people moving in and out, in a software-based solution: it was possible to measure the height of people, count how long they looked in the nearby display cabinet at the product, i.e. a lot more than just a dumb sensor.

We met Bob Brown, CFO, who joined Cepton in May 2019 from Velodyne LiDAR, where he had also been CFO. He's a University of Michigan man, which gave me a segue to refer to May Mobility. "We had May Mobility in our booth at CES," said Bob. "They got a

good investment from Toyota recently³. They're one of the few companies actually to make revenue from this. But it's early days."

Before we continued to the main part of the interview, Jun quipped about Bob's high stature as a CFO, "Bob worked after grad school with a semiconductor company. When we were both in semiconductors I could not even make an appointment with him, yet now we are together working on something great." Jun continued, "Bob is a tremendous asset to the company. I don't know what we did right to get his interest -we were introduced through an investor friend, had a coffee, found common goal in life and agreed to do something together."

LM: Thank you for inviting us back. What's going on?

Jun: Good to see you guys. We are eager to provide updates, but I have become more nervous talking to the media. When we last met, Cepton had about 20 people, now we are approaching 100. We just got an investment from Koito Manufacturing Co., Ltd.⁴ When we started, much investment came from me and my family. You don't want to talk about family money, so for years I did not want to talk about how much we had raised—unlike other lidar companies! This time, we are doing so because Koito is a Japanese automotive tier 1 and world-leading provider of automotive lighting systems. It's a multi-billion dollar public company that supplies the majority of Japanese vehicle headlamps

³ <https://www.autonews.com/mobility-report/toyota-leads-50-million-funding-round-may-mobility>

⁴ <https://www.businesswire.com/news/home/20200205005678/en/Cepton-Expands-50-Million-Investment-Koito>

and a dominant percentage of Japan's street lamps. So Koito had to disclose its investment in Cepton under the rules of the Japanese stock exchange. Then people would find out, so we issued a press release! Now, suddenly, I get pings from all over the world, all sectors, the technical end, the financial people, the marketing people, the media, everyone's trying to get an understanding. It's fascinating what one press release can do!

LM: You've said your total financing up to now is ~\$100 m—that's a lot of money.

Jun: It is a lot of money and we've been shy to talk about it. The amount of war-chest ammunition doesn't necessarily guarantee that you win the battle or the war, but it's a good thing. I'm an engineer by trade and I'm always shy of media attention. I remember my piano-playing picture in the last article and it was nice to get a chance to get a good review.

The biggest change, other than the build-up of the place and the expansion of the business, has been the congregation of great people. The landscape is changing in the lidar industry. I'm always grateful that I've lived in Silicon Valley, I came to Stanford in 1992 and never left. I just cannot decide to go anywhere else; this is the place for me—weather, career, marriage, everything is here, this is home. A great number of people with talent, with integrity, with a desire to do something great, they're all here.

TR: Other cities in the world have tried to re-create Silicon Valley but haven't been successful. The blend of cultures, immigrants, universities, as well as of course the weather, is a nice mix that's conducive.

LM: When we were here at the end of 2017, it was all about technology and



Dr. T.R. Ramachandran, EVP of Marketing, photographed while bird-watching in Colombia

the focus was on product development, direct sales, just getting the product out the door, but now you're in a different world. You're in the solutions world and you've got partners. What's changed?

Jun: I showed you the demo. Cepton is slowly growing from being just a simple sensor company to being more and more a solution company. It's no longer just having the raw point cloud. If I'm sitting beside you giving you driving directions, I can't just give you XYZ coordinates—that's a dot! I need to tell you that in front of you there's a tree, so make a left. Turning raw data into an abstract concept that everyone knows, e.g. a person crossing the perimeter, let's count him as one person, or a person over three feet tall crossing a perimeter, i.e. not a child, things of that nature are starting to materialize with our sensor and software solution. The company grew over the past couple of years and at the last CES we won two awards for the solution rather than just a simple sensor⁵.

⁵ <https://www.businesswire.com/news/home/20200106005357/en/Cepton-Showcase-Award-Winning-Lidar-Solutions-Multimarket-Collaborations>

The software solution brings more meaning to the applications of lidar. A supermarket wouldn't buy lidar but would buy a solution that counts the people coming through the door. Yes, we're building a product or a product series, but really we're building the company and the company is a lot more than just a product—it has the business engagement, facilities, fund-raising, money, but the most important of all is the building up of the people and that's where we shine amongst all the lidar companies. In the past three or four years, I would say, this has become a magnet of great people.

LM: You have a great management team, almost all with PhDs from Stanford.

Jun: There's also an MIT camp and USC! This used to be an open space, then we built a big white wall to make a conference room, and we couldn't figure out what to put on it. So we decided on photos of people's schools, Stanford, MIT, then two Chinese universities—one is Tsinghua, one is Peking [both in Beijing]. We have five people from Tsinghua and two from Peking. The second to last in Princeton, where Mark [McCord, CTO] comes from. And I had the privilege of putting one more for myself, the very last one, that's Brandeis [where Jun did his undergrad]. As people such as TR and Bob join, we run out of space, but let's leave it the way it is. It's an incredible grouping of talents and just great people.

LM: I see your product family and trophies on the other side of the room! What is responsible, what do you think drives that?

Jun: On the top level, I really don't know. Then I do know. To me there's a more personal level. There's the natural grouping of people. I have my own close friends

and, when we meet up, their personalities involve similar interests and similar passion for things. There's a natural grouping of people who just like to come and work together or be together. It could be on a personal or a professional level, but there is always a mix between the two, there is a natural attraction of this place. Cepton is pretty well known in the Valley, so top-talented lidar people, whether in business or in electronics, optics, finance, they just like to be part of this, and as people group together, we work and accomplish a little bit and that attracts more people. There's a positive cycle. Last time we met it was just Mark and I, but now I don't call the shots anymore—I'm just a facilitator for the company. Bob calls the shots in finance, TR in business and marketing, and Mark at the technical end. The bottom line is that I'm very slowly losing my job right now, but I'm not complaining!

LM: I was interested also in your own personality. You are the CEO and you have to be a technical expert—that's why you founded the company in the first place. You have to be good at giving pitches to customers, distributors, partners, venture capitalists, investors,



Co-founder and CTO Dr. Mark McCord presents Cepton's unique approach to lidar at technology conferences worldwide.



yet you have to be good at attracting a top team. But as you say, it also happened because you were friends.

Jun: I think that, as a start-up company, when you grow from a few people, to a hundred people, it is really difficult to hire or work with someone who cannot be your friend, that's just not possible. In a 2000-person company, you just have to be colleagues, you don't have to be friends, that's fine, but in a small company there has to be personality match first. Just this morning, a board member sent me a resumé, a young

software engineer. I have to take this seriously, so the first thing I do is I send the kid an e-mail saying why don't we meet for coffee on Saturday afternoon, couple of hours, let's just feel each other out. I don't want to invest in a full interview process yet, but I want to feel whether he belongs in this group, do I see him working in this growth. So even for the lowest software job, it starts from me and I look for a personality match. I'm very technical, but I don't talk about technical things, I feel the pulses, I feel the temperature and assess whether the person would be a good fit to work in this group. A bunch of us want to jump on a bus and go somewhere, so we have to figure out whether we want this guy to get on the bus. Then we figure out where to go and how to get there. There's a huge emphasis from me, a self-imposed emphasis, to hire people right. An effect is that we have very few people leaving here. The attrition rate has been extraordinarily low.

LM: In recent weeks or months, the CEOs of Velodyne LiDAR, Trimble and Quanergy have left their positions, to be moved upstairs to chairman, or to an evangelical role. Can you comment on that? Will it happen in Cepton?

Jun: What do you think?! I think there are different personalities of CEOs, so inevitably there's different personalities of company. The culture is very much set by the CEO. We don't want to say anything about our competitors that we're not supposed to know. I know Dave Hall very well. I know Louay [Eldada, former CEO of Quanergy Systems] reasonably well, we've met at conferences and shared insights into the industry. But it is public knowledge that the Bloomberg article exposed

Quanergy's issues in both technical path and management style. Start-ups are tricky—you always have to balance the project you want to do, the people you have to manage and the amount of money you have in the bank. It's hugely important to know how much ammunition you have left and whether you want to fight the next battle or whether you will die from hunger. So, these are tricky maneuvers, sometimes you have to adopt different strategies, you have to be nimble. You have to get to the next place. You have to change your generals to get there. Whether it is for financial, technical or morale reasons, there can be hundreds of factors that cause you to make a big change. I don't think we should publicly comment on these changes. They won't happen here—yet! The reason is that things here are going very well. We have delivered every product that we have promised. We have attracted the interest of Koito. They have vetted almost every lidar company and they chose us as their partner and invested hefty money into us to go on. So, from the product end, the technology end, the money and the partners, we are doing extremely well. We're probably one of the most well-positioned lidar companies right now. There are probably 50 or 60 out there and the vast majority are likely to struggle this year and by the end of next year I'm sure half of them won't actually exist. But we're in a very comfortable position and we're going to do better—we have projects coming up that will make an even bigger impact than the people-tracking solution you saw in the hallway. So we're doing extremely well at a time when other companies are not doing so well or are struggling, so it's unlikely I'll be replaced.

That said, one of the goals as a business owner is to get yourself out of a job. For example, if you run an ice-cream shop, you don't go there every hour of the day. As a business owner, you want to make a self-sustaining, self-lubricating organization. As an engineer, I draw a parallel with making automated machine systems—you don't want to always have a screwdriver or a wrench in your hands, you want to press one button and take a nap. But with an organization it's a much taller order to accomplish that. I'm very much looking forward to the day when I can retire from my position, when it will just go by itself. I'll probably still go back to the lab or the machine shop... and continue with my hobby.

LM: The original benches!

Jun: Yes, I handmade them myself—also the drawers, where I made the runners able to carry a lot of weight. I don't have any of that stuff at home any more. The garage can hold cars!

LM: There seems to be intense movement of staff in Silicon Valley, i.e. a great deal of staff turnover. Some of this is from one competitor to another, e.g. between yourselves, Velodyne and Quanergy. What do you think about that—is it healthy? Is it ok for IP and good for health?

Jun: The movement is only one-way, other companies' great people moving into Cepton! I am not aware of anyone quitting here and joining a competitor. I get resumés from the competitors all the time and we do our due diligence to get the greatest people. They join and they stay here! It is the natural way for people to behave—they see we are doing the right things and they want to join a winning team. This is very, very

healthy. As for IP, I think that's a level of professionalism that people generally just observe. In addition, since last time you were here, we have quite a few patents already granted and more coming. The MMT[™] (Micro Motion Technology) is unique, we are the only one in the industry with this patent. People come here to work on it, their work will be based on it, and it has zero overlap with Quanergy, Velodyne or any other competitors. Very few people know what we're doing or how we're doing it. This is another reason Koito,

number of companies with small fleets who are doing development, testing, early trials etc. But let's think ahead to what is required to get AV fleets into the thousands and tens of thousands. What is required for passenger vehicles that are currently in SAE Driving Automation Level 2 to get closer to Level 3? If I set aside the software, AI etc., which is more typically owned by the OEM or the Tier 1, the lidar technology has to mature to the point where it is highly reliable for use in hundreds of thousands of vehicles. But

them the technology, many agree. They're not shipping 100,000 yet but they've been in the market for 20-30 years and they have their own way of doing assessments, evaluating the risks, figuring out whether this is going to scale. I feel good that this architecture is likely to be positively viewed by customers and so far it's playing out very well. That's an important factor. Bob and I obviously came over and other people have approached us and said they really want to come and work here. So the success in building products with that sort of capability will continue to draw good talent in my opinion and the Koito announcement is another testament. Koito started working with us over a year and a half ago, they evaluated quite a few of our sensors, put them through testing, integration, proof of concept—so where we are today is evidence that, for a large company, the top automotive tier 1 for lighting, for them to feel this is a scalable architecture, so we're not just doing a technical partnership, they're going to invest, that's a big deal for us.

“Lidar technology has to mature to the point where it is highly reliable for use in hundreds of thousands of vehicles. But of the dozens of lidar companies, few can realistically achieve that goal.”

after evaluating all the lidar companies, decided ours was the winning technology. So there's not only people from other companies joining us but also a concentration of attention from customers who realize what we do is the winning package. It's a healthy motion and it's one-way.

TR: If you think of the lidar industry, there are lots of start-ups, it's an exciting field. The excitement got built around the AV market and obviously Velodyne has been the leader for lidar sensors in that space for some time, so, with the excitement they created, now there are lots of companies in that field, trying to compete, trying to get some market share from them and some others. In the AV space you have a

of the dozens of lidar companies, few can realistically achieve that goal. For a small fleet you can hand tweak, but it's very difficult to scale to 100,000. If a customer is using 50 sensors from a supplier, that sensor or architecture may not be the right one when you need to deploy 100,000. For me, having spent time in the lidar space, it was very important to really be involved and bring to market a technology I felt had a high likelihood of scaling to that capability and when I saw the Cepton technology and the underlying MMT, it gave me confidence that that was one of the few technologies likely to succeed in the long-term. What is fascinating for me is that as we've talked to customers and partners under NDA and showed

LM: Congratulations on your recent injection of capital from Koito. Clearly, you are still running on VC. At what point does a company like yours earn enough revenue and profit to plow back and ensure growth and sustainability without further injections? Where do you think you are in that process?

Jun: Before this company, I had AEP Technology, a mom-and-pop shop, which was profitable from the first quarter—rather like ice cream, if you do it right you can be profitable from the first week. As a small-business owner, I'm very interested in profit. For lidar, especially lidar applications in the automobile industry, how often

do you get a new model of car? Every four years. So people are working right now on 2023 and 2024 models. Then you draw a profit out of it, but once you do it's a very solid business, as the stickiness of a sensor in a car, especially one that's there for safety, is very strong. Our business model is slightly different, it's not immediate profitability, more of a long-term engagement. Take Koito: when they started making headlamps for cars, it would be many years before they would start being profitable, because a headlamp was a low-margin piece, so they had to sell millions before becoming profitable. But Koito has had the vision to move from headlamps to headlamps with sensors and smart headlamps, so they're taking the lead, together with us. It just takes a little bit of time and patience to get to profitability. It's a completely new sensor in the automobile industry, but we have the people, patience, technology, and financial backing from a tier 1 supplier to get there. Even a year ago I would have still been uncomfortable thinking about what the future would be, but now we're on a solid footing. In this day and age, you have to be good but you also have to have good partners.

LM: I see you have opened an office in England. Why Derby? You also have offices in Germany and Canada. Could you comment on your distribution strategy? When I was here last time everything was based on direct sales.

Jun: As I said earlier, it takes time. There is a huge automotive market and we are taking care of it through partners and a distribution channel. We identified two talented people interested in lidar and willing to work for us and they live near Derby—no underlying big reasons, just

mere fact and convenience. Frankfurt and Munich are near automobile centers. We have an office in Ottawa with quite a number of people. We do development there too.

LM: In addition to opening your own offices, you've also formed partnerships, for example MechaSpin and CNL.

Jun: I know the owner of CNL well. TR is the person responsible for forming these alliances!

TR: I'll start with a very basic point. We're still a small company, so we can't afford to have a massive sales and direct marketing team. We want to optimize where we focus and where there are partners who can help us to go to market.

The second part is identifying the right partners. They could come in different forms. Sometimes people think of a distribution partner or reseller or VAR. I use the word "ecosystem". We want to create an ecosystem of partners across the full life-cycle of our product delivery, from architecture and design, prototyping, validation, manufacturing, to integration at end-customer level and helping customers to deliver their own solutions. For this whole chain, we are trying to build partnerships. We invited a few partners and collaborators to come to the booth at CES and give presentations. An example is Dataspeed. They do drive-by-wire kits and build small autonomous vehicle fleets for their customers. That's a good example of a partner which can build an entire system using our sensors, demonstrate it to a customer and say, "This works just great. If you need help we can help you build a few vehicles with Cepton sensors." That takes a lot of work off our plate.

Autonomous Vehicle Technology gave Dataspeed and Cepton a 2020 ACES



Cepton's state-of-the-art Vista-X120 lidar has a 120° horizontal field of view, high angular resolution of 0.15° and long range of up to 200 m at 10%

Award Winner in the Autonomy | Sensors category⁶. Dataspeed was selected by the State of Michigan to build an autonomous fleet for the North American International Auto Show⁷, using Cepton sensors. This is the kind of thing we look for—it's win-win. There are other examples. The partner benefits, because they can achieve solutions with our sensors and we benefit because our partners bring us new customers and give us visibility. It's really not just about selling, but about where could we bring in the right partner to improve our product, our own solution, so that when we jointly go to market, it's an even better solution.

LM: When I last visited, you had the Sora and had just launched the Vista and the second model of Vista was imminent. What has happened since then on the product side? Now you have Vista-X120 and you've also been successful with the Helius™ software. Please comment on both the hardware and on the software.

⁶ <https://www.autonomousvehicletech.com/articles/2121-dataspeed-ception-partnership-speeds-av-rd-and-integrations>

⁷ This was canceled owing to Covid-19. It is now planned for June 2021 in Detroit.



During CES 2020, Cepton showcased its award-winning Helius Smart Lidar System to track the booth traffic in real time. The installation had a Vista lidar sensor running behind the automotive windshield, with the Helius software-processed crowd tracking data overlaid onto live video imagery.

Does your product development path reflect any changes in your assessment of the different markets?

Jun: Yes, we still have Sora and Vista. We have made significant improvements in those sensors, which have come a long way after a couple of years of maturity. May Mobility is using dozens and dozens of them for their fleet deployment. We have exposure in many areas of the world with those sensors. I see as product progress the Helius™ Smart Lidar System, which enables solution deployment rather than just a sensor, which gives the company much bigger exposure in a variety of industries. If you go out in the street and say you have a 3D sensor called lidar, not many people would know about it. If you say, we have an anonymized people-tracking system that can be used to monitor how much time people spend in front of your counter, then

that's valuable. These are the things that we're slowly but surely merging into the product development, ultimately we have the interests of running our business. We are going one step beyond all the competitors. I hope we are very slowly eating into the market and will dominate with our complete solutions. Helius can run on different hardware platforms. We also provide Helius as a complete package including computer, such as the demo you saw. It's a generic perception solution.

LM: I've noticed that Audi claims its blind spot monitoring goes back 200'. Is it lidar?

TR: It's probably radar. The range is too long for ultrasonic. My wife drives a Lexus we bought over 13 years ago. It has "proximity detection" for when you're reversing or trying to park. Ultrasonic is very good for that application, but

the challenge of trying to scale is false positives, the kind of resolution you need for autonomous navigation is more difficult, what if it's beeping too much or not enough? As we go further up the [SAE] levels, companies look at lidar.

A lot of customers ask for short-range lidars with a wide FOV, that's increasingly of interest. We could do that. For us it's more a priority decision, we don't want to spread ourselves too thin, trying to build too many things at the same time, so at the moment we're trying to focus. If you look at our markets, automotive ADAS is big: these are front-looking, long-range sensors. That's a big focus and the Koito partnership is tied to that. But we've also seen that combined with our lidar we have the Helius Smart Lidar System, which has a full perception layer. That's becoming quite popular in markets adjacent to automotive, like intelligent transportation systems (ITS). It's becoming popular in the security market, anything that requires crowd analytics, of people and objects moving around in large spaces, like airports, theaters and stations. It turns out we don't need to do any customization of our core lidar for that application, so it's much less work for us, because we're just re-using an existing product in a different market, but in those markets we offer the software layer on top, which makes it easier for customers to adopt.

LM: Do you do offshore manufacturing or do everything here in this building?

TR: We do manufacturing here in this building, but we call it a pilot line. Our intention is not that 100,000 units be built here, so we've actively been working on partnerships with contract manufacturers, essentially

to qualify them to build pieces of our product, which we call modules. Our manufacturing team has been actively doing that, getting them ready for scale. The announcement with Koito is an example where now we have an automotive tier 1 that's saying, "We're going to manufacture a sensor using Cepton's technology." It's not specific to headlamps, more for an automotive application. It depends what the customer needs and where they would want the sensor located.

LM: *LIDAR Magazine* is in the geospatial world, which has been the beneficiary of companies like yours and your competitors. Your primary market is automotive, in the sense of both ADAS and AVs, then you have security, smart cities etc. We're a very small market for you, but it just so happens that your sensors work very well in UAVs. I know, for example, that you've worked with Jeff Fagerman at LiDAR USA in Alabama and he'll have given you a testing time!

Jun: Right. We'll continue to work with geospatial solution providers. They find

that our point cloud is very dense and that we have specific scanning solutions that are different from others, so would be a good fit for some applications.

We'll continue to work on that, though there's no specific case study I can share. We're a lidar company after all, and if there are opportunities out there, we tend to be engaged.

TR: We've found him [Jeff] very objective. He said that he's amazed by our sensor's performance, but if we could just make some improvements, then it would be game-changing. We value the feedback. That's one thing that I like about the culture here: it's a very responsive culture. We can't fix everything, but we try to improve the product on a continuous basis.

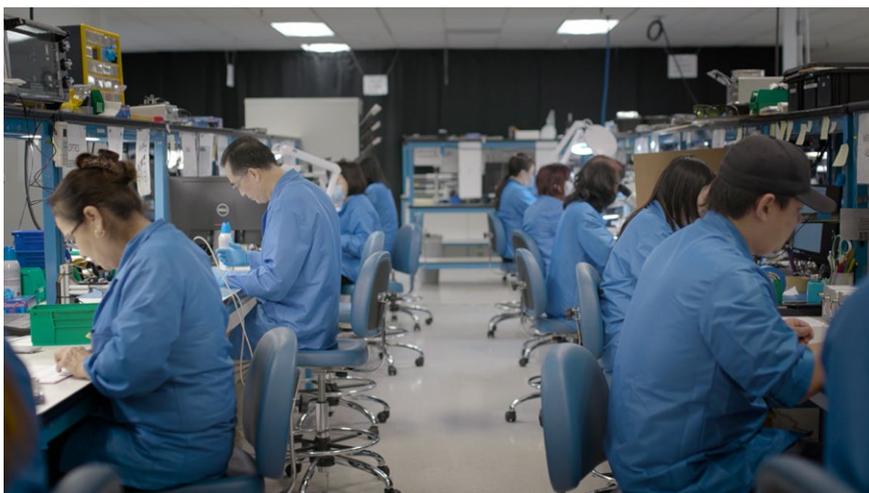
Jun: We have already identified this technology; our path is defined. Even for smart cities there is another facet for real-time monitoring, intersections, car monitoring for speed, location, risk reduction. These are not for survey-grade equipment but low-cost, high-reliability lidar units. We want to focus enough so that we actually become

successful. I see some issues with some of our competitors, too defocused, you run out of money very quickly, no more bullets to fire, then trouble.

LM: The last question is more whimsical. Larry Tesler, the inventor of copy and paste software, died recently. He did much of his work for Apple. In a 2012 interview with the BBC, he spoke of the culture at Silicon Valley, "There's almost a rite of passage. After you've made some money, you don't just retire, you spend your time funding other companies. There's a very strong element of excitement, of being able to share what you've learned with the next generation." What do you think? Might *you* say that in 10 years?

Jun: Yes, of course, this is very natural. There are a lot of people of this caliber. I may not belong to that high of a level, but I belong to a category of people that consider what we do not to be a job but a hobby, which is something that you do whether you are paid or not, to stimulate your mind. I expect that I will continue my interest in optics and acoustics, in the technology overall, if I have the resources to do it. Investing and helping other companies demands a different type of skill and I don't know whether I have it. I'm just at the age of 50 and my eyes are open.

LM: Dr. Pei, Dr. Ramachandran, *LIDAR Magazine* is enormously grateful for your time and insights. Thank you very much indeed. ■



Cepton's in-house, pilot-line manufacturing capability

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