Space Capital Podcast S01E11 - Lots in Space with Dan Ceperley Transcript

The situation in space directly impacts what's going on the broader industry. So sometimes I pitch LeoLabs sort of like the weather service. You know, if you're operating a logistics company or a communications company, on the ground you want to know about the weather because it can strongly impact your business. Well, now a lot of other businesses are using space assets in the space industry. So, you really need to know what's going on in space in order to understand how that's gonna impact your overall service levels.

Chad:
Welcome to The Space Angels Podcast, episode eleven, Lots in Space. I'm your host Chad Anderson, CEO of Space Angels - the world's leading source of capital for early stage space ventures. The purpose of this podcast is to provide investors with the context and information necessary to understand the real risks and opportunities in this dynamic new entrepreneurial space age. Today's guest is Dan Ceperley, CEO of LeoLabs - an early stage company that spun out of Stanford Research Institute back in 2016. LeoLabs is tracking objects in orbit and are able to provide ten times the precision at one percent of the cost of traditional methods. They're a portfolio company of ours, and we're looking forward to learning more about how we're dealing with all this activity in low Earth orbit. So, let's dive in. Hi, Dan. Welcome to the podcast.

Dan:
Glad to be here.

Chad:
Thanks. So, to get us started, just like to get a brief history of LeoLabs, the company, and how you found yourself to be CEO.

Dan:
Yes. Absolutely. So, at LeoLabs, we do space traffic management. We're in the business of building out a worldwide network of radars, and then building the analytics tools on top of that to turn the radar data into risk information about collisions, about satellite operations. And we use it to inform various elements of the space industry. So LeoLabs got its start just a few years ago, Summer of 2016. Actually, our founding team had worked in the topic area for decades before at a company called SRI International, a research lab in the San Francisco Bay area. So, I myself had spent a number of years researching how to better track satellites, in particular because of the commercial revolution going on in low Earth orbit. So CubeSats and the like. And at the time, I was looking around for better sensor technology, and it turns out down the hall were a couple people working on radars. And they were studying aurora borealis, or the Northern Lights, and at the time they were tracking satellites and space debris. But to them it was noise in their data, so they developed great algorithms to identify the satellites, identify the debris, cut it out of their data sets and throw it all away. So, when we met up, we realized they had a great tool. So, we turned it around and created LeoLabs.

Chad:
So interesting. So, one company's rubbish is another company's business model.

Dan:

That's right.

Chad:
So clever. So, LeoLabs spun out of Stanford Research Institute, as you mentioned. So this, obviously, this institute has a long track record in tech, right? They have created everything from LED screens, the computer mouse, ARPANET. Some of the greats, like the digital fax machine, 9-1-1, SIRI and natural language speech recognition. Basically, a lot of technology comes out of this institute. And just a lot of our listeners may not be familiar with this approach to starting a company. So, can you help us understand the benefits and maybe some of the challenges that come with spinning out of a university research organization?

Dan:
It is an interesting model, and one I think that is quite successful. So, as I mentioned before, we-three of the four co-founders spent a number of years at SRI. And at SRI we were pursuing a lot of Federally funded research. And so, when we actually went to start the company, it meant that there was a very long technical background, during which time we built up our skillset. It also enabled us to launch the company with a set of radar hardware, and with a set of software, and with a set of IPs. So, we basically knew the technical solution was gonna be a good one. And it enabled us to start focusing on the business aspects of the startup from day one. So, in a way, it-working at SRI functioned as an accelerator and really helped speed up the development of the company. You asked about challenges. You know, one of the interesting ones is actually explaining the relationship between LeoLabs and SRI. This often comes up with investors, and we have to explain that, well, know we're a fully independent company completely separate from SRI International. And the relationship with the research lab is they're a small stakeholder in the company. But we're now completely separate. The other interesting challenge is that as you're launching it, you're specifically creating a spin out to pursue a new business activity, a new risk activity. And there's some level of explanation that you have to give to the other stakeholders within the company you're leaving. And it really helps to clearly explain that you're going after a completely different business model, and you're going after a business that requires substantial investment, because there always is an internal decision about whether to pursue this opportunity as a spin out or as a more traditional business development opportunity.

Chad:
Right. And so, you were there at SRI helping to develop the technology, and then when it was ready for commercial use you then spun it out, and now work with SRI strictly as another equity investor on your cap table.

Dan:
Yeah. That's correct. And probably the biggest reason we spun out LeoLabs was because of the commercial revolution going on in low Earth orbit. You know, it's companies like SpaceX and reusable lower cost rockets, and it's all of these CubeSats and these small sats. Probably many people listening to this podcast are familiar with IOT constellations and the mega constellations. All of the opened up this commercial opportunity for Space situational awareness services. And those services had historically been defense only. But with the commercial opening, there was this opportunity to work with the satellite operators. Also, to work with government regulators and to work with the insurance industry, as well. Probably the second reason we really spun out

LeoLabs was this sort of startup requires a substantial investment in new hardware. Specifically, in building radars located on the ground and distributed around the world. So, it requires a substantial investment, and because of the excitement investors now have in space there was the opportunity to raise investment. And to really raise investment effectively, we needed to have a new company for investors to put money into.

Chad:
Right. And then- So help us understand the current state of space situation awareness. So, how much stuff is up there? And a little bit of the history too would be really helpful, I think. How long have we been tracking things? How has it been done in the past, and how is LeoLabs doing it differently?

Dan:
Yeah. Very good questions. So today, the US Department of Defense, specifically StratCom, provides some tracking and collision warning services. And they've been doing this for a number of years, going back at least a couple decades. So, they provide basic orbital information about where the satellites are, and the larger debris is. And they also send out collision alerts. So, if a piece of the large debris is likely to go close to a satellite within the next week or so, they will send out a notice. And this really got started in a big way in 2009, when there was a large collision between a US commercial satellite and a defunct Russian satellite. And at the time, the US government was probably the only organization in the world with the sensors and services necessary to really compute those potential collisions. So, they've been providing that for a while. At LeoLabs, we realized there was actually a very strong need for a new generation of sensor capabilities and a lot more data. So, before I go into that, just a couple numbers. Right now, the number of active satellites in low Earth orbit is growing pretty dramatically. Just maybe two years ago, there were about six hundred active satellites in low Earth orbit. There are now about a thousand active satellites. And projections over the next five years say the number's gonna go up to around ten thousand, maybe fifteen thousand. So, there's just a lot of new traffic. The second thing though is the amount of space debris dwarfs the number of active satellites. So today, the large debris is tracked. That's ten centimeters and larger, or essentially one new CubeSat in size and larger. And there's about twelve thousand of those objects in low Earth orbit. So about twelve times more pieces of large debris than the active satellites. In addition, there's another two hundred and fifty thousand pieces of small debris, down to two centimeters in size, that are not tracked today. And this debris is critical because it actually carries enough energy, if it hits a satellite, it can catastrophically destroy that satellite and turn it into a cloud of debris, and dramatically increase the risk of operating in low Earth orbit. So, one of LeoLabs main missions is to deploy the radars necessary to track all that debris, that two hundred and fifty thousand pieces of debris that aren't tracked today, and make sure satellites and companies are not harmed by it.

Chad:
And how are they tracking that debris today? StratCom and the Department of Defense. What are they- what radars are they using?

Dan:

There's a network of radars called the Space Surveillance Network. They have been built over, frankly, the last few decades. Many of them built in the Cold War. And they're now used for satellite and debris tracking. And the latest radar is called the Space Fence. It's a project that's been going on for about a decade and has cost over a billion dollars. And it's set to come online soon, and it will be the next radar in their network and also the only radar that tracks smaller debris. So, debris smaller than ten centimeters in size. And I actually, I bring up the- the term the "only radar" because it's actually critical for collision prevention to have a worldwide network of radars. To be able to track the debris in many different places around the world, and to be able to get updates many times per day. And so, that's why we're actually building out a network that is gonna have four of these radars that can track small debris, rather than just a single one, because it gives us the accuracy that's necessary to protect satellites.

Chad:
Makes a lot of sense. Okay. So, there's two problem. The tens of thousands of proposed new satellite constellations that you mentioned, but there's also a lot of old stuff in bad orbits. And there's different bands or clusters. So, orbits of, you know, let's say seven hundred and fifty kilometers and then on and on. And it's just old stuff that we launched, and we left up there, like satellites, and rocket stages, and things. And I recently heard that there are a thousand collisions each year within a kilometer or something like that, which basically- If you have a system, like the old systems that we're using today, and it's just going, "Ding. Ding. Ding. Warning. Warning. Warning." All day long it leads to warning fatigue. Can you help us understand all of that? Where'd that stuff come from? Why is it still there? How big of a problem is it?

Dan:
Yeah. You're right that all of the object that are being talked about for space traffic management, they're all manmade. So, it is old satellites, old rocket bodies, and the bigger problem is fragments of these things. So, fragments of rocket bodies or fragments of satellites, and there are usually every year a couple breakups where fuel tanks or battery charging units, and the like, eventually just explode and throw more debris out. There are guidelines in recent years that you need to deorbit your satellite within twenty-five years after the end mission. And compliance rates still aren't great, but they're improving. So, the idea is at the twenty-five years after the end of the satellite mission, you're supposed to burn the satellite up in the atmosphere if you're operating in LEO and keep space clean. Now the problem is that may be much longer than is really good, especially when we're talking about a lot of additional traffic. There's talk that maybe that- that twenty-five year rule needs to be shortened, so that we get debris out of space sooner. And so, that's an interesting aspect of the discussion, and it actually kind of highlights the need for the data that LeoLabs is providing. So, a lot of these discussions really zero in on one or two issues, but we're hoping to make the discussion really grounded on the realities. What orbit profiles, what satellite constellations are actually leaving space nice and clean? And what practices really aren't working? You mentioned kind of different debris belts and some of the collision risks. You're right. That actually around seven hundred and fifty kilometers altitude is a pretty tough place in LEO. There was a weapons test there. China actually tried destroying one of their own satellites and create a big cloud of debris. And there was the satellite collision I mentioned earlier that left thousands of pieces of debris there. So, it's actually one of the densest areas of space. A little bit above it, about eleven hundred kilometers altitude, is where some of these mega constellations are proposing to go, and it's actually cause it's the cleanest part of

space right now. So, I think its good thinking that they're going where collisions are less likely. But actually, once those satellites are there, it will become a much denser part of space. And active management is gonna become quite critical. Maybe one final thing is, you mentioned all these conjunctions are essentially close approaches. So, yeah, every month there are thousands of close approaches, where a piece of debris comes near a satellite and there's a lot of informational alerts sent out by StratCom that try to assess what the collision risk is. How close the close call really is. And there's actually a need for tighter error bars, or essentially more accuracy, more precision on those. So that you know exactly which conjunction, or which close approach really is the one that is likely to hit your satellite, and which ones you can avoid. Because if you have very large error bars, there's a lot of uncertainty. You live in this world where either you can maneuver your satellite all the time and impact your ability to generate revenue, or you can just kind of ignore it all, and then you risk taking a collision and looking negligent. And so, we're really aiming to improve the accuracy and the precision in these collision alerts.

Chad:
When I explain to people what you do, most people immediately focus on debris. And I've kind of done that myself in this conversation so far. But that's just one part of what you do at LeoLabs. Can we talk a little bit about what else you do, in addition to, you know, just tracking objects for collision avoidance and debris mitigation? You have customers that are coming to you for a lot of other services. What are those?

Dan:
Yeah. We actually view ourselves as a software, as a service company. And so, we have a whole portfolio of services that address satellite needs throughout the entire life cycle. From before missions launch through early operations, through normal routine operations, and finally deorbit and end of life. So, some of the things we do are reporting on satellite safety and health. So certainly, the collision alerts, but also, we can get some early signs of a satellite malfunctioning, such as looking for signatures of tumbling, or looking for changes in the maneuver pattern of the satellite or even new debris. We also do a lot of kind of risk analysis, risk reporting. So, we're building out services that can analyze the risks a specific satellite or a constellation will face, and then also report those in real time to the operators, to the regulators, to the insurance industry. Looking at a little bit the technical delivery side. We've built out a modern web services architecture where all of our services go through our API. So, we send out information, we sent out alerts through our API. And that's really so that we can have kind of maximal reach throughout the space industry and even beyond. Any software engineer who's dealt with web services before has programmed to an API. And this has been compared against the space industry in the past, where things were very bespoke, and you had to create specialized interfaces. We're trying to knock that down and just become another layer in the software stack for the industry. In addition to the API, we also build online dashboards. So essentially web pages that present the information in a human readable format. I encourage anybody who's interested to go to Platform dot LeoLabs dot Space. There's a link there to an interesting visualization where you can see the last twelve hours of our data. So, all the satellites and the debris flying around the Earth. And then there's a separate web page for every single satellite or piece of debris that's in our catalog, and you can see information about where it is right now, how many measurements we have on it, what our data quality is. And there's some additional visualizations and alerts that subscribers can get access to.

Chad:
And I would really recommend that people do that. I've spent many hours. The team here, we've gone in and plotted all of our portfolio companies, we can go and see where people are at any given time and the types of things that are surrounded them. It's really, really interesting tool. And it's great to see customers getting access to this data. So commercial customers are obviously a key piece of your focus and your market focus, but the government is also a key customer. We talked about the Defense Department in the beginning. So, I'd like to speak to that a little bit. The National Space Council, the original one in '89 to '93 under Bush, the senior Bush, and revived again just a couple of years ago. It has come out with a number of different directives focusing on our National space strategy. Number one was getting humans back to the Moon. Two is streamlining regulations of launch and space policy. Directive three is national space traffic management. And it ordered the Commerce Department to be in charge of the publicly releasable portion of the catalog of objects in space. The idea being to free up the Air Force to protect US assets in space. And the directive, which the President signed in June, also asked agencies to increase research and development into new space traffic management technologies, and work to reduce debris in orbit. I know that you and LeoLabs have been very involved with the Commerce Department and now the newly formed Space Commerce Department. I'm wondering if you can talk to, you know, how LeoLabs fits into all of this.

Dan:
Yeah. I was very excited to see those Presidential directives, because I think it really emphasizes that the space industry is becoming an important part of the larger industry as a whole. You know, as these new commercial constellations come online, the services they're providing are just becoming routine parts of the normal ecosystem. And because of that, it's even more important to understand the situation in space, and in low Earth orbit in particular where a lot of these commercial activities happen. Because the situation in space directly impacts what's going on in the broader industry. So, sometimes I pitch LeoLabs sort of like the weather service. You know, if you're operating a logistics company or a communications company on the ground, you want to know about the weather because it can strongly impact your business. Well, now a lot of other businesses are using space assets in the space industry, so you really need to know what's going on in space in order to understand how that's gonna impact your overall service levels. The fact that the Department of Commerce was highlighted in the Presidential directive number three is also really interesting, because it emphasizes the fact that space situational awareness requirements are diverging between defense and civil and regulatory. In the past, SSA, space situational awareness, was entirely a defense activity. You know, spot the threat in space. But now, with the rise of all these commercial activities, there is a need to understand which of these activities are going well, the satellites are being operated safely, they're not creating debris, they're being operated within the bounds of their license. And also, there's a need to promote space sector, as well, to grow these commercial activities and do so in a sustainable manner. So, I think it's actually leads to a slightly different set of capabilities that have been -- what have been available from defense in the past. So LeoLabs is actually building out the platform that can serve, basically is the information source for defense but also the information source for the regulators and commerce, as well.

Chad:

It's really interesting that you mentioned weather, because I was thinking about this earlier, in the space policy directive it also talks to - Well, I'm gonna quote it. "Improve the US domestic space object registry. Transparency in data sharing are essential to safe, stable, and sustainable space operations. Consistent with National Security constraints, the US should streamline the interagency process to ensure accurate and timely registration submissions to the United Nations, in accordance with our international obligations under this convention of objects launched into outer space." There's been- It's been tricky some of these new satellite startups that are focused on weather data, and there's a lot of technology that can be used to provide better weather data. But then the markets a little tricky because the US would be the biggest purchaser of that, but then it has these treatises in which it would share this information freely with the rest of the world kind of, and then eating up the rest of your market. How is what we're talking about, with what you're doing, similar or different?

Dan:
Yeah. You bring up- You bring up an interesting point that- Actually in many industries there's a new, essentially, round of investment of data sources, and rapidly improving data quality. And I think anything the enables commercial investment to be brought to bear will lead to a much faster pace of innovation, and overall deliver a lot better service. But it can be tricky, because you're also integrating those data sources into arenas where older models are in play. So, particularly with SPD-3, there was an emphasis that the government, US government, will continue to deliver a baseline set of services, essentially what's been delivered in the past. And that the government would look to commercial providers to develop the innovative new capabilities, and I think that's a really good role for the commercial sector. I also think there's a really interesting opportunity here for the regulatory side, and that's particularly around the area of looking at best practices and standards and regulations. And there's been a lot of talk in the industry for space traffic management around the need for maybe new guidelines, new regulations, but it's been tricky to develop them. In part because the data is not available. So, LeoLabs is fixing that data problem. We're making the data available. But now we're really hoping to spur a new round of discussions about which best practices for managing really large constellations are working well. You know, which ones are working well from a debris standpoint, making sure we're not creating new debris. And which ones are working well from a business standpoint. They're profitable, they're successful. And I'm hoping as the space industry and the space community can highlight those, because I think those will lead directly to industry wide best practices, and eventually standards, and eventually regulations where needed. And I think the Commerce Department could play a leading role in that area. And kind of one other aspect to highlight too, is that in many other sectors, be it transportation or communications or financial services, the government has shifted out of the role of being an infrastructure provider and into the role of setting standards and best practices and regulations. And that enables the government to really ensure a vibrant and, in many ways, level playing field for an industry. And I think that would really go a long way towards promoting the US space sector and making it very healthy.

Chad:
Yeah. Setting the ground rules and fair playing field and allowing the commercial companies to go in and compete and innovate. I totally agree with that point. And your answer was a good segue to this next question about NASA. And they've said that space situational awareness is a

strategic priority for their organization, but we've done some research recently. We dug and found that as of, at least, Q3 of last year, that no real government funding has gone to entrepreneurial space companies that are operating in this area. So, how are you working with the US government? And in addition to the regulatory things that we just discussed, is there anything else that they could be doing to further support development within this sector?

Dan:
Yeah. Yeah. Very good question. And I guess... What I think is probably the most important thing to do is to continue some of these early efforts, to buy services from companies, like LeoLabs, and then you also see it in the launch sector. So, some of these contracts for the International Space Station resupply that, kind of, anywhere that you can take the opportunity to start using commercial, start working it into your daily workflow, will ultimately, I think, benefit everybody. That commercial's quite good at driving down the cost and driving up the reliability. And we're going through this interesting phase where, in the past, the government built almost all of the infrastructure and provided almost all the services. But now that there are a lot of commercial services on the market, it would be good to have budget priorities changed around, so that end users could purchase commercial services where available. And some of these other organizations that have been tasked with early stage RND, and ultimately developing and building large scale infrastructure, they're focus should probably be shifted to kind of new activities in areas where the commercial sector has not brought a solution to bear. So, I guess I would go back to this kind of notion that the government, in many areas, has shifted out of being an infrastructure provider and into setting standards and best practices. So, you know, I'd love to see that sort of activity continue in the space sector.

Chad:
Absolutely. Yeah. And you mentioned commercial crew and commercial cargo, and we're starting to see a lot of the benefits of that reach the taxpayer, and the benefits of innovation on those fronts. And they now extended that to the clips, the commercial lunar payloads services, and that's really fantastic to see. And there's certainly an opportunity here to bring it to some other sectors within space, including yours. So, I'd like to ask, what does the future look like in space? Given that the significant increase that we expect in the volume and diversity of commercial activity in space. How much of it is collision avoidance versus debris mitigation? You know, responsible actors of these new constellations. How important is that versus a new type of rubbish collector that is collecting in space? Do you see what I'm saying? In this future that we envision with these tens of thousands of objects in space, how do you envision this coming together?

Dan:
The future of the space sectors is really exciting. So, I think we're just seeing the first round of large-scale satellite deployments, and they're bringing in a lot of really interesting capabilities. I think that as we shift more into a mode of large-scale manufacturing of satellites, and some of these production facilities, we're going to see even more capable satellite fleets and larger numbers go up. And I think as we really get into the large-scale manufacturing, we'll see reliabilities go up too, which is also quite important. So, in terms of the- the kind of collision risk and the space debris side, in a large part, the debris comes from past activities. So, the big problem with space debris is once it's created, it tends to stick around for decades or even

centuries. So, it's a problem that you really want to avoid in advance. So, anything that we can do to develop best practices, minimize the creation of debris is just critical. The debris cleanup industry is very interesting, because that's an opportunity to potentially undo some of the problems created in the past. Or as more satellites are launched, naturally some of them won't be functional when they reach space, or they will go defunct early. And being able to get rid of those will improve the risk situation in space. So, there's a few companies that are already developing technology to do it, and I would expect in the next five years or so to actually see some missions where satellites are flown into space, debris is grabbed, and deorbited. And in fact, we saw the removed debris mission, late last year, test some various technologies like a net and a harpoon to do just that. So, it would be great to see that carried forward into a commercial service. So, I think we'll see it over the next few years. There's an area where I think LeoLabs can play an important role, and that's specifically in helping to make the business case for some of these operations. So right now, if you want to fund or launch a space debris mission, you're often relying on the good will of a space agency. So, you appeal to the notion that we should really remove a satellite or a rocket body because it poses a big risk to the entire community. At LeoLabs, we're working on detailed risk assessments and trying to put financial figures on all of those different pieces of debris. So that you could make a very levelheaded decision about exactly what the cost should be of cleaning up a defunct satellite or piece of debris. And hopefully, that will lead to an acceleration of the industry. One other thing I'll toss out there is there's a really fertile area for research and development. And that is, how do you get rid of small debris? And I'm talking about the stuff that's only a few centimeters across, or even smaller than that, because there is a lot of it. Hundreds of thousands of pieces of debris, and it's going in different directions and it's moving so fast. I haven't seen any cost-effective way of cleaning it up. And it actually poses the dominant collision risk. You know, we can talk about tracking ten-centimeter objects or larger objects, but they are only about five percent of the problem. And so, in order to really get a handle on the debris situation, we need to find a way to clean up some of the small debris. So, LeoLabs will track a lot of the small debris, we'll help satellites prevent collisions with it, but you'd really like to get to a situation where you can actually grab some of it and throw it back into the atmosphere to burn it up.

Chad:
Yeah. Really valuable insight, Dan. And really important work that you're doing. Thanks. One question before we let you go. On the show, we like to say that there has never been a better time to get involved in space investing. Can you give us your perspective on that, and which areas are the most exciting for you?

Dan:
Yeah. Absolutely. I think it is kind of a once in a lifetime opportunity in the space industry. Whether you're investing, or launching a new company, or working on some new technology, we're really seeing the price of accessing and using space go down. We're seeing the ability to use modern computing technologies in space. So, it's a great time to jump in. I guess the area that I really like is the notion of infrastructure services, or sort of pick and shovel businesses, as people like to say. So, there's a gold rush going on and people, like LeoLabs, who are supplying information to satellite companies have a very healthy future in front of them. And they can also supply services to a broad range of actors. So, the satellite operators but also the governments, and the like. So, I'd really say, take a look at some of these companies that are providing

supporting services. So, launch companies, space situational awareness companies, satellite payload companies, and the like. Because the industry is moving from a vertically integrated one to a realm where there's all sorts of different service providers, and I think it's going to lock in a lot of the gains we've had and actually make the innovation cycle go even faster. So, we're gonna see, certainly gonna see, winners in the satellite constellation arena. But I think we're also gonna see investment winners in many, many of these supporting services and technologies.

Chad:
Dan, great talking with you. Thanks very much for your time today.

Dan:
It's been a pleasure, Chad.

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