The Rational Optimist Podcast

Stephen McBride // The Rational Optimist Society
Jason Lu // Flyby Robotics

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Stephen McBride: Jason, people often describe self-driving cars as a brain on wheels, and I know you've called Flyby Robotics drones "flying brains." Tell us what that means and what Flyby is really building.

Jason Lu: We started Flyby Robotics mostly from this intuition that intelligent behavior is directly downstream, is a direct downstream effect for the ability of a system to do math really fast in any given second. I think around 2022, 2023, we can see the trajectory that increasingly we have these advancements in machine learning. We have these advancements in AI methods and techniques. We have these breakthroughs, but when I looked around and I see where can we actually run these breakthroughs as a physical form, it's actually really limiting, right?

Your phone doesn't have all that much processing power. Your car now is getting more processing power, but most cars in the world don't have really good processing power. You can run them in these servers isolated, closed. They can't really, you know, they don't, they can't actuate, like a server cannot pick up an object, right?

And for me, I was a person building drone stuff when I was a senior in college, and I realized this is one of the most useful form factor of actuation ever conceived by mankind. We should put incredible amount of compute power for these things to be able to do math really, really quickly on these flying machines.

As the first step, being able to put incredible amount of computational power on these drones so they can fly and do a lot of compute per second. But two, build it in such a way so that is accessible. It's not like this is not something that only the military have access to. This is not something that only certain select companies have access to. Any customer, as long as you're not a nefarious state actor, can purchase a Flyby Robotics drone and make your own AI stuff come true. You can embody your own AI and your own AI applications on this drone.

And what we have proven over the past year, especially this month because it was a really hot month for us, is that people are responding. People are buying these drones. I'm not just using them for traditional drone-based applications, which there are many, but are actually using them to deploy new applications, doing new things that previous drones couldn't do before. And that's what makes it really exciting running Flyby Robotics stuff.

Why an Open Platform is the Future

Stephen McBride: Talk to me about the decision to build that open platform to make these drones modifiable.

Jason Lu: Yeah, so a lot of it, it's from my own frustration. So when I was a senior in college, I was like, okay, building drones is really hard. I know how hard building drones are. It is really, really difficult actually to build drones that are reliable and fly super well and really stable in high winds and in a cost effective way.

I was like, okay, I want to do ML stuff on drones. What are my options? I could try to buy a drone from DJI, but they have really limited compute power and DJI is, it's like, they're like Apple. It's extremely verticalized closed from a software perspective, like the amounts of changes I can make to the aircraft is really limited.

And my second option was like, oh, okay, maybe there's somebody out there building drones that I can purchase. And at a time, one of our early investors in my company at the time we were doing drone delivery was Naval, and he was an early investor in Anduril. So poor Jason emailed Naval. I was like, hey, can you email the CEO of Anduril for me so I can buy an Anduril Ghost?

And Brian actually, the CEO actually responded to Naval. He was like, no, that is not something we're ever going to let people do. So I'm like, okay, that kind of sucks. I want a drone that's really good that I can fly and program, and it has, and it's a performing performance drone that can lift the payload that I want, that can have the fly time that I like. That's really good. That's compact. It's portable. That's like polished product that can just buy and just focus on making the machine learning stuff onboard aircraft, and I couldn't find one, so I was like, you know what? I will build one with a team of people. And that's what we did.

It was from a point of frustration that we, I wish we could do this, but we couldn't, and it was so difficult. And it's sad that this thing doesn't exist. So we're like, you know, let's grab a group of really good friends, good engineers together, let's build this thing ourselves and we're going to make it the way we like to make it, which is it's highly performance. Really good performance, really high flight time, really great payload capacity, really high portability. Made with good production volume.

We, in fact we actually just got our first German customer, so they're Germans buying American stuff. That means your stuff is good. And it's open and then people can get it and they can manipulate it with really deep controls. And that's something that I wish existed in the world five years ago, but now it does through Flyby Robotics.

Controlling a Drone Swarm in 2 Months

Stephen McBride: What's the most mind-bending or impressive thing that developers have already built on top of your platform?

Jason Lu: Yes, there was one developer who, he is pretty good. He was previously the CEO of Virgin Hyperloop. And within two months of receiving our drone, this drone took two and a half years to build, but within two months of receiving the drone, was able to use that drone to control a swarm, a smaller group, one FPV size aircraft. And have the onboard GPU inside the F11 to control the swarm, like actually change the behavior of the swarm and fly it through the F11 instead of humans and not, and instead of writing prescripted missions is to be able to react to situational inputs.

So you can kind of think of the F11 as using kind of like a mothership. We built our drones with mesh radios so you can talk to other robotic systems. And they were using the mesh radios to talk with other drones and command other drones as a mini swarm of six. And they were able to do that in two months.

I think that's what makes this product extraordinary is just like, it takes us two and a half years to build a drone, but we bring it out there and then other developers within like one month, two months, three months, and we hope one day to be cut down to weeks, build new applications and deploy new applications that haven't been done before. And of course the military application of having a drone like this be able to fly six, six, goodness. It's not two, it's not three, it's six drones. It's really incredible.

So that's one of the coolest, some of the public customers that we have. For example, Palantir is doing a lot of really cool stuff with our system, along with a lot of research universities as well. Another startup like PicoGrid, they're trying to build our drone such a way to fly, like, almost like you play with things in StarCraft, so you can just mouse and keyboard and drag and you can send stuff to missions. Super awesome. So there's all these people building really cool stuff for the F11 system, so I'm really proud of that. Shout out to Zane over at PicoGrid.

300 Trillion Operations Per Second Onboard

Stephen McBride: I think your F11 drone has 157 trillion operations per second. Is that correct?

Jason Lu: It's going to be 300. It's going to be more than 300 because we're going to put a second GPU in it. We realize we actually have the power capacity and people are asking us, because they want one oriented to do dedicated machine learning tasks and have the other one to be more flexible. So it will soon be able to even support 300 trillion operations per second onboard processing power onboard the aircraft.

Stephen McBride: Just put that into layman's terms for somebody. How much processing power is that versus like something like a modern iPhone? An iPhone 10 years ago? What's actually possible now that you have all that processing power on this drone?

Jason Lu: Well one is that you can start running pretty complicated object recognition, recognition models, and classification directly onboard the aircraft. If you have one of your two dual GPUs to be dedicated into training, it can actually start doing some post tuning for models on edge. So you can actually, the drone can start kind of learning, no, still in a limited way. It's

not AGI, but they start learning with applications that's running inside the aircraft, so you're actually tuning it slightly. So that's what we sort of see as step one.

But what we sort of perceive as step two is we can start putting even more powerful GPUs onboard our drones. So for example, the F22, our next generation product, we're aiming to have a GX4090 inside. And that you, you know, you can really do like actual legit training onboard the aircraft, but also running like straight up large language models onboard a drone for developers. So then you can have these drones actually do like, you know, start to emulate like basic levels of human reasoning. So now you know, the drones can actually, like, you know, you give it a mission and it can start accomplishing tasks without human pilots inputting everything that the drone does.

Stephen McBride: Incredible. I think the F11 carries a six pound payload. How much damage or how much utility can that carry?

Jason Lu: Oh, it's massive. So most cameras that are really high resolution are typically around two pounds. So you can carry like a full frame sensor in the photography world. Full frame, the sensor size is full frame. Like you can, you know, like that's like a DSLR quality if, slash better. There's people who built multi-sensor payloads that are really good. So 1280 resolution thermal cameras. You know, 2.5 kilometer laser range finders for really accurate target designation. Having that payload really helps people to be able to put on, whether that's sensors, LIDAR devices. There's people who do stuff in SIGINT, the signal intelligence in the military world, and having that payload allows you to do stuff. You're able to do actuation. And that is what makes it exciting.

Because, you know, in drones, if you don't have the payload capacity, you're kind of limited. You're kind of shackled, constrained creatively. But the more payload capacity we can put on these things, the more creative freedom people have in using the onboard compute in working with sensors and actuation.

And where we kind of see where these drones go is, you know, the payload's trade-off is always with flight time and portability. So, because you can have much bigger drones, but then it's no longer portable. The F11's built in such a way so if you could easily check it on a flight, it's, you can be transported and set up halfway around the world. I was just in a military exercise in Thailand. I just went myself. So imagine like I'm just myself on a plane, flew all the way to Thailand with my drones. It was just one dude. You only need one guy to deploy this thing halfway around the world. And that is kind of what makes it a really, really awesome product. Because you don't need like a, in larger drones, you need like a truck, like three people to deploy that stuff. And with that, you don't have to worry about that on the F11 system.

Stephen McBride: How many times did you get questioned about the drone in your hand luggage? I seem to get every time I go to an airport these days, I get stopped.

Jason Lu: Yeah. Surprisingly, not as much as you would think. But you know, like people kind of look at it, I explain, you know, like we, it's a drone. It's a little big, but, you know, it flies. Yeah. It's alright. Don't worry about it. It's not going to hurt you.

The Challenge of an American Supply Chain

Stephen McBride: What's been the hardest part of building a truly American drone?

Jason Lu: Oh, everything. There is, so the Chinese supply chain for drones is really good. So I think one challenge with trying to build drones with no parts from China, by the way, Flyby F11 has no component level stuff that's coming from China. The propellers are from Europe, the motors are from Switzerland. It's American carbon fiber. The injection molds are done in Detroit. The boards are made in Milpitas. So yeah, like the entire supply chain, we don't use any components sourced from China.

And two things are challenging. One is Chinese drone components are really high quality. So you have to basically trade off in different areas of your build in order to make up for the slightly lower quality of components from non-Chinese sources. And so that allows a lot of, lot of times you also have to build a lot of the stuff yourself, even some really basic stuff yourself, like even like a motor mount. Like you got to make it yourself to be able to hit the payload constraints and the rigidity constraints that you have. So you have to build more parts yourself as well. You can't just buy some of the, a lot of these components off the shelf as you can if you're using, building a drone using a Chinese supply chain.

Stephen McBride: If you could snap your fingers and have one drone component, whether it's batteries, motors, chips, optics, reliably made in America, what would be the biggest game changer for you?

Jason Lu: I think that's the thing about drones, is that it's never like one component that changes the game. Drones, how good a drone is, it's from a collection of every component throughout the system. So for example, in weight reduction, right? You don't cut a lot of weight from this, like one part. You cut a lot of small amount of weight across all, everything in your airframe, and that added up give you a superior performance.

So I literally have a spreadsheet that I have, and I marked the weight in grams, 0.1 gram, to the tenth. To the tenth of every single thing that's in our aircraft. And we try to subtract like five grams, six point, like 6.5 grams, like all these little things, they're added together and that's what makes your aircraft better. So that's like batteries, motors, printed circuit boards. It's everything. It's that's what China does really well, is that every little piece of, little bit of a component, their motor is just slightly better, their wiring is just slightly better. Their PCBs are just slightly smaller. But then when you add it all together, oh wow. The drone is like two times better or something.

So it's a collective that every little piece needs to be a bit better to get extremely good performance. It also amplifies when you put it into a system, it actually amplifies. And that's partially what makes stepping away from a Chinese supply chain so difficult. If it's just one component, it won't be hard to step away. It is like all of them combined. That's what makes it difficult.

It's not impossible because we did it. And from a component level standpoint, we don't use any parts from China and we don't provide a component, a system performance trade-off for the customer by using non-Chinese components. So you still get extremely high performance with ours.

How DJI Came to Dominate the Market

Stephen McBride: Is there one decision that we can look to for why China's DJI dominates, you know, 70% plus of the global market? Or has it just been decades of leadership?

Jason Lu: It's decades of leadership. Again, with the drone industry is never one thing that makes someone dominate. It's a lot of little things added together. But if you were to say a kind of top couple of things, I think the first I would say is manufacturing volume. China makes over 3 million commercial drones per year, not military, like commercial quality drones per year. 3 million units. That is incredibly high amount of drones. You combine with the non-commercial stuff, you combine with the military stuff, that is a lot of drones being made. And yeah, they're the factory. They the factory of the world. Like the 80 to 90% of the world's iPhones are also made in China.

With that scale, they're able to invest more on these upfront things. Because a lot of the things that make drones good—batteries, print circuit boards, injection molded airframes, so we don't have to use aluminum—they all have really high upfront cost to do, and we have high upfront cost. And you'll be able to leverage a more advanced manufacturing method that's also high upfront cost and you're able to spread the high upfront cost against a larger denominator of units produced, then you got really good results. But the American robotics ecosystem, you know, previously it was largely driven by the military. So guys like Aero Environment, et cetera, they make like sub 1,000 units a year. So like, that's why they suck, you know, that's why they're expensive and unreliable. It's because you don't make that many per year.

So one of the things that's really important is we as the West, need to make more things, period. That is how we get good, is we need to make more things. And of course, the way the government cannot control, like who makes what, how many things to make, but what they can do is to control how things are purchased. Which is why, you know, a lot of the, that's, you know, a lot of these import export policies come into play.

Stephen McBride: Do you think we're on the path to a full scale manufacturing revolution in America? Or does something else need to change? I was at the re-industrialized conference in Detroit a couple of weeks ago.

Jason Lu: Yes, there was tons of energy, tons of companies working on different things. I think we are at the start of a really long journey in order to reshore Western and American manufacturing. It's only been 12 months, 24 months since the movement really started to pick up. Reindustrialization takes decades. It takes a long time to build an industrial country and to walk back some of the damage that was done to the western world. And that is the entire Western world. And I'm talking about everything from the making of mundane stuff like screws and basic microchips to the complex stuff like drones and GPUs.

But I think it's important. I think people are starting to realize that the idea of, hey, we can just be a financial services economy. We're not making anything, doesn't work. You need to make things as an economy, like physically make stuff, is extremely important for you. But that's, we're, you know, like a thousand steps journey begin with these initial steps and we are definitely seeing those initial steps happening.

What a 30,000 Drone Attack Looks Like

Stephen McBride: You mentioned swarms earlier, often talked about, often hyped. Where are we with swarms today? And how close are we to say swarms overwhelming defenses?

Jason Lu: The work is being done. A lot of it, it's at a secret and a classified level. The thing about the Chinese swarm is that, you know, you can see those Chinese show drones online really easily. Yes. But a lot of the things that we're doing with swarms are kept kind of under lock and key, a bit secretive. But we are, that is an area that our government is investing heavily on. And if you look at the most recent DOD budgets for 2026 allocation, billions of dollars are being spent on aerial autonomy itself. So it is an area where our government do recognize that it is something that is important for the United States to take a lead in and that work is happening.

Maybe not exactly to swarms, but Flyby Robotics was recently awarded a contract with AppWorks to develop pretty high level autonomy onboard our systems. So yeah, like that work is happening.

Stephen McBride: Just talk me through how that autonomy works. Like what's the components that make it actually possible? We talked about the GPU and the NVIDIA chip. I believe you have LIDAR as well. Just talk me through all the technical components of the F11.

Jason Lu: Yes. So from a really basic perspective. The F11 is what enabled the F11 to work super well is its onboard compute capability. Its onboard mesh radio capabilities and those mesh radios could work in—we have different versions of the radio, so you can, we develop the payload base so you can swap different radios in and out, so you have jam resistant radios as well. And really high onboard compute and really high onboard memory.

So we have up to two terabytes of onboard SSD storage onboard the aircraft. And from a sensor perspective, we designed the system to be really easy to plug different things in. So it is entirely sensor agnostic. So if you need to change the sensor based on the autonomy mission that you have, you can do that really easily. So what that allows you to do is kind of tailor the sensor to your specific autonomy mission. Say, I really want something that has really high zoom thermal in particular for a mission because I want to fly this thing 600 feet up. That's something you can do really easily. So those things combined inside the airframe is what allows it to do autonomy super well.

And we built these drones to be less than $20,000 a pop versus like $80,000 military Group 2s, or even like almost a quarter million dollar helicopter type drones. And basically make it extremely affordable and accessible for people to actually get and use.

Stephen McBride: Talk to me about the importance of the intelligence surveillance and reconnaissance. It's almost like where drones started, and it seems like for the last two years in Ukraine and Israel and Iran, we've been hearing about kinetic strike drones, but you guys are going back to ISR in many ways. Talk to me about how that's going to evolve in this next era.

Jason Lu: So intelligence gathering is one of, remains one of the most important use cases for a for an army or a military in general, in a battlefield. It's fog of war. You don't know what your other guys are doing, and previously the way you found out is that you just send dudes. Out there. And look, some, even with binoculars. I mean, even right now, a lot of base defense is done that way. And when you do that one, you know, the, the human, there's limitations of the human eye, right? I can't, there's spectrums that I can't see with the human eye, like I can't detect radio waves with the human eye.

And there is also a dangerous element, which is you're putting people, you know, either at the contact line or beyond the contact line. That's where the action is. Right? That's where the enemy is. And you're putting guys at risk.

So reason why drones are selected, because ISR is like such a big part of what you do. It's like when you're playing video games, you always need to scout. Scouting is like one of the most important thing that you do. Similarly in a military context, having awareness of your battle space is extremely important. And so that's why robotic systems are so focused and that as a focus area to do that.

Making Drones "Unjammable"

Stephen McBride: You mentioned jamming earlier. How do your drones deal with jamming? I met Nathan and the guys from CX2 Industries a while back and just reading about what's going on in Ukraine and jamming and electronic warfare seems to still be a big issue. What are you guys doing to counteract that? And then just maybe after that, what do you see as the most potent adversary? Is it kinetic strike? Something like Allen Control Systems' Bulldog? Is it electronic jamming? Is it something else? Lasers maybe.

Jason Lu: Yeah. So I think for jamming, there's two things a operator of a Flyby drone could handle jamming. Number one is because we have this like really adaptable payload, you can always change the radio. As the war goes on. Right? So let's suppose at the beginning of war, your Silvus 5200 is what worked. And then, oh shoot, the enemy has developed new ways to counter the Silvus 5200. We have Silvus 5200 B3 or whatever. You can swap that radio in pretty easily on our system. Or like, hey, turns out the enemy has figured out ways to defeat the Silvus. Let's put this new Trellisware radio in instead.

So the way we think about jamming is that jamming is a game of cat and mouse. You have these radios that got developed, that gets countered. But if you can make your system super adaptable, then you can always adapt and put in the counter to the enemy's counter. So that's how we design the F11 to make that basically evolving back and forth really easy on our system.

And the second way that our system can deal with jamming, and we have developers that are working on this as well. Some of them are doing in a way, in a classified level that I can't talk about, but is to basically not needing to command a drone with a radio at all. So you have sufficient amount of computing power. You can figure out a way to run the drone's mission and you can still accomplish, let's say your ISR task or your strike task with the aircraft again. It is six pounds of bang. You don't need to communicate with radio to accomplish that task. Then you don't, then it is like unjammable, there is nothing to jam. Right? And, you know, jamming is range dependent, right? So when you relay your instruction to the aircraft you're doing so in a place that is, that jammers are outside of jammers' range. But after that instruction has been received by the aircraft and it's on that different mode, it's going after it.

So there are people working on that currently. And that is something with the high on edge compute, it throws the shackles off for these guys. Like, you're going to do whatever you need to in order to accomplish your mission. It's like the computing power onboard aircraft is not what's going to be limiting you from doing something like that.

Stephen McBride: Eric Prince has said drones are the biggest disruption to warfare since Genghis Khan's stirrups on horses. What are some of the second order effects that you think people are still underestimating about just how big of a change drones are to warfare?

Jason Lu: I think people haven't actually seen, let's suppose our government created an attack wave of 30,000 F11s and throw them at a side, at a front that is, let's say three kilometers across front, and to saturate that three kilometer area with 10, 20, 30,000 F11s. I think people have not sort of even have a mental picture in their mind what that will do to a frontline, which is kind of ridiculous, right? Like that's, well at 10,000, 20, 30,000 F11s, you were producing them at such a high rate that we can bring the cost up super substantially. But then you, but then you all have really advanced GPU onboard. They can all talk to each other in a mesh way, in a jam resistant mesh way, or they can not talk to each other and just use the GPU onboard. And you just throw that at an adversary.

And what would that do? Right? I think that level, 'cause right now, even now, the employment of drones in these conflict zones, with the exception of really basic terminal autonomy, has been largely driven by human pilots. But you know, you are limited at the speed of human piloting. And even with fiber optic stuff, you know, fiber optic drones fly really slow. But when you start to have warfare where the principal combatants can process things much faster than the limitation of the human brain, it's a new style of warfare, you know?

So I think that's something that can happen now, right? It, what is stopping our government from doing that, right? Like, or anybody's government from doing that, who has the technology? Like it's possible, it can be done.

Stephen McBride: We've all read the reports from Ukraine and Russia and Iran and Israel as well. But as someone who is deep in this industry working on the problems, is there something that you've seen, read about or otherwise that you think, oh, that's really a game changer?

Jason Lu: I think the biggest game changer is like how the idea of using these cheaper systems, how it changed the dynamic of warfare from a more strategic level. So, right. Like I think in the beginning of the war, everybody kind of predicted that Russia is just going to absolutely crush Ukraine, you know, from like an equipment perspective, from a manpower perspective.

But yet. The country's holding. And a lot of that I think is from the fact that this is a war that has a big chunk of the action done by robotic systems. And when you have that kind of a conflict, it kind of doesn't matter like that you have such a high advantage in the number of tanks, for example. It kind of becomes like almost an equalizer to the conflict. And I find that quite extraordinary, because, you know, like traditional weight of warfare thinking is like, yeah, you know, like, these guys has more equipment. These guys have more men power, and you're fighting not a guerrilla war, right? This is not a guerrilla war. This is not like an Afghanistan, this is not an insurgency. This is a, you know, frontal, traditional war situation. But the employment of these robotic system really changes things from the strategic level for these combatants.

The #1 Metric for Drone Companies

Stephen McBride: There are so many exciting drone startups out there, and many of them based in America. Break down the KPIs. The things that we should actually be looking for when comparing drones or drone makers. Is it flight time? Is it payload? Is it computing power cost per unit? What in your mind are the key metrics to look at?

Jason Lu: I think with drone companies, it's really important to look at if their system can actually do the things that the developers even said they could do. That's like 101. It's really easy to claim really cool specs, but then to actually hit it and actually hit it in a environment that is relevant to the end operator is actually quite difficult. So I think what you should look for is can they actually meet the claims that they say they're going to do? And have they actually done that? Like, have people, have you actually done the things that you say and do you have customers who said, yeah, like they did the things that they claim they could do. Because when, I think when most customers are excited about buying drones, they are sold by what the drone claim could do. That is not the hard part. The hard part is delivering what you said it will do.

And I think the best drone companies historically, when they're early, right? Of course. If you look at a drone company that's like super far in and they're already huge, okay, yeah, that makes sense. They're big, whatever. But then if you want to predict how a drone company is able to be successful, you look like, are they able to do the things that they claim they're able to do? And that's usually a really strong signal that like, okay, yeah, you got something good going on here.

Stephen McBride: Besides Flyby, is there any other drone maker that you've been impressed by besides DJI as well, I guess?

Jason Lu: Oh, yeah. There's a lot of really great people doing stuff in the drone space. I think Quantum Systems from Europe, they're really impressive. They're building the world's best fixed wing drones. On the American side, Skydio has absolutely transformed drone as a first responder type missions. So basically sending drones to respond to police calls. They did that extremely well with their DFR integration with the X10D. And for the FPV side, we have people like Nero

tackling a really difficult problem. It's like, how do we make these drones $2,000 to $3,000 a pop with a non-Chinese supply chain? That is a really hard thing to do.

For us. We're not trying to do that, right? Like, making drones $2,000 to $3,000 a pop, it's not easy. So these are all people who really care about the specific customers that they're serving. So in this case of Skydio, there are police DFR officers in the case of Quantum, in the case of Nero. And I think those are all really impressive guys. They all do really hard things every single day.

Stephen McBride: It's been unfortunate that America has kind of stifled drone innovation for so long with the beyond visual line of sight rules, although I think that's either gone or changing. Besides maybe America and the obvious ones like Israel and Ukraine, is there any other country or regional ones around the world that you think really gets the innovation happening in drones?

Jason Lu: I think the Germans are doing a lot of good stuff. Yeah. Interesting. The Germans are doing a lot of good stuff. That's counterintuitive. Yeah, I guess people are, people are hating on Germany these days.

Maybe another question, I know you're working with Atomic Inc., an injection molding startup. You obviously have the partnership with Palantir. Based on what you see, based on your partnerships, are there any startups or companies that you'd go max long on or you think are doing really great work?

Jason Lu: Max long. Oh, sick. I think I'm really long on Atomic. I think injection molding has been an art that we're losing in the United States for a really long time. And, but yeah, it is extremely powerful. Like injection molding as a manufacturing method is an extremely powerful manufacturing method. So a lot of the work that they're doing of being able to do those molds in a less expensive way, in a more reliable way, are going to be one of the foundational building blocks of building anything in the United States of America.

I think there are a lot of companies now that are doing really amazing things with autonomy that are extremely exciting. And I think that the future of startups in a United States, it's going to be moving away from, you know, like your traditional SaaS companies, more into being able to build in the physical world, being able to enable things in the physical world. And I think people are starting to realize that, hey, you know, the physical world is a really big chunk of the US economy, and I think a lot of these startups are going to be the next $10 billion, $20 billion companies in the US.

Stephen McBride: People listening to this may have—we did the big deep dive on drones a couple of months ago. What's the one thing that you would tell them that separates Flyby Robotics from all the others?

Jason Lu: I think the main thing is we do a really painful work and we do it well, and we go to work every day being really happy with things that we do. And I think, and it's like a team of people too, because I think it's really easy to give up when you're building in the drone space because the work is so hard and it's a naturally, a really painful thing you have to do every single day. But we like that pain. We find that deeply, deeply satisfying.

And I think that quality in our company is what is going to end up one day, you know, making us win because as you push the frontier of what you can do with drones, whether that's compute power, that's payload, that's flight time, et cetera, and stability and costs. As the more you push the frontier, the more difficult it gets, the more painful it gets. So you want a team of really high pain tolerance and embraces, as the way, and also have a culture that makes that a collaborative environment where people like doing that. That's really key.

Stephen McBride: What's the internal motivation for Jason Lu waking up every day and chewing glass? What's the thing that keeps you going?

Jason Lu: I think one is seeing other people build stuff off our drones is it really makes me really happy. Because when also when they build stuff, they like text us and they're like, they're super excited. They got their thing to work, which is extremely rewarding. It's like, you know, you're enabling other people to do really cool stuff, which is a deeply rewarding thing. I mean, I've met, that's why a lot of the engineers in the video game industry, you like, you know, people getting their GPUs and building really cool stuff out of it.

And I think the second one is, there is, because drones, hitting high performance drones is a really hard thing to do. So when you do hit it, it's really rewarding. You can actually feel how the improvement in the product when you're flying it with your hands on the control sticks. And it's almost like it's a taste, you know, like you taste one wine versus another wine. That's kind of the way I would describe the difference in flying a drone that has been more perfected and more refined. And of course we are always chasing that. What is that peak refinement. And I think that's maybe not impossible to attain. You do taste the improvement, and that is something that is intrinsically really rewarding as a drone builder.

How Drones Will Change Everyday Life

Stephen McBride: Jason, as we gear towards closing here, paint us a vivid picture of how our everyday life or national security is going to change when Flyby becomes wildly successful.

Jason Lu: I think number one is that you're going to see those drones everywhere, in places that today you don't see them in. The history of drones has been because the system get more capable, because the system gets more reliable, it gets introduced in more and more verticals and industries and use cases and applications. So what you will see is you're right. Now most people go about their day not seeing a drone of our size. You know, you see maybe like a small one. Somebody's flying in for hobbying. But you increasingly see them more on your everyday life. Right now there's 400,000 registered commercial drones in the United States. That number is going to be exceeding in the millions as these drones are being deployed in more and more verticalized use cases.

And we know that and which is, and we know that future to be true, we've seen that happening with sectors and industries over and over and over again. So what we prioritize and what we build a product around is accelerate that innovation cycle. Because ultimately the guy with the idea of using the drone for a new use case, it's not going to be us. It's not going to be Flyby Robotics. It's going to be someone who works on a farm, somebody who works in oil and gas,

somebody who works in a sewage plant, somebody who works as a tinkerer on his ranch in Texas, which we have customers like that too. And enabling those people to do decentralized innovation and come up with these new verticals of using the technology and using it well and making a huge difference in their lives or for their company. Is why we built this product the way we built it.

Stephen McBride: Awesome. Jason, we'd like to finish the podcast with a quick game of overrated, underrated. So I'm going to name 12 drone or defense related technologies. And you can give me a quick one word. Yeah. Overrated, underrated, or properly rated. Good to go?

Jason Lu: I think I don't like talking bad stuff about other companies, so I think I will say everything is good. It's, yeah. All good. They're just technologies. No companies involved. Yeah, let me do. And first one, swarms.

Jason Lu: Swarms. I think people have no idea how big swarms will be. It's going to be massive.

Stephen McBride: Edge AI.

Jason Lu: We are still at the really beginning, both in terms of the processing power we're putting on these aircraft. So it's a starting point. It's like pre-iPhone on the edge AI with robotics and drones right now.

Stephen McBride: Electronic warfare.

Jason Lu: I think with increase in edge AI and the amount of attention paid on EW, I think EW will actually be less effective as a meaning of countering drone threats.

Stephen McBride: Anti-drone lasers.

Jason Lu: I think that is an area where, because EW is going down solutions, like anti-drone lasers is going to be going up in rising, rising, rising in status as Tyler Cowen would say. Yep. Yep.

Stephen McBride: Autonomy.

Jason Lu: I think autonomy has been a buzzword in our industry for the past five years, but I think now we finally had the technologies and processing power provided by Flyby Robotics to actually do real autonomy, worth calling it autonomy, like previous version of autonomy aren't actually like autonomy, you know, like it's not real autonomy. But now we're going to an age where real actual autonomy is possible. So it's underrated.

Stephen McBride: Alternative propulsion systems, other than batteries.

Jason Lu: Alternative propulsion system. So for at least in the world of quadcopters, propellers is the gold standard there. There's not a whole lot you can do outside of propellers. In the long

range strike and fixed wing drone area and hypersonic supersonic area, there's a lot of things to be done on alternative propulsion.

Stephen McBride: Fixed wing drones.

Jason Lu: I think fixed wing drones, they're really great, amazing things. But I do think there are a stop gap solution to what is fundamentally a battery problem. The only thing of fixed wing drones better than a quad right now currently is longer flight time. They're worse in every other aspect. Reliability, cost, portability, and also flexibility there. There worse, all of those. But the only one thing they have going for it is they can double, triple a drone's flight time. But that's actually fundamentally in my belief, a battery energy density issue.

Stephen McBride: Cheap expendable drones.

Jason Lu: Cheap expendable drones. It's got to be just, you know, the default warfare.

Stephen McBride: And loitering munitions.

Jason Lu: Yep. I think there's, I think, cheap expendable drones and loitering munitions will slowly merge into just one thing. Just cheap expendable loitering munition drones.

Stephen McBride: Last one. Subsea drones. Underwater drones.

Jason Lu: Underwater drones. I think the ocean is an unexplored frontier. So I think there is a lot of opportunities in subsea drones. However, there's also, it's also a really difficult area to do things at scale in because of some of the technical challenges, I think with drones. You don't have the funnel because like, we know China can make like a lot of drones, like the making a lot of drones. It's not a risky thing for like flying, but making a lot of drones that can go under water. It's still an unproven concept. But that is also areas for new entrepreneurs to crack open. Shout out to Will and the guys at Saev Undersea Robotics.

Stephen McBride: Jason, thank you so much for your time. This has been fascinating. And you just have to promise me you'll come out to Abu Dhabi with the F11.

Jason Lu: Oh, absolutely. We're probably going to have some oil and gas plans down there in a couple months.

Stephen McBride: Excellent. All the best. Thank you so much for your time.

Jason Lu: All right. Thank you so much.