The Rational Optimist Podcast

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Stephen McBride: I saw you post about your grandfather, Thomas. You had some incredible things to say about him. How I think he slept in a bar booth in Detroit, you know, throughout his teenage years. Tell me about Thomas, and just tell me about how that story of grit and kind of innovation shaped your own life and your journey to starting Aurelius.

Michael LaFramboise: Yeah, for sure. You know, in a lot of ways my grandfather raised me, so I grew up, didn't have a dad really. And so, you know, just growing up around him was really, really great. 'cause he's just kind of like, I think a lot of the silent generation people are kind of like very, especially men are like very solemn and silent a lot of the time. They don't, you know, necessarily express too much emotion, but you know, when it came to learning how to do hard work and do hard things, even when the cards are kind of, when the decks kind of stacked against you. That's something that I really, really took away from him.

So that experience, especially during my formative years, was great. Where, um, my grandfather Thomas, you know, uh, grew up in Detroit. Um, most of his formative years, he was sleeping like in a bar booth. So like when. Basically this is around like when World War II is happening in Detroit and like people would be, you know, soldiers and sailors would be home in a bar, I think on, on Joy Road off of 96 on the entryway to Detroit, maybe 10 minutes outside of the downtown area. Um. I hope that's right. I think that's the crossroads. But, um, you know, he'd have to wait until like two in the morning to go to sleep because like people would just be like drinking and stuff. It's, it was just crazy.

So his life's crazy. He, he ran a paper route in Detroit from when he was six to when he was eight, I believe. 18, maybe 17, 18, 17. Um, and was able to save all the money, uh, uh, to go to University of Detroit. Um, we studied chemistry. Ended up, he did a few other things. He joined the army. Um, and then he went and, uh, worked at Ford for 36 years, maybe 40 years, something like that. Ended up being the chief chief chemist there. And so he is done a ton of glass and crystal work. Um, so, uh, so yeah, just growing up with someone like that, kind of like raising you was just amazing. Great experience. So yeah, I would highly recommend having a dope grandpa that's hardcore.

Stephen: What do you think your grandfather be will be working on if, if he was alive today? Oh, what would he be working on right now?

Michael: Oh dude. He'd be like 92. I don't know how much he'd be working. I think what he would be doing is No. Sure. Say, say, say he was, say he was still in his prime, say he was in his thirties, forties today.

Stephen: Oh, okay. Gotcha. 'cause. He was at the cutting edge back then. What would he, what would he be doing?

Michael: Oh, he'd probably be working on, he'd probably be working on physical chemistry, something technical. Um, he wasn't a great student. He was just a really good experimentalist, so he really liked to actually try things out and build stuff. Um, but uh, yeah, he would probably, oh, I don't know. A lot of his frame of reference was around being a company man. You know, he stayed at the same company for 36 years. That would definitely change. Um. He probably would wanna make a lot of money.

Maybe he will do, maybe he would do cs, I don't know. But then also CS is kind of, I don't know if you've seen the unemployment rates for new grads, but, uh, it's pretty heinous out there. So I don't know if that's the move anymore.

So I, I think my grand, I don't, I don't know if my grandfather was so much compelled by. But he definitely enjoyed working on like cutting edge new technologies. But I don't know if he was so much compelled by that rather than compelled to work as hard as he can for the best life that he can provide for himself and his family. And I think that was really what compelled him.

Stephen: Mostly timeless principles. Exactly. Listen, let's, let's talk about what you're building at Aurelius Systems. Walk me through your flagship product. I got to see in Detroit last week. It was, it was a real joy. Uh, walk us through the technology, how it works, what it's strength to accomplish.

The "Archimedes" AI Laser System

Michael: Yeah, definitely. So what we do at Aurelius Systems is we make edge deployed lightweight, small scale laser weapon systems, where right now there are laser weapons deployed by Lockheed in Northrop. They're generally very large and and expensive. Like the Helios 60 kilowatt system is, you know, tens of thousands of pounds. These things are tens of millions, if not a hundred, low, hundred million dollars per system. Um, they're really cool. You can shoot a missile down from like 20 miles away. You can cut a plane in half from like 10 miles away. They're awesome. I used to work on, work on some of the subsystems to support them, but, you know, uh, against, against drones, like group one, group two, UUA s or small quadcopters, or like smaller plane size, plane size drones, you know, as, as you might have talked about this on your podcast already with other, with other guests, is like those, those systems that may benefit of those systems for the enemy is that they're mass deployable, they're cheap, they're, they can be. You built by like your grandma in a basement really quickly.

And so what we do right now is we shoot very expensive single use munitions at them. The promise of directed energy, which is like the PC wave of saying laser weapon or microwave weapon, there are microwave systems as well. Um, the, the promise of directed energy is that

you get like a, basically a no marginal cost to shoot down. It's like the cost of electricity. The electricity in a battery is your ammunition or in a generator, and so you get a 10 cent cost to shoot down. But the capital expenditures on these very large and heavy Lockheed systems are like $50 million.

So what do we do? We want to get the most best of both worlds. Take mostly commercial off the shelf components, use really, really advanced software, huge edge deployed AI systems. Um, very, very, uh, uh, power vision laser systems where we get into the guts of some of these laser systems to, to make them a little bit better, um, and make an auto tour. So that is our first product. It's called the Archimedes. Um, our communities of, uh, Syracuse is a really famous physician and, uh, uh, ancient engineer. Uh, when the Romans were Seing Syracuse, he was like in his seventies or eighties, and the king. Called him up to like, help defend the city. And he made two things. One is, one is more famous than the other, uh, the Archimedes lever, where, you know, he is like, give me a lever long enough and I can lift anything. Right? So he built that to flip ships in the bay. And then he also built the first directed energy weapon in like 200 BC where he set a series of mirrors on the city walls. Bird ships in the bay. And so that's why, why we're calling it the, the Archimedes.

So I just little history lesson, you, you don't look too amused, but we can uh, we can continue to answer the question, Steven. Sorry I'm all over the place, but, uh, but, uh, I love it. You go, it's early and I'm just excited to be here. So, um. So, yeah, so that's our first product. Our our, um, we have demonstrated for the Navy at the Naval Postgraduate School at a few hundred meters, you know, a shorter range. Um, we go to a Army demonstration at, um, camp Grayling here very soon. And then there are a couple more in the fall that we'll go to and the whole goal is to get out to, um, a couple kilometers. An effective range. I can't talk much more about like the specs than that, but I think, um, but I think, you know, things are going really real well and it's really interesting where. Um, I think a lot of people are really tuned into advances in AI in terms of like maybe object identification or like language processing, things like that.

But, um, mechanical engineers are getting in an AI by doing super advanced control algorithm work that's informed by reinforcement learning or by neural networks in some way. And so that is a really, really interesting kind of edge. Edge of technology that we're getting into to, to make do without millions of dollars in support equipment. You know, you got like $50,000 in support equipment for your weapon system. So how does it, how do you, how do you differentiate? You get really good at software, I think. I will share that. Say what? You can I, yeah, yeah.

How It Detects and Destroys a Drone

Stephen: So No, no. Good. All good. Say, say what you can about how the system actually works on the ground from, you know, the time it detected threat to the, to the moment that threat is neutralized. What's the key innovations? Obviously you've been able to shrink these big, huge, expensive lasers down, so just talk me through, talk me through everything to do with the product.

Michael: Yeah, I think, well one of the things is that, um. Those, those big, those big laser weapons systems from Lockheed or Northrop, they worked really well. They're really advanced.

They put a lot of power downrange on target at many, many, many kilometers, many, many miles. Um, and I think with the Golden Endowment announcement, they'll continue to get funding for that. Um, I know there are a couple companies kind of in that conglomeration that are going up and trying to do, um, even an even bigger laser weapon system, right? They're talking about like Arial. Targeting and so that is something that you know to do that you need to raise kind of a capital, capital cost or you need to raise an amount of capital. That's kind of like you'd be pitching, like starting a semiconductor company kind of where you're like, I need a hundred million dollars to like have a stab at this. So that's very difficult.

I think what we do here is, is what we want to do is see like what is the like AK 47 version of a laser weapon. Where it's like very robust. It is mostly you, mostly you're mitigating for lower quality hardware or you're mitigating for, you're, you're mitigating for like less bespoke custom pieces in the hardware, um, by using really advanced software. And so that's kind of, that's a thesis we have in some way. Um, we have to go to production with our own laser system, which we're really excited to do. We'll, we'll start that here soon. And, um. And, uh, yeah, I talked about some of the subsystems. What else did you wanna hear about?

Stephen: Yeah, no, just talking me through, actually, you know, when, when you detect a drone, when you, oh. When you detect kind of an enemy system, just talking me through how it actually works. Got you. I dunno. People who Lasers, lasers are Yeah, yeah, yeah. I, we're all, we're all, um, 8-year-old boys when we, when we hear lasers. Tell me more about the laser.

Michael: I think 95% of it from first principles is like you take lasers that you can, you can, the architecture's figure it out. You know, it's not experimental. You, uh, we don't wanna be experimental. We, we wanna be like deployable. So you take lasers that are used in, say, industrial machining, something like that, very high power laser systems. Um, and then instead of focusing the output at like two inches away, you're focusing your output at your target distance, which could be three miles or something like that. And from a first principle's perspective, that part of like the laser destruction is not too complicated.

Now, where you wanna make advancements is manufacturing the lasers 'cause they can get very expensive. Um, so you want to try and you wanna try and extract cost volume savings on the dio, it's try and follow the alternative like alternative markets that you can sell, um, your lasers into. Because in in optics, you extract a ton of a ton, I think more than other. Uh, parts of the heart, what world you extract a ton of value in, in selling volume. And so that is, that's where a lot of the advancements are in, um, dealing with cooling, dealing with electrical efficiency, dealing with actually getting power, drawing down from very high draw down batteries. Um, we're battery powered. We, from the beginning we knew we didn't want to be attached to a generator. Um, you see these systems that are like, have to be, have to be in like a. Like an armored personnel carrier. We don't think that's tenable. We made the decision to do that pretty clearly.

Um, when we detect a drone that is out in the field that is coming toward a target, we essentially have a series of, we have a, a series of sensors that are that very range between coarse and fine in terms of detection capability. Um, 'cause you don't wanna raw. Look through the sky actively or passively or whatever, right? A anyone sensing that's a very, very hard algorithmic problem to do and it wastes a lot of compute power, so. You wanna have a series of sensors that kind of like

optimize how much power you're looking at your, your, how much power you're drawing down, how much compute you're drawing down when you, when you want it, detect something.

And when we detect something, you turn to it and you have an advanced control system. So it's very, it's very quick in the course and then it is very smooth and you don't wanna wiggle around. Um, when you're targeting the system and then you continue at a very high rep rate to identify, target, track and destroy that, that drone. And that's probably as deep into it as I can get right now, unfortunately.

Stephen: Yeah. Yeah. I'm trying to dance around the, uh, the, uh. The rules. I'm trying to, trying to make sure I don't, you know, mess anything up.

Why This Laser Needs to Be Built

Stephen: So of course, what was the moment you said to yourself, this needs, this system needs to be built and I'm gonna be the one to build it? Was there like a specific catalyst?

Michael: Yeah, so I worked at Coherent for a while, which is a big US laser company. Um, I worked in research and development, um. Building material processing systems in the systems development group, um, that has tho those systems are very similar to directed energy. And then I did a little bit of work in, in that area as well, especially as we acquired some directed energy companies, I think, uh, in the early time that I had worked there. Um, from there I moved into sales and I ran, um, west Coast component sales like diodes, fiber, things like that. All subsystems, amplifiers that would go into, um. That would go into some, uh, directed energy products on, on behalf of primes. So I worked in that space a bit, and we knew that you could do this, you could do a small scale lightweight laser weapon system, but it's not in the incentive or like the business model of some of the larger defense companies to do anything to, to go and do that.

Like it, like we're talking about things that. You know, just the volume that they were looking at, and you would've to go to production and stand up a manufacturing line that sucks. You would go and do that and then you would be cannibalizing potentially some of your existing products. There's, there's this whole innovator dilemma thing. Um, and things move even slower in defense than in like tech companies. And even this can even happen to tech companies where they don't wanna do new innovation.

So. All this is saying we knew that we could do it. Um, we didn't have a, we didn't have anyone that wanted to do it. And also in like 20 19, 20 20, it wasn't like, I think there obviously like Andro, there were companies that were on the cutting edge and people that knew Jones were gonna be a problem, but it wasn't a mass problem. Where it is now, where it's very clearly the most salient issue in the DOD is how do you deal with these, with these drones? Um.

So I was in my PhD in 23, at the end of 23, beginning of 24. And then it just became apparent that this was the time to go and do this. Everything was taking off, funding was opening in San Francisco to be able to do this. So I dropped outta my PhD to, to, to do this. So yeah, and that's it. We're like a year and a half on now. I think we're, yeah.

How Portability Changes Modern Warfare

Stephen: Awesome. When people think of lasers, they might think of, you know, these big static installations like the one you were mentioning, but your system is portable. Just talk me through the, the reason, the reason for that and how you think it potentially changes warfare going forward, either on the defense or offense side.

Michael: Yeah, for sure. I think that if you are, if you are in an LTV or a, a troop carrier or a tank, for example, especially we're talking about the ground vehicle application here. Um, which is, uh, one of the earlier ones that we're going after, like the, the way that you attack is in, in a tank, for example, is you suppress and then you move in and, and fire for, for the kill. So you move to suppress your target. If it's like a machine gun installation, you can do that and you can move and acquire around and actually go in and engage your target and destroy them.

And the US military operates an extremely aggressive doctrine. Um, whereas say the Russian military is like. Like, we'll try and bait you like the Ukrainians into engaging in a fight, pull back and then pull you into their defensive line. So it's just a different doctrine and we run an extremely aggressive one compared to most countries. And right now, a, a like two or three or four FPV drones could go fly into like a tank and like blow it up. And that tank could be like in Abrams could be between eight and $13 million. Right. But also, but it's not even that much about the money. I think what it is, especially for the, for, for. Our context in the DOD what it is for them is like, how do we get our offensive capability back? How do we actually become effective at destroying targets? 'cause it's, it's, it's when you're talking about either protecting like American lives in combat, or you're talking about executing your goals in, in war and an engagement, um, the money question kind of flies out the window. It's like, how do I get the capability to, to some degree, if it's a billion dollars, you know, it, it's not tenable. And you could feel two of them. But, um, you know. That's, that's, that's kind of what we, that's what we look at.

And so what we want to do is allow you to not have to care about the group one, group two issue. If you have, uh, uh, I dunno, I forget off the top of my head how many tanks are, would, would be in a column. But let's say you have like eight tanks that are, that are in a line in there. They wanna be, they wanna be spread out, right? If every other one has an system on it, that you can go and provide a bubble of defense for our own, for, for our own soldiers, for our own tanker crews. Um. And you don't have to care about the group one, group two issue. You can go execute the mission, you can go close in under your target. You can do whatever you need to do. And that's really what we want.

We think that's incredibly important, and we think we can get a cost differentiated. We, we can, we can get a cost differed, differentiated way to, to deploy that, where it's not like $200 million, right? It's, it's a lot, a lot less. And so from there it becomes, we essentially just unlock your capability to, to actually go and execute your mission.

Stephen: Ballpark figure how much you know, because we all hear about swarms and you see the, um, the drone, the record, the Guinness World Record Drone swarms in China. It's almost like a Rorschach test. Do you see art or do you see next gen military capabilities? Just gimme a

ballpark figure on how much one of your system, how many drones one of your systems could shoot down in, I dunno, a minute or two or whatever. If possible.

Michael: I can't do it. Can't do it. You can't do it. I'm thinking about it. I'm like, nah, nah, I don't. I don't think so. I think so. I think I, uh, the, the way we think about it is there's obviously some fundamental limit when you have a laser and you're going target to target, there's some fundamental limit to the number of joints you could take when you're coming in. We wanna be small enough, lightweight enough, and, uh, uh, reproducible enough so like our cost comes down so that if you are in an area where you're gonna be engaging more, it's actually really easy to, to add another one or a third one. And these systems can coordinate fires. So that's how we think about it, right?

The 10-Cent Shot: Lasers vs. Bullets

Stephen: Yeah. Right. What benefits do lasers have over your physical solution? Like bullets or, or something else?

Michael: Yeah, for sure. Well, number one, like our range. So, so we, you pretty easily get out to a 1 2, 3 kilometer range on a relatively modestly powered laser. As long as your output aperture is big enough. Um. And, you know, it's pretty apparent that drones like, uh, there are some, uh, uh, kinetic systems out there that use, like machine gun. There's like the remote weapon system and everything. Um, when you have a, a machine gun firing and you have a bullet drop of, say, 700, or you have a, a, a, a muzzle loss saves say 700 meters per second, and that system is firing at a drone that's. Say 2000 meters away, you have like a two second, you have like a two second, uh, time delay before you actually hit target. Right. That's a lot.

Uh, I think what you see is a lot of the remote weapon systems are targeting at like the sub 500 meter range. Something around there pretty accurately, but you do have to fire a spiral burst, um, that can get very expensive. You have to carry ammunition around with you. Um, and so it's just something where. It's just something where, you know, your, your, because the ER trajectory plus, because of the ballistic trajectory of the bullet as well, um, you have to have an extremely advanced control system. Part of what we can do here is like the laser is a stick. You just point and turn it on and you hit and it moves the speed of light as fast as possible. When that is true, our control problem is easier to some degree.

Now we do have to stay on target, so there's some, um, vibrational considerations. There's some precision considerations we have to. I take into account. But when you're using a, a, uh, uh, a firearm to shoot down a drone, you have to forward path plan in a very advanced way, and like probabilistic time horizons, frame horizons in the future where that drone is gonna be, what is its pose? How, how is it going to move in the future? That's extremely difficult and I don't think scalable really. I don't think that you want to do that. So I think we, we provide a very differentiated way to, to go and take down drugs.

Stephen: There's been all this talk about bits versus atoms and how, you know, we've had this narrow kind of progress for 50 years talking to you and other entrepreneurs in the aerospace and defense industry. It seems like it's, you're really approaching the problem on two fronts. It's

really a whole lot of atoms innovation, but a whole lot of bits in there too with software. Just talk me through, you know, how much innovation has gone on either of those sites for you guys?

Michael: Yeah, I mean, we do not. Our team is split about 50 50. I know that's not, I know that's not attractive or they're very, I know that's not as fun. But, um, so we build our whole turret. We design the whole thing. We don't, we, we, we buy power systems. We bicep components, we buy chips. Um, we buy cameras. But, uh, you know, we buy lasers right now, but we're modifying them. And then we'll go out and make our own here soon.

So we do the vast majority of the hardware work on our side, but then we also write our own fire control in our own C two. We don't buy software from anyone. Um, we write our, like, you know, we use our own identifier, we train our own models, we collect terabytes for of information to go and train models on for object identification. Um, and like multimodal id, so.

I don't know. I, I think, I don't think I've thought about it too much. I would, I would just say 50 50 split. If the question is how much are we investing in either one, 'cause I think both of them kind of, both of them kind of come together. Like if you do a controls, controls, if you do controls dynamic modeling and any kind of dynamic system, you want an extremely well-defined. Uh, hardware set in order to have an accurate controller. And then the utility of that controller to some degree depends on how, how accurate, like, how accurate your sensors are, how high your rep rate is for, um, for sensing, where like trying to understand in the state space where your controller is, where your system is. Um, so I'm just rambling. It all comes together. I'm gonna give you the boring answer. It all matters equally.

Stephen: It's probably true too. Yeah. Yeah. It seems like in Ukraine there's this been this game of co constant game of cat and mouse. It's like one side invents, you know, one technology and they get ahead and then, you know, the other side invents a counter technology. The UDA loop is really, really fast. Mm-hmm.

Can Anti-Drone Tech Make Drones Obsolete?

Stephen: Do you think it's possible for anti drone technology to get so good that it essentially eliminates the, the tread of drones on the battlefield?

Michael: Do I think it's possible, I mean, express a very uneducated opinion. It just vibes based, um, right. The, the, during World War II and after it was apparent we were kind of in a, not only in the nuclear edge, but in age and kind of the. The, the distributed force aircraft carrier where really your capacity to, to go and, and have a mobile strike force wherever in the world, basically along, along the coasts. Um. It was like really a very ultimate expression of, of power. And we built a lot of our military around that to some degree. That's very reductive. Um, but I think in, in, in some parts, you know, we spent billions and billions of dollars on like 13 aircraft carriers, right? It was some of our biggest expenditures.

And that is 80 years on, 70 years on, I think drones are probably like a 70, 80 year thing. Where it's like a next massive revolution, right? It might be as important as the bullet where it's like a 500 year kind of era defining thing. I don't know though. I don't know. 'cause I think radio

frequency attack, radio frequency was like the way to do it that was very cheap and had to deployable to take down drones, and that is not not working. You know, you can put a coral TPU and a raspberry pie into. Into a drone and then vibe code, a term metal guidance system in like an afternoon, right? And so it's like there's nothing to, there's no signals to jam.

So you need some way to hard take down a system. And those hard kills are much more difficult to deploy. You have to deploy a machine gun or a missile or another drone, or a laser weapon, right? And that all those things are hard and expensive to go and deploy. Um, yeah, those are my thoughts.

Stephen: Yeah, just, just speaking generally how much power is needed for something like this. 'cause what I find fascinating is your ammunition is, is essentially electricity, right? So it's, it's kind of like, it's fascinating. Um, you know, could again, but ballpark will, could these things stay up for, you know, hours, days, or, or just talk me through maybe the different trade off versus other connect systems.

Michael: Yeah. Appreciate, um, well. We deploy, we would be deploying mostly on vehicles and then in some states, uh, cases and static installations. So in almost all of those cases, you actually have power. Available to, you're on a truck or a tank, you're generating electricity from your alternator. It's not enough to power the system to go and be firing directly from vehicles in most cases. And so the way we, we, the way that we are, are looking at it is from an operational capacity where when you're engaging, when you're engaging in combat or like a drone storm, it doesn't take place over the course of hours. It generally takes place over the course of minutes very quickly. And then you have. Downtime.

And so we want to be ready to quick draw down a lot of power very quickly, but maybe not a, a large total amount, just like a high, just a high load, um, for short periods of time. Um, and then be able to go and recharge and, and, uh, either replace your battery system or recharge it with what you have available to you. Um, we think that makes the most sense right now, um, yeah. Yet to be seen.

America vs. China in the Laser Race

Stephen: It seems like you guys are the force in America to deal with this, but where are, where is China, where are the nations in the kind of laser technology space right now?

Michael: Yeah, for sure. There are some really cool companies. Um, there's one that's a little bit older than us out of Australia called Aim Defense. Um, they're very cool. They're very, very cool company. Um, uh, I've chatted with the guy from, from Aim Defense very briefly over email, so, um. We will try and link up. I think the, uh, there is a French company I believe as well, that I don't think they're doing autonomy, but they're doing kind of like laser rifles in a way, which by the way, laser rifle, even sick seems sicker than the laser turret. Much easier. I, if there's a market for a laser rifle, I can make it like next week. It's actually very, very easy to do.

But I think you're, you're really shitty at aiming though. Like you, you're just like, like wiggly human hands. Like you're not gonna hit anything for long enough over like 50 meters I think.

But you could blind, blind cameras and installations, so that might be the way to do it. But, um, but yeah, that's that. Uh, in the UK they have, I think they're, they're making Dragon Fire laser systems for like 120 million pounds or something. I was reading each, so that's kind of. It is sick, it's cool, don't get me wrong, but it's, uh, uh, that's kind of not, not really in our space.

Um, and then there are Ukrainian and Russian options that have come, that have come out there. So, you know, like necessity is, is incredible. It'll make you do crazy things. So like the Ukrainians and the Russians have deployed these, these laser weapons that are like smaller than, they're, they're, they're like small. They have a lower power than ours. Um. And they don't work as at as far of a distance and they don't work very well at all, but they kind of work and that's good enough for the Ukrainians sometimes. And they'll go and deploy them and try them out and so they'll probably evolve that technology.

Um, I. So I think there are other countries that are doing what they need to for their own mods. The way the United States is gonna work is like we are not gonna deploy something that works 20% of the time. We're not gonna deploy like a radio frequency system that destroys all of the electronics, like in an EMP on a soldier, right? The soldier carries tens of thousands of dollars in electronics. So I think when you go out and do this, you can look at what other countries are doing and we do, and it's really interesting. I think it's very clear that the bar is higher for the US military, and so we need to go and answer that.

Could These Lasers Be Used on Humans?

Stephen: Yeah, maybe allowed me to ask a dumb question. Could these laser guns, laser turrets harm humans? Or is it only, you know, drones and airplanes and stuff?

Michael: Yeah, so we essentially, so what the, the number one thing that you wanna do is just never fire at a human. And so that comes down to like a, like a safety and AI controls. Uh, AI and controls kind of problem where you really are only trained, you essentially are training on the data of things that you wanna shoot and things that you absolutely cannot shoot, like humans or objects that might have humans in them or have humans near them. You apply kind of an inverse waiting where you're like, definitely do not shoot anywhere near there. So that's number one. The number one thing is never to shoot at human.

Um, the second one is that, you know, there is kind of a, a, um, there's kind of a, uh, you know, if you are not being fired at. Like, you'll, you'll be fine. Essentially, if these lasers, you know, it's like a bullet, like if you're in the pointy end of a stick of a bullet and the the, uh, the, the gun fires, you know, you're gonna be in trouble. So it's, we would have a very, very similar, I'd say safety, operational, um. Like book on safety on how you kind of deal with these and what is the operational capacity for using these in the field to, to a machine gun and training associated with it as well. That'd be the best way to do it.

But you know, you, these systems will never be used to, to, to kill humans. Um, you have way too much water in you. It's going to like, are you gonna like wait to burn a hole in you for like. Two minutes or something? Or are you just gonna use the thing that there are millions of all over the place in the military, which is like an actual gun, where the gun's been developed for 500

years to kill humans. It's like a, it's like an evolutionarily optimized thing to kill humans, so you probably wouldn't replace it.

Stephen: Walk me through the commercial applications of this technology. It seems like, I think we both got to, to meet Arthur Herman, the, the author of Freedom's Forge last week. Um, and one of the things I really took from that book was how World War II was won by this fusion between civil companies and military companies. So, you know, general Mills, they made Cheerios in the morning and scopes at night. So yeah, just talk me through the, the commercial applications of the, of the technology.

Michael: Yeah, for sure. I think a lot of it has to do with laser systems that. That, that we're developing. There are only a couple US laser companies now. Um, one, the one i I used to work for the, the bottom end of our product lines would get killed by China every five years. Um, the Chinese were able to procure, uh, some tech, some technology, I believe like 15 years ago out of, um, out the fiber draw towers at Coherent. And I think another company, um, where it went back to China and now there's like seven Chinese fiber laser producers.

Um. And so I think what we'll do is we'll be like the first total US-based, uh, laser producer to be stood up in a while. Um, there are some shops that are around, but no one really produces things at scale other than two or three companies. And if you look at the optic supply chain in the US it's crazy. Um, like there's maybe one or two companies that do every. Everything across the board.

So you have to, um, mine rare with materials. You have to, um, actually kind of extract them and refine them. You have to go and cut dyes or you have to go and, and, uh, cast dyes. You have to then cut in a very advanced way if you wanna do any kind of, um, and kneeling, cutting, welding, everything like that. Of say glasses for example. You need lenses, you need mirrors that are very, very high fidelity. You need capital equipment that is kind of like a SML type semiconductor equipment to go and do that. So barely anyone does this stuff. And if they do, they need to get volume on something.

So like if you buy glass, if you buy a glass lenses, for example, in the United States, um, and you wanna buy them from like a mass producer, like a Thor Labs or an admin optics. And you wanna buy a, you can buy one inch circles, you can buy half inch, one inch, and two inch circles. Generally some things are three inch circles. Um, for say high powered laser light, like near ir, fiber, laser light. The two inch one could be like $700, 800, $900, something like that. And then if you wanna go to a four inch or any kind of like other shape than a circle, it's like $5,000, uh, immediately. Because you're talking about retooling like an A SML type tool.

So the, there's, it is just, the supply chain is extremely, extremely weak across the board. We're not gonna tackle all of it, but what we can do is we can go and stand up a, a producer of laser systems and provide them. In an area where, like the, the, the, the market growth is like 10% per year. It's grown by four. It's grown, it's grown by 10% per year, on average for 40 years nonstop, just massive market for especially like, like cutting in and kneeling material, processing laser systems.

Stephen: This technology sounds very futuristic, but I know you've had some successful live fire tests. Tell us what you can about those tests, what you've already demonstrated in the real world.

Michael: Yeah, for sure. I mentioned it a little bit earlier. We're we, we have a, I'm not, I'm not gonna say the ranges, but we have a, um, we have probably four stages of, of development for, for shooting that we wanna show. We are, uh, finishing up kind of the second stage where we wanna go from a very short range to a very medium range of shooting. And we should be done with our, with, uh, like the final distance in fidelity of the system by the end of the year. And, um, from there we'll be ready to, ready to produce, do some DFM, get into manufacturing, which is always a joy. So, yeah.

Stephen: Welcome to manufacturing. Hell, huh. Um, do you know, this is obviously an autonomous system that you're building. Do you think the future of, of, of the battlefield, um, you know, in, in five years or even less, is fully autonomous? Do you think that's where we're going?

Michael: I actually agree. When, when. When military officials, especially in the US say, you know, you always will need boots on the ground. You always will need boots on the ground. You need someone to take ground and hold ground. You need, you know, like what is the point of, of, you know, what is the point of having machines just like hold, hold, hold ground.

So I think, um, I. Does everything become autonomous? I think a, a lot of it does become autonomous. Um, it's apparent that the offensive capabilities of drones are part of the reason why they're, they're so effective is because they're, they're, they're semi-autonomous. They're using a lot of like targeted identification and tracking techniques that are really, really advanced. And it's not that hard to put a logic, like a logic path planning on it to, to do everything autonomously. So that, that's pretty clear to me. I think that it becomes probably mostly autonomous.

Um. Yeah, probably not a very exciting answer, but, uh, well, yeah, probably mostly autonomous, but I think you always need, you always need like, like green Berets and seals to go hold stuff.

Anti-Drone Lasers at the Super Bowl?

Stephen: Drones. They still, it, it amazes me how fringe they still seem to some people. Do you foresee, you know, a world in the near future, um, where the drones aren't just used on battlefield or anti drone systems like yours aren't just used on battlefield, but they're common sites that, you know, every presidential rally, every Super Bowl, every major concert?

Michael: Yeah, almost certainly. I think, I think it, I think just because of how easy it would be to cause a lot of. Devastation on the homeland with a drone, it you, we should probably prepare for it to happen. We should probably just presume that it's going to happen. Um, and so I think what you need is you need some way in the least disruptive way possible to actually get hard kills on drones in a civilian setting. Um, my bid would be on the laser, but I think there are a few different ways that you could do it. You could probably use radio frequency method if. The, the

problem is it's so easy to terminally guide the drone also. So that wouldn't, that wouldn't do anything.

Um, if you use a directed energy system, you're silent and invisible. Um, and if you were above, like, if you're on the top of a stadium or an embassy, for example, um, you could be relatively non-disruptive. You can tune your wavelength, um, and your pulse parameter to be very lethal from a short, at a short period, and then very, very quickly, um, kind of cubicle dissipate your power density. And so you're very, very, and absorb in glass so. Anyone in the building would be safe. Everything like that. So there are ways to mitigate, to kind of deconflict the, the, the issues there. Um, yeah.

The Myth About Mirrors Defeating Lasers

Stephen: What's one fact either about lasers or defense tech that you think would genuinely shock people if they knew it?

Michael: Oh, a mirror does not work if a mirror. It would reflect the laser. My system would be much, much cheaper because we, you use some mirrors and lenses to do some modification on the beam, and you have to really, you have to expand your beam to get the power density down so it doesn't destroy mirrors, and it still destroys mirrors. And so when you're focused on something, it's, it's annihilated pretty quickly.

So I did, when I was raising our first, our, our second capital round, I did like a nine page writeup on the physics and the cost too. To what you would have to do to a drone to defend it against, uh. Several, several kilowatts per square centimeter of laser light, um, near nearby are laser light. And it's, it's very expensive and bespoke. Um, it's not impossible, but if an enemy drone instead of a thousand dollars has to cost $300,000 to defend itself again and, and weigh five times as much to defend itself against a laser, that's a win that makes those drones not, not mass producable. So that's, that's what we look at.

But, um, I do have a meeting in a minute, so I gotta go, but, uh. Yeah. Anything else?

Underrated/Overrated: Space Weapons, Swarms, Iron Dome

Stephen: Yeah, can I, can, can we do a rapid fire round of overrated, underrated. Okay. Take one minute of your time. Let's go. Let's go. Alright. Swarms,

Michael: correctly rated

Stephen: subsea drones,

Michael: underrated

Stephen: space weapons.

Michael: Underrated.

Stephen: Electronic Electronic warfare

Michael: overrated.

Stephen: Iron Dome. I like Israel's Iron Dome.

Michael: I think correctly rated the Golden Dome. The hype is so high, but I think still underrated

Stephen: microwave weapons.

Michael: Uh, I don't wanna talk my book. I think probably correctly rated. Yeah.

Stephen: Loitering, munitions,

Michael: ac, accurately rated. I think people are properly freaked out.

Stephen: Anti drown turt.

Michael: I think correctly rated.

Stephen: And last one, fixed wing drowns

Michael: overrated.

Stephen: Michael, thank you so much for your time. Tell people, uh, where they can find out more about what you guys are doing.

Michael: Yeah, for sure. Uh, you can check us out on aurelius systems.com. Uh, we have our website. Um, if you wanna reach out, uh, send out, there's just the on me, on x, uh, at La Frogman or on LinkedIn. We're pretty active and, uh, yeah, come chat with me about laser systems. We're hiring a bunch right now. We just finished a cabinet route, so, um. Yeah, would love to, uh, would love to chat.

Stephen: Well, Michael, thank you so much for your time. I'm looking forward to seeing you next time. I'm in San Francisco in November, and we'll chat soon.

Michael: Yes, sir. We'll chat soon. Thank you so much, brother.