00:00:10 Noah Kravitz
Hello and welcome to the NVIDIA AI podcast I'm your host, Noah Kravitz. The theme that AI should and does augment our human capabilities give us superpowers, if you will, has been central to the podcast for some time now.

People as conductors of AI tools, be they on screen tools or tools manifested in the physical world, is a metaphor that's been used more than a few times around here. Today we're going to dive into that idea quite literally, with Moon Surgical and Maestro. I'm going to let our guest talk about it, but it's an amazing surgical robotics technology that's more than that. It's a platform. It's a reimagining of minimally invasive surgery in the modern world.

Anne Osdoit CEO of Moon Surgical. She's here with us to talk about the company, how it got started, her own background in medicine and kind of what led us to the point where Anne and her teams at Moon are really rethinking and making real a new approach to surgery.

So Anne, thank you so much for joining the podcast and welcome.

00:01:13 Anne Osdoit
Thanks, Noah. Thanks for the invitation.

00:01:15 Noah Kravitz
So I'd just love to turn it over to you to tell us about Moon, how the company got started and the vision to humanize robotic surgery.

00:01:25 Anne Osdoit
Yeah, with pleasure. So you know, Moon got started really in a way many years ago, right? The company really got going in 2020 or at the end of the end of 2020. But it was based on work that had been really pioneered by this surgeon, Professor Gayet, and a robotics lab based in Paris at Sorbonne University, where they had been looking at this concept of really augmenting the surgeon, but leveraging, you know the surgeon and what their capacities are today, right? And really turning them into super surgeons essentially for years, right?

They had experience, of course from other robotic platforms and surgical approaches, but had this frustration or concept that hey, you know, it's great to be completely changing the way surgery is done, but wouldn't it be greater or easier to implement if you could essentially just turn the surgeon into this, a lot more powerful surgeon? And leverage on you know, the standard of care that has been developed in surgery over many decades.

And if he did that, wouldn't it essentially broaden access, right? Because it would be easier to teach, easier to learn, easier to deploy. And so they had this goal in mind and had been toying with technologies and approaches to really get it to life and how to demonstrate you're in the lab, which is what I saw in early 2020, that got me to think about, OK, how do we apply this in an operating room? What are the current pain points that you know hospitals are facing in terms of staff shortages? In terms of just, you know, not only keeping and increasing efficiencies within the operating room, but also empowering surgeons to do things that are a lot more tailored to how they do things to who the specific patient they have in front of them is.

And so we really try to write the specifications for our platform so that it would really meet all of these needs and be equipped to grow into that over time.

00:03:54 Noah Kravitz
Right. How how specific, how individualized are these procedures if two random people go into the operating room for the same and I'll let you if you want, give an example of a procedure, you know how similar? How different are the experiences?

00:04:11 Anne Osdoit
That's a great question. So I mean overall they're fairly similar in a way, right? You know, surgical techniques have been described and are being taught in a way that it's fairly structured. You have little bit of geographical specificity as to how they do things, but we're seeing minimal.

However, every single surgeon does things differently. They have their own surgical preferences, as you call them, to the point that you know in operating rooms there are like physical cards like cardboards, where those surgeon preferences are written down. And this would be you know, what instrumentation they typically use, how they like things set up at the beginning of a procedure, and then what are the specific steps or things that they might need throughout the procedure, how the surrounding staff, you know, should be supporting them where they should be positioned, etc.

00:05:08 Noah Kravitz
Right, right.

00:05:08 Anne Osdoit
So really these, you know, surgeon preferences.

00:05:10 Noah Kravitz
All the preferences, yeah.

00:05:13 Anne Osdoit
And then each patient is unique, right? Their anatomy is unique and you know the way the surgery unfolds is, is to some degree unique. So you know the, the sequence might be similar or supposedly similar, but the execution is incredibly variable.

00:05:29 Noah Kravitz
Yeah. Yep.

00:05:29 Anne Osdoit
I mean this is well known, right? We all know patients who are supposed be going in into a very benign surgery and then things happen, right? Because part of it to some degree is unpredictable and part of it is just sheer variability. So I would say it's very variable after all.

00:05:46 Noah Kravitz
Right, right.

And so, I mean, how does Maestro work in practice and you have to go into great detail. But you know I've seen clips of it and the robotic arms and the whole thing. But how does it work and then what I want to get into or have you talk about if you will is, you know how then it's all the system is redefining how surgery minimally invasive surgery happens and what's possible. But maybe if you would start with kind of the high level of how it works?

00:06:13 Anne Osdoit
Yeah. So the Maestro system is really about empowering and implementing the surgeon with two additional arms, right? Surgeon typically has two arms which holds and maneuver 2 instruments, right? Which holds the active instruments in the surgeries. So these are the instruments that the surgeon would use to cut dissect, you know, take things out etc.

And then typically you would have two additional instruments used in these surgeries that are absolutely critical because they really deliver basic functions to the surgeon, which are the vision right? The ability of the surgeon to see inside the abdomen which is delivered through a camera that's inserted inside the body. And in the second function is access, you know, tissue exposure the ability to present the target tissue to the surgeon in the right way at any given time. Right?

00:07:14 Noah Kravitz
Right.

00:07:14 Anne Osdoit

Because you get into the abdomen, but you're usually not operating there, right? You need to put things aside.

00:07:21 Noah Kravitz
Yeah, right. Right. Right. Is it odd that as I'm listening to you, my own appendectomy scar seems to be tingling a little bit, or is that a pretty normal response? OK, good. Good. Sorry to interrupt.

00:07:35 Anne Osdoit
Everything is fine.

Yeah. So you know these two critical functions are kind of inherent in surgery.

00:07:42 Noah Kravitz
Sure.

00:07:45 Anne Osdoit
You can imagine that they are very surgeon-specific in terms of what their preference might be. You know what they want see and which distance? How dynamic they want this to be and similarly how they want, you know, tissue presented to them during the surgery. I mean this is incredibly important, right? And incredibly individual, right? In terms of how you know it matters.

And so what we're doing with Maestro and is we're giving the control to the surgeon over these things. Right? Vision and the tissue exposure and ability to access tissue, these would typically be managed by someone who is a surgical assistant, first assist. But that way of doing things is inherently flawed, right? I mean, you're relying on someone who's standing somewhere else around you know, the operating table to position things and anticipate things in the right way for you which like is really going to be imperfect no matter what.

00:08:44 Noah Kravitz
Inherently, right. Yeah.

00:08:49 Anne Osdoit
And even though you know you might have a fantastic persons that you've worked with forever, this person is better off doing higher value tasks, right? Bringing the right thing, anticipating the next move, correcting the next patient, etc. So the surgeons absolutely love the fact that you know they're in control of all these different elements because no

one is ever going to better assist them than themselves as we're just more efficient, more consistent and more confident after all.

00:09:17 Noah Kravitz
Right, right.
00:09:23 Noah Kravitz
That's amazing. So robotics has obviously been around prior to 2020 when Moon was founded and the idea of robotics and surgery has been around for some time as well. When did AI machine learning, deep learning, computer vision, everything we talk about when we talk about AI, when did that sort of enter your vision as not just a thing, maybe to explore, but I know this like this needs to be part of it. Robotic surgery, AI. You know, it's all part of the vision.

00:09:55 Anne Osdoit
OK, so this is a great question and I think that AI and what we're doing today with, you know data and artificial intelligence was there from the beginning because if you think about it, this notion of surgeon preferences is extremely specific to a surgeon, but can absolutely be taught through a system, right?
It is about how a surgeon likes their, you know, tools and cameras position over time and how they you know, might dynamically manage throughout the procedure. And you know, the more a surgeon uses the system, the more you can, you know, learn from that and it's going to continuously perform better and better.
And then the second aspect behind that is, OK, you're equipping the surgeon with two additional, you know, arms and hands. But like, how are these two additional arms going to be controlled and moved around? Right? Because you know, the surgeon if they use two of their hands to maneuver for arms, it means that they have to let go and grab something and move it, etc. And this is really where the concept of physical AI you know, came into play before it even existed, probably, which was, hey, how about we learn and leverage this data for learning to actuate our extra arms and control them right? Which sounded like a bold idea, right? Hey, like, you know we're in a regulated environment. We're in an operating room, you know. Is it, is it really feasible to do this without risks? Etc. But if you think about it, the only way to deliver those efficiencies and to empower the surgeon right. Otherwise they're always going to be limited by, you know, their own, you know body and capability.

00:11:46 Noah Kravitz
Right. No, absolutely. As you were describing. First, the cardboard sheet with the preferences on it. And I thought, oh, that's like a preference pane on a software application, right? And that, you know, that translates. But then you know, kind of more interestingly and importantly that kind of dynamic understanding and applying that to the idea of well now you have 4 arms, but this surgeon for their whole life has had you know as you said

likely to, but however many arms that they have and so, I'm thinking me as the patient, I don't know if I want like the surgeon to have the burden of trying to think about how to manipulate the extra arms right? And so this notion of well, how do you just make an extension? And that's what AI is so good at.

00:12:30 Anne Osdoit
Yeah, absolutely. But at the same time as a as a patient, would you rather have arms from a platform like, arms that behave like a surgeon? Or arms just, you know, systematically controlled by an algorithm that doesn't.

00:12:47 Noah Kravitz
Oh 100%. Yeah, yeah. The human expertise. Yeah, absolutely.

00:12:50 Anne Osdoit
But that's the whole point about humanizing the platform and turning who's that surgeon who is operating today on that particular patient.

00:12:59 Noah Kravitz
All right, so how did you come to start working with NVIDIA and maybe tell us a little bit if you would, about the partnership?

00:13:05 Anne Osdoit
Yeah, so working with NVIDIA has been quite an incredible journey which started, I have to say by luck and serendipity. I mean totally right? I mean, NVIDIA has very talented scouting people out there in the field and one of them, you know, happened to be in Paris and focused on healthcare and reached out very early in the life of the company.
So clearly someone who had been, you know, keeping the pulse and you know knew us really well.

00:13:34 Noah Kravitz
Right.

00:13:34 Anne Osdoit
But you know so we got into the inception program and got familiar with the capabilities and what we could access. We, as I said had this vision that we wanted to equip our platform with very, you know, extensive sensing from the beginning.

Whether or not we would use it immediately or further down the road, we wanted to make sure that the infrastructure, you know accounted for that and similarly, we wanted to equip our platform from the get go with very edge computing, right? We wanted to make sure

that it was able to basically live for many years without changing the hardware and in all these evolutions, etc.

And so we sort of embarked on this technical bet with the NVIDIA R&D team where we were like, OK, well, you know, let's assume we're going to put a medical grade GPU in this thing and we need it, you know, by that day. So, you know can you guys make it?

00:14:32 Noah Kravitz
Yeah.

00:14:34 Anne Osdoit
And the team was incredibly responsive and reactive and like, yeah.

00:14:37 Noah Kravitz
Amazing. Yeah, yeah.

00:14:39 Anne Osdoit
Let's use this as a pilot to you know, really get familiar with this industry and write specifications together and test it. And so we were on our deadline. They were on their deadline we kind of make sure that the operating plan sort of coalesced at some point and it worked right? So when we got to our commercial product and we were ready to submit it to the FDA we had the NVIDIA GPU in there right?

00:15:07 Noah Kravitz
Right. That's fantastic.

00:15:07 Anne Osdoit
And how the product was approved? And so what this has enabled us to do since then is really build on that. You know, it is the training environment. It is now the simulation environment and developing these features that are enhancing the product right? And we've been, you know, deploying some of them over the last few years.

00:15:29 Noah Kravitz
I'm speaking with Anne Osdoit. Anne is CEO of Moon Surgical, whose Maestro surgical platform is really, as Anne's been talking about, revolutionizing the concept of being a surgeon. Being a super surgeon, augmenting the human surgeon's capabilities, and kind of just rethinking what the operating room of the future is. I was going to say will look like, but really it's and is at this point.

Which leads me to want to ask you about the impact so far of everything Moon's been doing in Maestro. What does Maestro allow surgeons to do and deliver to the process that just wasn't possible before?

00:16:08 Anne Osdoit
Yeah. So Maestro allows the surgeon to do more in a way that is, you know, more efficient, but also more specific, more tailored to that patient, more tailored to the way they do things in the best way with fewer resources, essentially in a way that is more autonomous. And that is going to deliver greater quality care in a way that is very accessible, right? And so typically, you know, surgical robots have been implemented in select hospitals and institutions because they are very, you know, well designed for complex procedures. Right? They tend to slow down the operating room and the workflow and so we were really attached to developing a platform that would be easily accessible, easily adaptable and that would be basically an asset to the surgeons and their staff in high throughput environments.

00:17:09 Noah Kravitz
Right, right. Makes sense. And so some of the initial results that I was looking at before today show reduced variability in procedure times and then also increased surgical quality as you were talking about.
Can you talk a little bit more about those findings and specifically you know why they're so important?

00:17:29 Anne Osdoit
Yeah, absolutely. So some of it goes back to what we were saying, right? So it's basically if the surgeon is in control of all these different instruments and elements during the surgery, they're going to be managing all the different steps, all the different transitions between those instruments, right?

00:17:47 Noah Kravitz
Right.

00:17:48 Anne Osdoit
So rather than having to coordinate with someone, anticipate, etc. and communicate, it is seamless, right? Because system behaves specifically to that surgeon. The surgeon is in control. Some of these tasks are automated leveraging AI as we said. So it really makes it more consistent, more efficient for the surgeon to go from point A to point B.
An analogy that we use, you know that is very simple but I think it illustrates it really well is the analogy around how you learn to drive a car right? When you run a car, you have two

people in the car and you're splitting roles and responsibilities and functions between those two people, right? And as a result, it's a little bit clunky, right?

00:18:34 Noah Kravitz
Uh huh, sure.

00:18:35 Anne Osdoit
Because you would need to coordinate everything perfectly for that drive to be fluid right?

00:18:41 Noah Kravitz
Right, right.

00:18:42 Anne Osdoit
And then at the minute that the driver has control over the gearbox, the brakes, the steering wheel and the vision, ut is, of course a lot smoother. It's a lot faster and it's also a lot more consistent when they go from point A to point B. So it's a similar concept.

00:18:59 Noah Kravitz
Right no, that's great. That makes sense. And from the patient view and you know, as I mentioned before, I've had, you know, a couple of surgeries that were long enough ago. Now that all of this is just man, why couldn't I? But I have kids, so I'm happy for them that they'll benefit from this.
But what are some of the specific benefits you've seen from the patient point of view? And then as well, you know you spoke some to the other people in the operating room, maybe from the hospital's perspective as well.

00:19:24 Anne Osdoit
Yeah. I mean the patient is central, right? I mean everything new is ultimately about delivering better care for patients. We we've treated close to 2000 patients and you know it, it's a daily source of satisfaction of course. And so from a patient standpoint, as we said, it's about access to the best quality care, and if you think about it then, and you know more specifically, what does reduced variability mean? Well, reduced variability means that as you were saying earlier, you know 2 patients getting into the same procedure are probably going to have more similar outcome than in the past, which is important.

00:20:01 Noah Kravitz
Right. Which is what we want.

00:20:04 Anne Osdoit

You know complications or outcomes in surgery. It also means that, you know, the surgeon is likely to end their day on time and basically get you on the schedule as you know, anticipated which is, you know nobody likes when you know things get delayed or you're kind of rescheduled etc. So it means a lot more consistent patient experience right? When they go through the surgical journey.
It also means, for instance, you know in in emergency cases, making sure that this surgeon can have the resources to operate in a way that is minimally invasive, right? There are a lot of times where, you know, during nights and weekends, the surgeon doesn't have the staff that they would need conductors, invasive surgeries, in which case they would either do an open surgery, which is a lot more invasive or they would just table the surgery to the next day. So you know giving the surgeon a lot more autonomy is also a way to ensure those procedures can be done in a timely way. So all of these things are important for patients.

00:21:14 Noah Kravitz
When you mentioned a moment ago, helping to keep things on schedule and ending the surgeries on time and the doctor's day, the surgeons day on time and then you were speaking about the patient. But it made me think about the doctor's point of view. The surgeons. Is physician fatigue, I don't know if it's specific to surgery, but it's something I've heard about outside of this context. How big of a problem is it? And I would imagine it's something as you've been talking about, that assistant near that Maestro can really help alleviate.

00:21:45 Anne Osdoit
Physician fatigue is absolutely real.

00:21:47 Noah Kravitz
Yeah.

00:21:47 Anne Osdoit
You know, it's interesting, we did our first in human study in Brussels, in Belgium with the surgeon and he used the system over 50 cases. And he told us after weeks, hey, when I get back home in evenings, he's like my wife tells me that I'm, you know, a lot nicer then before so like what's going on and you know.

00:22:09 Noah Kravitz
Yeah.

00:22:09 Anne Osdoit
I mean, he attributed that just to his own fatigue level, right? He's like, you know, I end my day in a way that is a lot more relaxed. It's about both the physical and the mental load. You

know, it's the mental load is about constantly adjusting, coordinating, communicating with this assistant resource, which is very taxing and as even with the best resources it's going to be imperfect and frustrating.
And in the physical load is really about, you know, being in position that that are not ergonomically optimized because you're sharing your workspace with someone and because you don't have easy access to everything and a lot of surgeons have musculoskeletal pain

00:22:56 Noah Kravitz
Sure.

00:22:57 Anne Osdoit
And you know they have to get infiltration and this and that. And that's that is very straining as well, right? So yes, we absolutely have many reports from surgeons telling us about their fatigue. It's not the easiest thing to quantify. But you know, operating rooms are short staffed, which is about the nursing staff, but also to some degree the surgeons.

00:23:21 Noah Kravitz
I know it's not technically quantified, but you know, if you're coming home from work and your loved one, your roommate, whoever you share your home with the saying you've been in a lot better mood lately, I think that's saying something. But those I was going to call them ripple effects but then I thought well they're not because as you described it Maestro is about humanizing the whole experience, and so these things I wouldn't have thought about the ergonomics of sharing an operating theater with, you know, assistants and other people. But I can relate to, you know, my back hurting at the end of the day, if I've been in a bad position and so it then sort of you think about the trickle down to you know, the surgeons happier, they're more relaxed and less fatigue. So they're no doubt giving better care, even if they were already excellent. It's always good to be rested.
Patient has a better experience, the hospitals are more coordinated. So it just seems like this virtuous cycle which I was thinking about when you were talking about building the platform with the sensors. Even if you knew you didn't need them right away, AI is all about collecting the data and using the data to learn and so you know it's just. It's it just sounds so great.
I do have two parents who are retired medical people, so maybe I'm a little have a soft spot for it, but it's just it's great to hear about.
So as you look ahead a little bit, we like to end on kind of a future looking note. What do you see as the potential say over the next five years or you can, you know, shorten or lengthen that if it's better, but the potential for Maestro and AI more broadly to transform the operating room?

00:25:00 Anne Osdoit
Yeah. So it's a very exciting journey, right? I mean, I mentioned we equipped the system with a lot, but we're only scratching the surface of what we're leveraging today. Right? So one of the first thing we did was to automate the camera movement, which is something that is now in our commercial product. And you know really cleared by the FDA. It's the first physical AI product in the operating room, which has been incredibly exciting.

00:25:25 Noah Kravitz
Oh wow.

00:25:25 Anne Osdoit
What that we did a few weeks after that was get a regulatory clearance about our ability to evolve that AI algorithm overtime without having to go back to the agency for approval...

00:25:40 Noah Kravitz
OK, right.

00:25:40 Anne Osdoit
Each time. Because you can imagine that regulatory bodies like things that are frozen.

00:25:45 Noah Kravitz
Yeah, how not to get us off topic, but how novel of a of an idea or a concept was that on the their on their end on the FDA's end?

00:25:56 Anne Osdoit
It was the first time they were seeing.

00:25:57 Noah Kravitz
Yeah. OK. Yeah, yeah. Amazing.

00:26:00 Anne Osdoit
So it doesn't have a lot of, you know, education what was needed to get this through. So you know I think it gave us a lot of knowledge now on how to get additional features into the product. And so I think the plan is to leverage that sensing a lot more right? And turning this into workflow efficiencies.
It is about things such as, you know, enabling operating rooms to have dynamic scheduling, right? Knowing, predicting the end time of the procedure, making sure that this is adjusted based on how you know the previous surgery is going in real time, delivering those notifications to the staff so that they can adjust when the next patient gets prepped and minimize you know the downtime.

It is about optimizing the staff thing and the resources in the OR, right? We will know when a given surgeon is able to do a chunk or a procedure without assistance, right? So based on that, we can optimize how staffing is deployed over the operating rooms.
It is about helping them manage their inventory. We can see what's going on in the OR. We can see what's going on in the abdomen. We know what they're using. Based on that, we can help them with, you know, instrumentation and inventory management.
It's about, you know, case notes. I mean, I don't know you. You said you went through surgery. Typically you don't have great surgical reports, right? I mean these things don't really happen because surgeons are busy doing the surgery, right?

00:27:32 Noah Kravitz
Mm-hmm. Right.

00:27:32 Anne Osdoit
These are things that you can absolutely you know, automate and get value out of. Right?

00:27:39 Noah Kravitz
Absolutely, yeah.

00:27:40 Anne Osdoit
So there, there are many things and then providing feedback to the surgeon and the staff. What makes you a better surgeon? In which cases have you been more efficient or have you delivered you know, better care? And what was that based off?

00:27:54 Noah Kravitz
Right, right.

00:27:55 Anne Osdoit
And we're very excited about it, that continuous training. Really creating that feedback loop into the operating room, which is incredibly exciting.

00:28:05 Noah Kravitz
Yeah, I can only imagine from your perspective, but it's exciting to hear you talk about it. So with all of this and you've talked about this throughout, the human, the surgeon being central to everything. But sort of just to land on this initial concept of the extra arms. How do you think about balancing all of the innovation that has happened and that Moon's been able to accomplish today and everything you were just talking about with, you know, both the physical operating process, but then all of the data in the background and all the things that you can do with it. How do you balance that with keeping you know, just the

physical reality of the surgeons hands are healing another human being, right? How do you think about maintaining that balance?

00:28:52 Anne Osdoit
That's. Yeah, it's a great question. I think two aspects to that.
I mean first, you know we're in a regulated industry, right? So there's only so much that you can change at a time. So you know we're pacing ourselves but also you know for us, the thing that has been incredibly critical in getting the product and the additional features through regulatory bodies, is the fact that the surgeon is at the OR table in the operating theater and can control everything manually and override anything at any given point.
And this is really a safeguard right for regulatory agencies. If anything goes wrong, you still have the surgeon there. You've been trained to operate like this. You have not put the surgeon behind the console at the other, you know, on the other side of the wall or...

00:29:48 Noah Kravitz
Right. Right.

00:29:49 Anne Osdoit
Back end of the room, right? And so this has been incredibly helpful in terms of convincing about the risk profile, right? The surgeon is still you know operating with their two hands who are assisting and enhancing them, but they're there with their traditional instruments and training.
And so the way we really see the opportunity is about not only what we can do inside the procedure, but what we can do surrounding the procedure, as I said. And that is really where these workflow efficiency improvements come from. And things such as you know, managing staff, managing the inventory, managing scheduling, providing feedback and really continuously improving you know, what they're doing in the OR with, you know, insights for the staff insights for the surgeon, insights for administration.
And the beauty of all that is that it's not regulated, right? It's not during the surgery. And so we can deploy those things at a pace that it's great.

00:30:55 Noah Kravitz
Right. Fantastic.
Final words of wisdom or just a message you might want to leave to surgeons, medical students, aspiring surgeons and patients for that matter, who might be listening on the future of, you know, surgery and robotic surgery. What would you like to leave them with?

00:31:13 Anne Osdoit
Well, I think you know what we're introducing is really a completing new way of doing surgery, but also training new surgeons. And as we said, providing access to high quality

surgery to patients, so it is incredibly exciting. I mean I think we're really at the beginning and you know this vision that we have is going to be deployed over the next few years and I think has benefits for all of these stakeholders, right? And so I would tell them to, you know, basically get excited and see what's coming with Moon very shortly.

00:31:52 Noah Kravitz
Fantastic. Anne for listeners who want to find out more about the company, the website best place to go, social media, where would you direct them?

00:32:00 Anne Osdoit
LinkedIn would be where we're most active.

00:32:03 Noah Kravitz
Moon Surgical fantastic. Anne Osdoit thank you again for taking the time to join the podcast and best of luck with everything you're doing.

00:32:11 Anne Osdoit
Thank you very much.