WE ARE ETH – Episode 39

With Christophe Chautems, CTO and Co-Founder of the ETH spin-off Nanoflex Robotics

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[00:00:00] Christophe Chautems: It's really coming from your leg, from the artery in your leg and navigating all the way up, up to the coronary arch with a long heart region and into the brain, into the small artery, into the brain.

[00:00:17] **Susan Kish:** In this episode, I'm talking with Christophe Chautems, an ETH alumni who specializes in medical robotics. He's currently CTO and co- founder at the ETH spinoff, Nanoflex Robotics. This is the We Are ETH podcast, and I'm Susan Kish, your host. Christophe, if I look at your career, it would appear that you really like robots. Is that correct?

[00:00:46] **Christophe Chautems:** Yes, yes, that is true. I spent the last 15 years working robotic in different field.

[00:00:51] **Susan Kish:** Very cool. How did you get started looking at robotics?

[00:00:54] **Christophe Chautems:** For the beginning, it already before starting my study in my ETH, I was looking what can I study on our interest in computer science, electrical engineering, mechanical engineering, and robotic was used as the crossroad of these three fields, but there was no robotic study at this time. So it was EPFL microtechnic ETH in electrical engineering and mechanical engineering and decide to learn German and come to ETH Zurich.

[00:01:23] **Susan Kish:** Very cool. And the first thing I read about you doing was the RoboCup in 2009, where if I understood correctly, you competed in the nano robot category.

[00:01:34] **Christophe Chautems:** Yes. Yes, it was, uh, one of the first projects during my study was still during my master, uh, at ETH Zurich. Then we had a

competition, a class where we have to drive microrobot on a two millimeter field and pushing object onto it towards a goal. It was the first time I was starting doing programming, autonomous control, we had to drive the microrobot driving autonomously on the field.

[00:01:55] **Susan Kish:** And that sounds like that was probably a lot of fun. Tell us about what the RoboCup is.

[00:02:01] **Christophe Chautems:** The RoboCup is usually a robot who are playing soccer. You have probably all of you already seen this video of, uh, roboting trying to play soccer when they try to beat the world soccer team by 2050 and a couple of years they've done a micro scale of it with micro robot. We were playing on a really small field.

So the goal is, oh, you can move object of a two millimeter field pushing a ball that was 550 micron height. It was quite challenging and that was led by, uh, Professor Nelson, the team and as a student, I was working with this team.

[00:02:34] **Susan Kish:** So did you track this on a microscope or how do you actually watch the game?

[00:02:38] **Christophe Chautems:** You´re watching the match on a microscope with camera so that you can screen it on auto screen. So yeah, it was really under a microscope.

[00:02:45] **Susan Kish:** That is very cool. And how did you, did you grow up in Switzerland?

[00:02:49] **Christophe Chautems:** Yeah, I grew up.

[00:02:50] **Susan Kish:** Is that why you were looking at EPFL and the ETH?

[00:02:53] **Christophe Chautems:** Yeah, I grew up in Switzerland, coming from Canton Fribourg, but quite away from Fribourg, between Fribourg and Neuchâtel, in between two lakes. So yeah, yeah.

[00:03:02] **Susan Kish:** That sounds idyllic.

[00:03:04] **Christophe Chautems:** It is, it's a really nice region, really a nice spot to grow up when you have three lakes at less than five minutes far away from your home. It's, it's amazing.

[00:03:13] **Susan Kish:** I can imagine. Now I had understood you did an undergraduate degree in Sweden.

[00:03:20] **Christophe Chautems:** I did an extension on my bachelor's. I went for,

[00:03:23] **Susan Kish:** Ah,

[00:03:23] **Christophe Chautems:** yeah, I went there for one semester for six months to, to get this, uh, Stockholm during my bachelor's degree.

[00:03:32] **Susan Kish:** That´s the Swedish equivalent of the ETH?

[00:03:34] **Christophe Chautems:** Yeah, yeah, it it is a Swedish equivalent of ETH.

[00:03:36] **Susan Kish:** Fantastic. And once you finished your undergraduate and you did your master's and PhD all through all this, you kept on looking at robotics and it sounds like magnetics and how magnetics direct robotics or

[00:03:50] **Christophe Chautems:** Uh, yeah.

[00:03:51] **Susan Kish:** What's the red thread there?

[00:03:52] **Christophe Chautems:** I think I was mostly working in robotics, so when I was in Sweden, I was working on grabbing objects with the hand or so looking or with, or we can best grab objects. So it was in the robotic field. Then I was more working on special robotics, or you can drive rover autonomously. But at some point I decided to move away from special robotics and going towards medical robotics in the first job in a startup who was coming basically from the same lab where we were doing the nanogram or RoboCup. And started with medical robotics, I found it more impactful medical robotic, that you can have more, more an impact on the life of the people by developing new, new solutions, like helping people who need treatment.

[00:04:31] **Susan Kish:** It looks like you've spent some time at NASA and Ames with that was where you're doing the planetary.

[00:04:37] **Christophe Chautems:** What I did.

Yeah. I was at the (Susan: Navigation?) So I was doing it in my master's thesis, I was recommended by Professor Seacroft, put in contact with the NASA Ames, and I was able to go there and doing all my master's thesis, spending six months programming robots to drive autonomously on Mars on demand it was a research project looking how fast can you drive when you only have camera available because you don't see more than a couple of meters in front of you, and you're in an unstructured environment, you're not driving on the road, so you need to be able to brake quickly if something show up in front of you yet you don't know. So,

[00:05:10] **Susan Kish:** There's a cliff.

[00:05:10] **Christophe Chautems:** Yeah. So, especially, especially the cliff problem, a cliff, you don't see it more than two or three meters away because your camera is

just there. So if it's, you can imagine if a road is seen as a cliff, you will not see it way before if you are driving because it's kind of high then if it's not flat the ground.

So that was the biggest challenge. How fast you can drive on breaking before you fall on a cliff if you don't know what is around you, so that was kind of my research topic.

[00:05:36] **Susan Kish:** There's a Rover on moon right on the moon right now. Didn't it just land?

[00:05:40] **Christophe Chautems:** I don't think there's so many robots on the moon, but there are more in Mars at this point of time. There's another couple of rovers driving at this moment on Mars for years. So there was some rovers sent to moon recently, but I stopped a little bit following that. I'm more busy with the medical robotic field.

So yeah, since I left that 10 years ago, I don't know exactly what is happening, but I still have some of these projects that I was working on, involving to it, I know going sand to space. And so it, it's quite a long timeframe between the development of a robotic system for special exploration and the time is landing some somewhere.

It's really long project and even more challenging on the medical robotic, because if there's a problem, you cannot fix it. So you even more, there's no way of sending someone for doing a survey.

[00:06:24] **Susan Kish:** Fantastic and also you had to do, because some of the work you do at Nanoflex sounds like it's remote. So that does sound like that's a common theme between that work you did.

[00:06:33] **Christophe Chautems:** Yeah, it's exactly common. So we are working, especially when after the NASA, we're working, oh, we can tell operate trouble on demand with a couple of seconds of delay, because you have the time for the command to go there coming back. This teleoperation problem is the same that we are handling today with Nanoflex.

Yeah, because we want to tell operator robot, so if the doctor is not at the right location and the right spot on the patient is getting a stroke that he can operate the patient from a distance because when you have a stroke, basically a blood clot in your brain every minute count and you don't always have a doctor who is there waiting on the patient coming at the hospital.

So it's, it's really important using technology for helping these, these people and so to the help of robotic and it's, it's both is still operation problem.

[00:07:21] **Susan Kish:** So I was reading, let me rephrase that. I was attempting to read some of the papers around the technology that you work on at Nanoflex and around things like, I think it was called distal boy, distal vasculature. And I was sitting

here going, I don't know what you mean by distal and I'm a little confused about what vasculature is.

So can you explain this in really simple terms?

[00:07:51] **Christophe Chautems:** So that vasculature is basically all the artery that you have in your body, for us when you're talking about vasculature, it's really coming from the, your leg, from the artery in your leg and navigating all the way up, up to the coronary arch with a longer artery joint and into the brain, into the small artery, into the brain.

[00:08:10] **Susan Kish:** Let me just make sure I get this right. So you're inserting something in an artery in your leg, and it's going to go all the way from the leg up your body and into your brain, to like a yard a meter.

[00:08:24] **Christophe Chautems:** Yeah, like a meter yeah, a little bit more probably because it's not all straight, but around the meter, yeah.

[00:08:29] **Susan Kish:** Doesn't it have to wiggle on its way up, like, around your internal organs or a bone or.

[00:08:35] **Christophe Chautems:** it's it's basically following the artery, but there's a lot of curve and a lot of intersection. So it's like a, a road that you need to follow, a road, you need to follow all the way, and you need to be able to steer the tip, so today when they're doing that, they have a tip with bend at the tip and they rotate it, push, rotate, push, using different tube with different shape.

But it's extremely difficult, I need a lot of skill and training to be able to push a one meter tube through your artery all the way to the brain. So for us, what we are doing in Nanoflex, we are providing a system, we generate a magnetic field, and we can orient directly the tip, like a compass by changing the direction of the field, we change the direction of the tip, so we can point in the direction where we want to do, and then push it forwards to reach the location.

Making it easier if you control the tip, as if you are trying pushing something and controlling it for one meter away.

[00:09:32] **Susan Kish:** Okay. So it's as if, again, I'm going to use horrible analogies, but as you said, you've got a compass, North, South, East, West, and you're telling it because somehow, you know, that it's going to have a hard turn to the right so you need to go East by Northeast.

[00:09:49] **Christophe Chautems:** Yes, is that what we are doing it, except we are not only allowing doing that in 2D, Northeast, but in every direction in three dimensions. So we can also go up and down at the same time, making it, we can point it really precisely in any direction that make the navigation way more easy to do for clinician.

[00:10:08] **Susan Kish:** That´s why there is a picture of a joystick on your website.

[00:10:12] **Christophe Chautems:** . Yeah, because for controlling that, we basically use a joystick. It's like a computer game. You are using basically the joystick for controlling the direction of the magnetic field on the advancement of the device, so we are doing that with a joystick and we use basically this magnetic technology for making the navigation easier and at the same time, we have a soft tool who make less damage to the blood vessel or can be less risk of perforation and with that is a low, also making it easier doing teleoperation. We already have all the infrastructure, uh, using the joystick, using the magnetic field that we can just use a joystick for anywhere in the world for control, uh, controlling the tip of the catheter.

[00:10:53] **Susan Kish:** Oh, that's cool. Again, I have to just say this back to you to make sure I get this. So you could have a technician in Zurich who's looking at a screen and he has a, he or she has a joystick in front and it could be somebody in Ann Arbor, Michigan, which is where I grew up, but they have a fabulous host hospital there too, but let's just pretend, right?

It's St. Joseph's hospital and the technician locally has inserted successfully this item in an artery in the leg and has the magnet thingy on top and then the joystick person directs it so it goes, it goes, migrates up the body into the brain.

[00:11:39] **Christophe Chautems:** Yes, it's exactly that. It's exactly what we are doing and what we are developing.

[00:11:43] **Susan Kish:** That is as the expression, as we would say in Boston, that's wicked cool.

[00:11:47] **Christophe Chautems:** Yeah. The, the first doctor we are using it, we're quite impressed we, so we have done demo between the Mayo Clinic and Zurich where they were controlling from the Mayo Clinic with the joystick, the system in Zurich. We had the right type. Yesterday evening, a paper published in Science Robotics, which has attachment the video of the doctor from Mayo Clinic steering the device in a silicone model in Zurich, but the next step is doing that into a patient.

So we are working towards that.

[00:12:12] **Susan Kish:** So once it's up in the brain, then what does it do?

[00:12:15] **Christophe Chautems:** So basically the first application that targeting is ischemic stroke is when there's a blood clot into the brain which doesn't allow the blood to flow to part of your brain. So in this case, we want to go to this blood clot and aspirating this blood clot to remove it and when you remove it, then the blood can circulate again in the entire brain, in the artery where it was blocked before.

[00:12:36] **Susan Kish:** What does aspirate mean?

[00:12:38] **Christophe Chautems:** You have basically some pressure. You basically remove the liquid into, uh, basically a

[00:12:45] **Susan Kish:** So it's a puff of air.

[00:12:46] **Christophe Chautems:** It's not a puff of air it's like a vacuum cleaner, more or less, but you are just aspirating the flow of the liquid into the catheter so you basically, uh,

[00:12:55] **Susan Kish:** You flush it out.

[00:12:56] **Christophe Chautems:** -you flush it in more or less into the catheter to removing for the patient.

[00:13:01] **Susan Kish:** Oh, and then it flows all the way back out?

[00:13:02] **Christophe Chautems:** Because you have basically, we put a tube, a catheter, basically a tube who is going from the leg to the thing and then you basically flush it in the catheter and pulling it out through this tube by, yeah.

[00:13:13] **Susan Kish:** Now this sounds like this is a process that is slow, but you mentioned earlier in the conversation that you've got this three minute window. So do you

[00:13:22] **Christophe Chautems:** You not have a three minute window to do the procedure. So if you have a procedure, if you have a procedure, usually every minute count because every minute where the brain doesn't get a blood flow, the cells die, the neurons are dying. But, um, usually they want to do this process do you want to do this procedure in the first six hours. But if you can do it faster, it's better. After six hours, the, the advantage of the procedure is reduced. So usually optimally you want to do it as quickly as possible uh, optimally, two hours after onset of the symptom, it will be good if you could have remove this blood clot. There's no time limit, when is best to do it, but every minute that is delay, it's worse. And the problem if you, the patient is coming to an hospital and need to be, who doesn't have this service, you need to transfer to another hospital, it quickly take two, three hours for getting the ambulance, putting into the ambulance, driving into the hospital, bring it to the operating room.

So if you can operate remotely, it will really be, be helping, helping a lot. And it's a new treatment. Ischemic stroke is quite new that they are doing this kind of aspiration of blood clot. They only started really removing blood clots around 10 years ago that they realized clinical study showing the big benefit of treating the patient.

[00:14:33] **Susan Kish:** Just when you think 10 years in the future, what are the other applications that this kind of robotic technology, especially now that you've got

the introduction of generative AI, what are the other applications this could have for medicine?

[00:14:47] **Christophe Chautems:** I think in terms of application, we're really focusing in Nanoflex of providing access to healthcare to everyone people with a distance from the center. So we will look towards heart disease, coronary disease, if you have a heart disease attack there's all the procedure we need to be done quickly.

There's different procedure in the vasculature when you, you may want to treat the patient quickly, but you're also looking towards endoscopy. If you can see an endoscope into the stomach for scanning, detecting tumor early, providing some service in local community by the doctor, just controlling it remotely but we're also looking moving forward. So technology we say enable bringing more AI to the operation. Now AI has been mostly focus on analyzing, imaging it, but can we connect the AI to also helping controlling the robot? Because the advantage of robotic, it can standardize better the way we are moving a device.

We can move the device in a more controlled way. So if you improve the control of the device, for example, in endoscopy, we could get better image, better quality, more reproducible image that will be easy to process to AI and getting better outcomes. So technology can be combined with AI to even improve the outcome that you have in AI, and we're also working toward providing assistive feature. Part of the feature can be done by the robotic system like you have seen today in car. We have some lane following feature, so we can start implementing feature for helping the navigation of the catheter to the target point, but aligning the tip with the direction of the blood vessel so we can follow better your artery, and then moving forward to provide partial automation and helping the doctor in the procedure, because there´s for sure a big difference ,you need to imagine when someone need to the procedure at three in the morning, it's a young fellow. It's going to be challenging, but then the robotic

[00:16:34] **Susan Kish:** They had been on call for 30 hours and a little bit tired.

[00:16:37] **Christophe Chautems:** Is a real problem because yeah, what you are doing it, you're on call you're sort of, you're off, but you're only people was available for doing the procedure. So you, you do it, but the technology can't help them. And just, we are really trying, providing access to teleoperation, which I realize is our biggest need.

This hospital has sometimes, it's quite regular having hospital, we have only three people for providing 24 /7 service for this kind of neurovascular procedure. So you may imagine having three people that need to be always one of them available to be in hospital in half an hour time. It's extremely stressing for them.

He has a big impact on his social life and they were also being, uh, data, we are showing it a lot of, there's a high rate of car crash accident, because imagine you are calling the middle of the night, you have to drive to the hospital uh, you didn't sleep

for quite a long of hours. There's no miracle. No one cannot sleep for 30 hours on being extremely aware.

So there is a problem and it's the same problem, you cannot bring this kind of procedure to more distal regions because you have less than three people doing the procedure. You cannot provide 24 seven, but at the same time, if you have less than, uh, on those patient and we need a life saving procedure, you cannot build a center because you will not have enough procedure because they need to do 20 to 30 procedure to a year to be good at doing it. So the only solution of providing this service to people who are not living in, in big city, in city for 50, 100, 000 people is having center connected together. One specialist per city on the, they do the, uh, the, the operational tele robotics, uh, in the different, uh, different centers. It's the only way of saving 20 people life in a mid size, mid size city.

Only the technology can help bringing that moving.

[00:18:24] **Susan Kish:** So if I look back at your background and through your stories, it sounds like out of your 15 years of professional life, it's been 13 of them, as I think you mentioned, were with ETH in some form or other. (Christophe: Quite a lot.) So how has ETH been important in your life and what you're doing today?

[00:18:43] **Christophe Chautems:** I think it's been a great place to be at. That is an incredible place to meeting people, think about innovation, looking what the future could look like. I always had an amazing time being at ETH in Zurich. And yeah, I was coming to ETH, leaving, coming back. So I traveled quite a lot, but every time I end up coming back around, around ETH so.

[00:19:05] **Susan Kish:** And how did your experience there prepare you for your position as a CTO?

[00:19:10] **Christophe Chautems:** I think ETH is really, doing the bachelor master, they're really focusing on giving you the basic fundamental understanding it because the only time you really have the time to understand the fundamental in terms of physics, mathematics, is during your time. When you are starting moving out of ETH, there's a whole range of skill that you need to learn, the way it's working in the academy is quite different from the way it's working in the, into the industry. So I think ETH is really giving you the fundamental to be able to build on top of it and, and then you have a lot of skills you need to learn later, but there is the fundamental, it will be a challenge moving forward, especially when you have so complex technology project that you need to move forward.

[00:19:51] **Susan Kish:** And Christophe, what, how are you involved with the ETH today?

[00:19:54] **Christophe Chautems:** Today, you have basically Nanoflex Robotic is supported by, uh Wyss Zurich. So that was a accelerator funded by Hansjörg Wyss, by donation who help project in the medical field, regenerative medicine robotic field to move towards a commercial project because you may understand that there's

amazing research done by ETH, but then the gap between our research done and ETH and getting a startup is quite big. So we have received this support from this week with kind of a joint accelerator from ETH Zurich and University Zurich. We have provided us office space funding for three years so that we were able to work on the fundamental technology developed at ETH to bring it to someone who can go towards a commercial project.

Basically bridging the, the value of debt of deep tech project, because for investor earlier, they were saying it, oh, it's too early technology is too fundamental is too far away of application. So you are not able to fund money for doing that and they are trying basically bridging this gap, providing money when you're coming out of the fundamental research, but moving to work commercial application.

Yeah because we you need a lot of resources to, to bring disruptive technology to the market and that is a part of ETH, the Wyss Zurich.

[00:21:17] **Susan Kish:** Very cool. Christophe, thank you. Thank you for explaining this in terms that I can actually understand and thank you for all the work that you're doing. This sounds fascinating. I'm going to close with some of the standard questions that we ask our guests and the first one is when you were young, when you were a little boy growing up between these two beautiful lakes, what did you want to be when you grew up?

[00:21:40] **Christophe Chautems:** Uh, I think I want to be an inventor. I was dreaming being an inventor, building things, putting things together at the end, yeah, it's more or less what I have. Um, we are filing patents, we are finding new ideas, bringing new technology. It's a little bit different than the way I was imagining it as a kid, where I was trying more building stuff by myself because no, it's every resource is multidisciplinary, we don't only need to bring electronic software to people. We need to bring a team, a multidisciplinary team to work together to print breakthrough but yeah, it's not too far away what I was thinking about as a kid.

[00:22:12] **Susan Kish:** And what are you learning about today? What are you curious about?

[00:22:16] **Christophe Chautems:** I always like to looking at problems are difficult to solve and can have a big impact. I like, I'm driven by challenge, I'm always driven by, by challenge. I like when something is difficult to look if, if it's possible. I'm usually, my approach is always looking at the problem, looking estimating, is it possible to solve it or is it outside of the bound of physics?

There's no solution. If it's possible, but difficult is what is interesting me and so it's usually what is driving me to move forward, so now I was looking to learn more, extending my range of skill to be able to bring people to, to work together on, on bringing some complex project to an end. Integrating, integration is really my, my, my interest.

Bring people to work together on the system to work together.

[00:22:57] **Susan Kish:** So Christophe, I'm going to move you from the abstract to the specific. So that means you are reading about what, right? And if you had four hours in a given day, would you listen to a webinar about a particular topic or would you read a scientific paper about a topic? What are the topics? What are the areas of technology or the world that you're reading about.

[00:23:21] **Christophe Chautems:** I'm reading as of the broad scope of technology, usually really more technology focused project so I really have a broad range of interest going for it, I always try reading something new on a new subject. So I'm usually not saying too long until

[00:23:35] **Susan Kish:** Like what? What, what are you reading now?

[00:23:38] **Christophe Chautems:** It depends. It's changing every, every day and so usually it's at the moment is quite a lot into the teleoperation scenario, all we can bring uh, new design of the internet. So at the moment I start reading about the Cion network I see you have interviewed someone before because for bringing this teleoperation, we don't also need to provide robotic, but you also need to rethink the way internet is working to be more reliable and more performing, so that is one thing I was reading right now. But yeah, I'm always strongly interested about technology process. So you bring people to work together. Oh yeah, bring innovation. So I have a strong interest in technology since a kid, I was more reading technology thing then.

[00:24:15] **Susan Kish:** And when you do go into Zurich, what is your favorite place, either in Zurich or at the ETH?

[00:24:20] **Christophe Chautems:** Usually, I like going towards the lake then, being able to swim in the city, in the middle of the city, in the river. It's really a nice spot in the summer for taking a cold dip, also in the winter for taking a cold dip. So, yeah, I really like the lake in Zurich, being outdoor.

[00:24:36] **Susan Kish:** Fantastic. Christoph, thank you so much for your time. I really enjoyed the conversation.

[00:24:40] **Christophe Chautems:** Thank you.

[00:24:42] **Susan Kish:** I'm Susan Kish, host of the We Are ETH series, telling the story of the alumni and friends of the ETH Zurich, the Swiss Federal Institute of Technology. ETH regularly ranks amongst the top universities in the world with cutting edge research, science, and people.

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