

Interviewee: Maria Bualat
Engineer at NASA on the ISAAC team
March 28, 2023 at NASA Ames Research Center

00:00:01:15 - 00:00:04:10

Speaker 1: Sabrina Barlow

Hi. Please state your name and what you currently do for a living.

00:00:04:10 - 00:00:12:28

Speaker 2: Maria Bualat

Okay. My name is Maria Bualat and I am the group lead for the Intelligent Robotics group at NASA Ames Research Center.

00:00:13:15 - 00:00:16:24

Speaker 1: Sabrina Barlow

Awesome. Okay. Can you give a brief history of your working with NASA?

00:00:17:16 - 00:01:17:06

Speaker 2: Maria Bualat

Ooh, it's a long history because it started in 1987. So, yeah, I've been here for 36 years. I started right after college with my bachelor's degree. And at first, I wasn't working in robotics. I worked on the tarmac processing and, you know, using light for computing and sensing. And then I think I turned to robotics in '95. I joined the robotics group, and I've been working on it since, kind of doing various projects on like robot control user interfaces, visual navigation and then and kind of also working up to doing a lot more project management and systems engineering type stuff and culminating in the building the ASTROBEEs of course, a few years ago.

00:01:18:03 - 00:01:53:16

Speaker 2: Maria Bualat

And I also became the group lead a few years ago, but in 2019, kind of just before the pandemic. So that was an interesting experience being the group lead through the pandemic. But and now I mostly do that, and I work on this project called Isaac, which looks at using intervehicular robots like the ASTROBEE to maintain, you know, monitor, maintain, fix crew vehicles like space stations, especially when there's not crew there.

00:01:55:05 - 00:02:02:00

Speaker 1: Sabrina Barlow

Okay, cool. So I know you worked on the ASTROBEE team for a while. How how was that like? What was your role and what kind of things did you guys do?

00:02:02:24 - 00:02:28:23

Speaker 2: Maria Bualat

So I was the project manager for that. So it was, you know, kind of a lead role helping with, you know, keeping on schedule, you know, tracking tracking schedule, tracking budget, helping make some technical decisions, you know, arbitrating technical decisions, just interfacing with the teams on the International Space Station, you know, integrating ASTROBEE into the International Space Station.

00:02:29:09 - 00:02:45:10

Speaker 2: Maria Bualat

Um, yeah. So kind of a little bit of everything on the team, you know, not kind of I wasn't in charge of any one sub subsection or some system of the team of the robot, but kind of the overall lead for it.

00:02:45:18 - 00:02:49:02

Speaker 1: Sabrina Barlow

Okay. And were there any challenges and stories put in particular, that you remember.

00:02:49:11 - 00:03:12:25

Speaker 2: Maria Bualat

Oh, um, let me think. It's been a while now and I've like, moved on to other things, so it's a little hard. I mean, you know, in general it was pretty challenging because we were trying to do it, you know, basically on a budget, right? Using as much as possible just commercial off the shelf technology and, you know, try to not have too much custom stuff on there.

00:03:13:12 - 00:03:31:23

Speaker 2: Maria Bualat

I think one big challenge was the propulsion system. You know, we started off with sort of one idea of how it would work. And after our first major review, some things were brought up about, well, you know, that might not be the best thing. And so we kind of did almost a complete redesign of the propulsion system. So that was that was exciting.

00:03:32:16 - 00:03:54:22

Speaker 2: Maria Bualat

And then just the whole thing of getting it integrated into the space station, you know, and dealing with there's a lot of constraints put on you when you have to interact with crew, with the humans on space station. Humans are problematic in having to deal with humans. Without humans, it'd be a whole lot easier. But then on the other hand, humans rescue us, so when we get lost as well.

00:03:54:22 - 00:04:16:24

Speaker 2: Maria Bualat

So, So they're, they're a good thing too. But just, you know, all the considerations you have to take into account of when you're in the same space as humans in space. Right. So just safety considerations and user interface considerations, Right? What if we run into a human what if a human runs into us, which is actually more dangerous, I have to say.

00:04:16:24 - 00:04:21:26

Speaker 2: Maria Bualat

You know, just things like that, it's very challenging.

00:04:22:06 - 00:04:28:21

Speaker 1: Sabrina Barlow

Okay. Thank you. And so now you're on on Isaac and can you describe kind of Isaac and like yeah.

00:04:29:13 - 00:04:57:18

Speaker 2: Maria Bualat

So Isaac is we're looking at developing technologies that let robots interface with vehicle systems. So when we talk about vehicle systems we're talking about things like life support, you just sensing that's in a vehicle like a space station. So International Space Station, Gateway, which is, you know, going to be a lunar space station and even, you know, for future beyond that, you know, vehicles going to Mars.

00:04:57:25 - 00:05:18:05

Speaker 2: Maria Bualat

Right. So but basically a human vehicle that doesn't necessarily have humans on it. Right. So in the case of Gateway, the plan is currently to only have crew on it for maybe about a month out of every year, which means for a lot of time that, you know, space station is just sitting there with nobody on it to watch over it.

00:05:18:05 - 00:05:37:15

Speaker 2: Maria Bualat

Right. And take care of it and make sure it stays working. So we're looking at ways of using the vehicle systems, the sensors that are already built into the vehicle, combining that with robots that can actually manipulate things or move around to make sure that that vehicle stays healthy.

00:05:38:23 - 00:05:41:08

Speaker 1: Sabrina Barlow

Okay. And quick question. What does Isaac stand for?

00:05:41:19 - 00:06:08:11

Speaker 2: Maria Bualat

Oh, my goodness. You had to give me a tough one. Gosh, it wasn't like I know there's like autonomous caretaking and there's like integrated system for autonomous and oh, gosh, I can look it up for, you know, asking people to spell acronyms. It's like a, it's a tough question. Ask your dad to spell spheres. To tell us what spheres stands for.

00:06:08:11 - 00:06:09:01

Speaker 3: Jonathan Barlow

Synchronized Position Hold Engage Reorient—

00:06:09:16 - 00:06:17:08

Speaker 2: Maria Bualat

Okay, you've have more years to this. So yeah.

00:06:18:05 - 00:06:21:16

Speaker 1: Sabrina Barlow

Okay. And then what made you want to move over to Isaac? Like, what?

00:06:22:14 - 00:06:50:01

Speaker 2: Maria Bualat

Well, so basically my role so my group's role in developing was to develop ASTROBEE, Right. It wasn't to keep running it right, because now it's a facility, right? So now the sort of engineering you do that your dad's team is doing is much more about integrating guess science and keeping the robot running, you know, just operating it on the space station, whereas ours was more just to build the thing, right?

00:06:50:01 - 00:07:09:06

Speaker 2: Maria Bualat

So so we kind of got past that. And then Isaac was sort of the next step, like, okay, what do we do with these things? Right? What kind of things can we do with a robot that's on the space station, right? And what technologies can we prove out in that environment? Right. And so that's where we we moved on with, with Isaac.

00:07:09:06 - 00:07:12:22

Speaker 2: Maria Bualat

It was kind of just the next step for us.

00:07:13:06 - 00:07:20:17

Speaker 1: Sabrina Barlow

Okay. And then were you there for like the start of Isaac? Can you describe like how did that work? Like—

00:07:20:25 - 00:07:42:05

Speaker 2: Maria Bualat

Well, so it was proposed to, you know, a particular program at NASA's with NASA funded program project. And, you know, with all these things, it's just, you know, helping trying to get the programs to understand why this is important to do. Right. So so, you know, I helped out a bit with that. I'm actually the deputy on it because I have these other roles, Right.

00:07:42:05 - 00:08:07:27

Speaker 2: Maria Bualat

I don't I can't be the lead on it or it's tough for me to be the lead on it. So. So I'm actually the deputy on supporting somebody with these, you know, programmatic parts of the job. So and again, like my lead role in that is more on things like the budget and staffing and dealing with the ISS integration because again, we're we're now an ASTROBEE payload, right?

00:08:07:27 - 00:08:37:01

Speaker 2: Maria Bualat

We're actually a user of ASTROBEE So we still do interact with the ISS program with integrating our software onto it. ASTROBEE So I still am the representative for the project to the International Space Station. So I work with with all the folks that your dad works with over there as well. So and, and then also work out just like what activities we're going to run to, to do our testing, right?

00:08:37:01 - 00:08:51:04

Speaker 2: Maria Bualat

So what are, what are ISS activities going to be? You know, do we need a crew? Like what's the sequence, you know, of the experiments that we're going to run? So I kind of leave that end of the project.

00:08:51:14 - 00:08:57:11

Speaker 1: Sabrina Barlow

Cool. That's awesome. Okay. Um, and what are you what are you doing right now with Isaac? What kinds of things?

00:08:58:06 - 00:09:19:08

Speaker 2: Maria Bualat

So we're actually going to just going to be getting back on to the station. We did we finished some activities about a year ago, I think is the last time we did an activity where we're trying to map the inside of the space station using the high resolution camera that's on ASTROBEE. So we're taking these panoramas inside, right?

00:09:19:08 - 00:09:44:11

Speaker 2: Maria Bualat

Because we've been mapping space station to be able to fly in it. But it's very different. What we're doing is collecting information excuse me, features that the robot can use to recognize where it is right? So that's more navigational mapping. But now what we're trying to do is really high resolution, dense imagery that humans can look at and like assess the state of the the ISS.

00:09:44:11 - 00:10:11:00

Speaker 2: Maria Bualat

Right. We can look and see, okay, is that, you know, stowage where we think it is like that they put that bag away where we thought they were supposed to put the bag away or can we look at this particular payload and see whether the switches are in the right place? You know, all those

sorts of things, again, like the status monitoring, the status of the station by with this high resolution imagery.

00:10:11:00 - 00:10:39:02

Speaker 2: Maria Bualat

Right. So so that's one of the one of our efforts right now. So we did a little bit of that like about a year ago. We did some testing. We have some really cool panoramas of inside the station. And now we're looking at actually having the two robots cooperate to do that mapping. Right? So currently or up till now, the way that we did those, those surveys was we use two ASTROBEEs so we could, you know, try and get things out a little faster.

00:10:39:02 - 00:11:01:15

Speaker 2: Maria Bualat

But we had two separate teams controlling each of those. ASTROBEEs Right. So you had one team controlling Bumble and another team controlling Queen. And what we are now working on doing is actually coordinating so that the robots coordinate amongst themselves, right? So you basically can have one team that kind of sends up the plan, right? That tells a robot, okay, survey this module.

00:11:01:15 - 00:11:19:19

Speaker 2: Maria Bualat

Right. And then the robot figure out, okay, you do that, I'll do this. And like while they're executing, one may say, oh, I'm falling behind, right? I'm not going to get that module of that part of the module. And can you take over for me and do that. You know, you're ahead. I'm behind. So you do this part of the module for me, right?

00:11:19:19 - 00:11:38:03

Speaker 2: Maria Bualat

So that's one thing. And then the other part that we're looking at is we did a little bit of testing of looking at if we can do like close up inspections. So this is part of that whole, you know, monitoring how the vehicle is doing. Like if you think, oh, there's a problem with this equipment, I want to get a close up look at it right.

00:11:38:03 - 00:11:57:10

Speaker 2: Maria Bualat

So we're looking at, you know, having the robot be able to fly in close and focus its focus its camera properly and, you know, get really high resolution imagery of a very specific thing. So those are the two are kind of two thrusts right now for for Isaac. Okay.

00:11:57:10 - 00:12:03:28

Speaker 1: Sabrina Barlow

That's really cool. Okay. And have there been any challenges or anything like the journey of working with Isaac?

00:12:04:15 - 00:12:30:12

Speaker 2: Maria Bualat

Yes. Well, so we've had most of our challenges have been funding because every year our program like moves our money around is kind of like, Well, we're going to catch you this year, but we'll move that money into next year. And so and it's usually somewhere in the middle of the fiscal year. And so, I mean, I don't want to get too much into it, but we're basically we've had issues with funding.

00:12:30:12 - 00:12:55:12

Speaker 2: Maria Bualat

We've also had issues with staffing. So kind of programmatic issues, right? Not necessarily. I mean, there are some technical things, too, that we've had to deal with. For instance, we're having a little bit of difficulty getting the kind of resolution that we want for what the ISS program would like to see for these close up inspections. So, for instance, the the crew takes really close up images of the hatch seal.

00:12:55:12 - 00:13:18:10

Speaker 2: Maria Bualat

So it's like rubber gaskets that run all the way around the hatch, Right. So when the hatch closes, it can a tight seal. And the problem is that, you know, the hatches are always open. So they get wear and tear, right? They get little nicks they get little dings right. And so currently crew goes and takes up takes really close up picture pictures of any dings or cuts that they see in those Hatch seals.

00:13:18:18 - 00:13:36:11

Speaker 2: Maria Bualat

And so we're trying to see they actually asked us, ISS asked us, could Astrobee do this? And so we did a few tests to try and see if it would work. And we weren't really able to get the enough resolution. I mean, we kind of see that there was something there, but we couldn't really get a good, good picture of it.

00:13:36:22 - 00:13:52:02

Speaker 2: Maria Bualat

So that's one of the things that, you know, we feel like there are problems with like lighting, right, because of where, you know, the robot kind of blocks the light. You want to get in that close, right? You cast a shadow on what it is you're looking at. And so so yeah, So there's been a few challenges with that.

00:13:52:02 - 00:13:57:26

Speaker 2: Maria Bualat

And, you know, there's always there's always challenges with running things in space. So.

00:13:58:09 - 00:14:04:07

Speaker 1: Sabrina Barlow

Yeah. And is that like, is that due to like ASTROBEE's camera or like something other, just.

00:14:04:25 - 00:14:25:20

Speaker 2: Maria Bualat

Part of it is yeah. Part of it is the camera. You know, when we designed it, part of it is that what technologies are available to you at the time For instance, we designed Astrobees like more than five years ago. So there's definitely better cameras available now, right? Same with the processing on board. Right. And and there's also things that we didn't consider.

00:14:25:20 - 00:14:47:12

Speaker 2: Maria Bualat

You know, we thought the main purpose when we when we first designed it for that, what we call it, the sky cam was more for like watching astronauts do their thing right, being sort of a third person point of view for what they're doing so that, you know, people on the ground can monitor, you know, how like a maintenance task is going on in orbit.

00:14:47:12 - 00:15:09:23

Speaker 2: Maria Bualat

And so we weren't thinking of this sort of application of the camera. Right. Like we're like, oh, yeah, that's plenty good for the distances that we need. Right. And we didn't because you could change a lens and get better, you know, put a macro mode on it. Right. And you could get better closeup images. Right. But we didn't do that because we hadn't considered this application.

00:15:09:23 - 00:15:16:29

Speaker 2: Maria Bualat

Right. So this kind of gotchas where you're like, if we'd only just done this thing, we would have been.

00:15:17:10 - 00:15:18:12

Speaker 1: Sabrina Barlow

Sounds like you're trying to find lots of new applications.

00:15:18:12 - 00:15:22:07

Speaker 2: Maria Bualat

Yeah, exactly.

00:15:22:07 - 00:15:28:16

Speaker 1: Sabrina Barlow

Yeah. Okay. And so and I guess you're not doing a lot of, like, current testing in space that like.

00:15:28:24 - 00:15:32:01

Speaker 2: Maria Bualat

Oh, we're going to start back up again, like all these things that.

00:15:32:11 - 00:15:33:18

Speaker 1: Sabrina Barlow

How does that work? Kind of.

00:15:34:12 - 00:15:57:10

Speaker 2: Maria Bualat

Well. So, you know, we we were for a little while when we finished our last round of testing, we were put on the what's called the non supported tab of the of the integrated payload list, meaning that the ISS program wasn't going to support support us because well, in, in all truth we weren't ready to do any other kind of testing and, and we didn't, we weren't sure what kind of funding we were going to have in this.

00:15:57:10 - 00:16:16:15

Speaker 2: Maria Bualat

It's our last year, right? So because we kept getting cuts and money moved and it turned out that the program decided to give us all the money that they kept cutting from us. So now it was kind of like, oops, we need to do more testing. So so there's this little bit of it's called that, you know, updating the scope of the project, right?

00:16:16:15 - 00:16:34:17

Speaker 2: Maria Bualat

So so we did a little bit of change on the scope of the project. And so that's why we have this now, this new round of testing that we would like to do on the space station. So so we've actually just we're just getting back on to the integrated payload list and getting more of that support. So so hopefully that will be upcoming soon.

00:16:35:09 - 00:16:35:19

Speaker 2: Maria Bualat

Yeah.

00:16:35:22 - 00:16:44:04

Speaker 1: Sabrina Barlow

Yeah. Okay. What's your favorite part about being like on the Isaac team and working with Isaac?

00:16:44:04 - 00:17:04:02

Speaker 2: Maria Bualat

I think, you know, testing on the space station is pretty cool. That's probably one of my favorite things. And like, it's tough sometimes. The nice thing I should say. So your dad will tell you that sometimes it's really tough because a lot of these activities are like in the middle of the night, you know? Right. It's kind of like operate the robot like in the middle of the night.

00:17:04:02 - 00:17:27:17

Speaker 2: Maria Bualat

One nice thing about most of the work we're doing on Isaac is because it's autonomous, it's all about autonomy. We don't need a lot of crew interaction, which means that they generally tend to schedule us late in the crew day, which is actually, you know, reasonable daytime hours for us. I mean, your dad still probably has to get on consol early to, you know, get the robot started.

00:17:27:17 - 00:17:49:16

Speaker 2: Maria Bualat

But the actual activity time where we're actually flying, it's usually, you know, 7:00 in the morning or something. It's not so bad. Right? So so that that is nice. But, but it's really it's very exciting, right. It's and it's really especially for me, you know, I think of the ASTROBEEs they're kind of like my kids too, right? So I like to kind of keep track of what they're doing.

00:17:49:25 - 00:18:01:15

Speaker 2: Maria Bualat

And so for me, just watching them fly around on the space station is just it's so great. It's like watching your kids be independent. Yeah.

00:18:01:15 - 00:18:14:27

Speaker 1: Sabrina Barlow

Yeah. Okay. Um, and yeah. So what are Isaac's current and future goals? I guess we've been talking about that kind of just, like, starting up the testing. Yeah. And. Yeah, and.

00:18:15:01 - 00:18:43:21

Speaker 2: Maria Bualat

That's. Yeah, pretty near term. We don't have, as I mentioned, that there's only one more year. Well, not even a whole year, like half a year left on the project itself. So once we get that testing done we'll kind of wrap it up. We are looking at for like, okay, what's the next step? You know, and it's probably it may not it's probably not going to be an extension of Isaac, you know, where we might propose doing more of the same kind of work but will be we are currently looking for, okay, what's the next thing?

00:18:43:21 - 00:19:10:13

Speaker 2: Maria Bualat

What's the next technology that we should be working on and to try and support, like the operations of Gateway? So and we're talking with other other groups, you know, at NASA other like companies and other space agencies like JAXA, which is the Japanese space agency and ESA which is the European Space Agency. Right. About, you know, and sort of strategizing together about.

00:19:10:13 - 00:19:25:07

Speaker 2: Maria Bualat

Right. Well, what's the next step for intervehicular robots? Right. So that's kind of the next thing. Hopefully we'll find it soon because we're running out of money.

00:19:25:07 - 00:19:33:27

Speaker 1: Sabrina Barlow

So yeah, I guess the kind of what you're talking about with the like in the vehicle taking care of is that I think I've heard the term robotic caretaking.

00:19:34:10 - 00:19:34:27

Speaker 2: Maria Bualat

Exactly.

00:19:34:29 - 00:19:37:18

Speaker 1: Sabrina Barlow

That kind of thing. Yeah. Can you kind of describe it like.

00:19:38:04 - 00:20:09:07

Speaker 2: Maria Bualat

Yeah. So as I mentioned for Gateway, there's not going to be crew on it all the time. And so it's funny, one of my colleagues likes to refer to it as the vacation home syndrome, right where you go away, you're only there, you go there on vacation. It's your you know, you own this home, right? And when you're not there, you either either you come back and it's like, you know, things have happened and broken or you have to get a care somebody, a caretaker to go in and just make sure everything's okay and fix things as they break.

00:20:09:17 - 00:20:24:20

Speaker 2: Maria Bualat

Right. And so the idea here for for Isaac or robotic caretaking is that you have a robot be that caretaker. Right. Who just makes sure that things are still running and and fix things when they break. Right Because because humans won't be there the whole time.

00:20:25:23 - 00:20:34:23

Speaker 1: Sabrina Barlow

And do you want to quickly, quickly describe parts of the relationship between like how Isaac is using robotic caretaking like I know how they're communicating?

00:20:35:19 - 00:21:02:23

Speaker 2: Maria Bualat

Right. So we're originally when we first envisioned Isaac, we planned to have two robots on space station that we would test out these, you know, technologies on. One was Astrobebe, the other was Robonaut, which is the humanoid robot that developed by JSC Johnson Space Center. And there were issues with getting Robot Robonaut back on station, but we wanted to have this manipulation capability.

00:21:02:23 - 00:21:19:21

Speaker 2: Maria Bualat

Right? Astrobees got an arm, but it really can't do much with it. Right? So for one thing, it can only there's a limited number of things it can grip and it also has a limited amount of torque that it can apply. Right. It doesn't have a lot of strength. Right. It would lose in an arm wrestling contest. Right.

00:21:19:21 - 00:21:44:18

Speaker 2: Maria Bualat

So so we can't really do a lot of manipulation with Astrobees. So that was kind of what Robonaut was going to give us was you look at Astrobees as kind of the the robot that can monitor. They can go take sensors near where you think there might be a problem. It can get closeup images, you know, can get other sensor readings, and then you'd send a manipulation robot to go and actually like fix the thing, Right.

00:21:44:18 - 00:22:12:28

Speaker 2: Maria Bualat

So if it's a leak, put a patch you know on the leak or if you need to throw a couple of switches or, you know, pull something out of a freezer. Right. So, um, so that was our initial vision and we are still, you know, working towards that, especially on the free flier side with, on orbit demonstrations. But JSC is also doing some like on ground demonstrations with the manipulator showing, you know, what you can do as far as like actually implementing a fix right to the problem.

00:22:13:17 - 00:22:18:05

Speaker 2: Maria Bualat

So trying to I forgot out where we were going with this question

00:22:19:06 - 00:22:21:00

Speaker 1: Sabrina Barlow

Okay, just the Isaac and the robotic caretaking

00:22:21:00 - 00:22:43:04

Speaker 2: Maria Bualat

Oh, yes. Yes. So so that's and then the other the other part of this is the integration with the vehicle systems. Right. Because you start with the vehicle telling you that there's there might be an issue. Right. Because there are built in sensor systems in the vehicle. So, you know, between say, like I said, like the life support system might tell you, oh, we have a high CO2 reading, right?

00:22:43:16 - 00:23:04:19

Speaker 2: Maria Bualat

And then so let's send Astrobees to check, you know, like the vent, right. Or the intake of the the life support system, right. To see if something's blocking it because that's that's often they see that often causes a CO2 rise like like they were saying like astronaut socks right blocking a vent or blocking an intake can cause issues, right.

00:23:04:19 - 00:23:16:24

Speaker 2: Maria Bualat

So you can send Astrobee out to to see if there's an issue there and then you send the manipulator to get the sock off the intake. right. So, so that's the other part is like integrating everything together.

00:23:17:14 - 00:23:37:05

Speaker 1: Sabrina Barlow

Okay, that's really cool. Um, and so, um, yeah. How do you, how do you think that these technologies are kind of like working together to like the technology and I know like Gateway and like the kind of the future, like, of humans in space

00:23:37:05 - 00:24:04:08

Speaker 2: Maria Bualat

um well I Mean, I think, I mean, I think there's agreement sort of, you know, in the agency that, yeah, robots have their part in human exploration. And I think what we're doing with Isaac is trying to demonstrate, you know, that yes, robots can do these things. And, um, and so, yeah, there's just some things that either humans aren't there to do the task that needs to be done.

00:24:04:08 - 00:24:25:20

Speaker 2: Maria Bualat

And so you need robots or there, there are some tasks that maybe it's safer for a robot to do it right. If you can reduce the number of EVAs that a human has to do because you can send a robot out to do it instead, you know, that's just safer for the humans or their tasks that, you know, frankly, humans don't want to do. right.

00:24:25:20 - 00:24:46:15

Speaker 2: Maria Bualat

So they're repetitive, they're boring. You have to like hold something in place for a long time and your arm gets tired, you know, So. So that's where robots really can take over and they don't care. So they'll do that thing. So. So yeah, that's, that's sort of, you know, where we envision robots having a role in human exploration.

00:24:46:20 - 00:24:47:03

Speaker 1: Sabrina Barlow

Okay.

And do you have any other talking like, like NASA's future in space and like what we're going to do with that? Because I know the ISS is supposed to get retired eventually

00:24:55:15 - 00:25:20:13

Speaker 2: Maria Bualat

Yeah, and that's where Artemis and Moon to Mars all comes into play, right? We want to we're trying to get because really what's happening is we're trying to well, there's this mandate sort of

of like us getting out of the whole low earth orbit. You know, we're supposed to leave that to the commercial entities now. Right. And there are several companies that are looking to put up, you know, space stations around the Earth.

00:25:20:13 - 00:25:44:00

Speaker 2: Maria Bualat

Right. So so NASA's really looking at like farther away. Right. The things that currently there's no real like commercial interest in. Right. And they're technologies that need to be developed that, you know, it's really it's hard for commercial entities to look that far in advance. Right. They need they need profits now. Right. So so they're not going to develop these things because they're too far too far down the line.

00:25:44:00 - 00:26:04:18

Speaker 2: Maria Bualat

Right. And that's that's always been NASA's job. Right. Is like, we'll do the things that are much more distant in the, you know, a little more bleeding edge. Right. That you might not find a profit from. Right. So that's the sort of thing that we work on. And so so yeah, so now so we're looking at more like, let's get back to the moon, right?

00:26:04:18 - 00:26:24:06

Speaker 2: Maria Bualat

Let's put people back on the moon. Let's let's from there, let's, let's see if we can send people to Mars. Right? So that's, that's kind of, you know, where we're going. And, you know, of course there's always the robotic missions to the outer planets as well in the outer moons. You know, we're very interested in the ocean worlds out there, you know, around Jupiter and around Saturn.

00:26:24:06 - 00:26:43:25

Speaker 2: Maria Bualat

And so so we're looking at, you know, sending robotic probes to those But those are they're not involved so much in this sort of the human exploration side. Right. So and we have a my group has a little bit of involvement in some of that as well. But for now, we just mostly been looking at the human side, the human exploration side.

00:26:44:01 - 00:26:53:19

Speaker 1: Sabrina Barlow

that's really cool, that sounds really exciting. Um, and then do you want to quickly describe Gateway to see

00:26:54:08 - 00:27:18:24

Speaker 2: Maria Bualat

gateway? Okay, Well, so I don't I'm not super familiar. I mean, it's part of the Artemis program, right? And it's it's a space small space station, not as big as ISS orbiting around the moon. Well,

actually, it's a halo orbit, Right. That kind of keeps it in a Lagrange point, which is like a gravity balancing point. Right. In the Earth-moon system.

00:27:18:24 - 00:27:44:23

Speaker 2: Maria Bualat

So it's called a halo orbit. And the idea is that we'd first send people there and then from there they can go down to the surface of the moon, right? And so it's part of the overall Artemis lunar exploration architecture right that we're looking at. And so so it's a smaller space station in some ways. So it'll have some of the very familiar parts like, like a Canada arm.

00:27:44:27 - 00:28:02:17

Speaker 2: Maria Bualat

Right? So that's, that's a robot that we've seen in space for a very long time. Right? We've had we had Canada arm on space, space shuttle. There's a Canada arm right now on ISS and they'll be a Canada arm Gateway as well. So we're now trying to convince to put robots inside the space station as well as on the outside.

00:28:03:15 - 00:28:17:19

Speaker 2: Maria Bualat

So and it's an international effort as well. It's not just the U.S. and NASA that's building the gateway. There's international involvement in it as well. So even though it's not called International Space Station, it is an international space station.

00:28:18:24 - 00:28:26:10

Speaker 1: Sabrina Barlow

okay. And then finally, how do you think Isaac's technology is helping us kind of move forward into this future, like robotic caretaking or.

00:28:27:06 - 00:28:51:02

Speaker 2: Maria Bualat

So I think we're we're proving we're trying to show that that robotics has advanced enough that we can even start considering this right, with the fact that we've gotten some interest from the ISS program to use Astrobees for some actual like operational things like inspecting, you know, hat seals and doing safety, you know, walkthroughs with the ASTROBEE.

00:28:51:18 - 00:29:27:27

Speaker 2: Maria Bualat

For me, that's great because that's exactly what we're trying to do. We're trying to get robots into actual human exploration missions. Right? And so so I think that's what Isaac is trying to do is helping to do it right. We're helping to advance Astrobees' capabilities. Right? We're working we work on some even some of the more like infrastructure, like software, like the navigation system, and then some of these capabilities of doing these, you know, tasks for caretaking like surveying and close up inspection that to to prove the usefulness of this of these robots.

00:29:29:17 - 00:29:30:15

Speaker 1: Sabrina Barlow
okay. Thank you so much.

00:29:30:16 - 00:29:31:12

Speaker 2: Maria Bualat
You're welcome.