Adam Kress

Hi everyone, and welcome back to another episode of Aerospace Unplugged. I'm your host, Adam Kress. On today's episode, we're continuing the conversation around autonomy in aviation. Specifically, we'll focus on the industry's efforts already underway that will help bring autonomy in aviation to life. We'll also talk about the road ahead when it comes to technology adoption and also public acceptance of autonomy in aviation. It's complicated. Now, we've discussed on this podcast before about how autonomy is a continuum. You don't just flip a switch and suddenly you have it. From assisting the pilot with simple tasks to potentially removing a pilot from the cockpit altogether, different levels of autonomy can take many different forms.

Now, we've also learned that autonomy goes hand in hand with safety, and there's never anything more important in aviation than safety. Today we're going to expand on past autonomy, conversations and explore its real world implications and the role of AI, how that's shaping autonomy in aviation and how AI is being used in the aviation industry. A little bit different from other sectors. Now, joining us today on the podcast are two experts in advanced their mobility, automation and AI, Honeywell's Taylor Alberstadt and Dr. Yemaya Bordain…

Adam Kress:
So Taylor, Yemaya, I want to thank you both for coming in today.

Dr. Yemaya B.:

Thank you for having us.

Taylor A.:

Yeah, happy to be here.

Adam K.:

Yeah, so Taylor is the senior director of global sales and account management for Honeywell's advanced air mobility business.

Adam K.:

Taylor, tell me a little bit about your work and your career background and how you got to where you are today in aviation.

Taylor A.:

Yeah, absolutely. Thanks Adam, and thanks for having us here today. It should be a lot of fun. I've been at Honeywell 15 years now, and over the course of that time I've had several different roles that I think have really led me to right now into advanced air mobility at a great time. It really feels like it's starting to take off. Pun intended. I've done strategy, I've done transactional, some go-to-market, product work and all of that needs to be part of what we're doing today, which is to create an ecosystem to really make advanced air mobility take off. So while I formally lead, as you said, account management and sales, what's great about this team is we're very startup-y, right? Very entrepreneurial. So there's an element of everybody on the team go grab your shovel and start digging. And that's really the great piece about this role. The excitement is there. No offense to the folks working at the DMV or building furniture. We're doing cutting edge things and that's really what attracted me to this space. It's a cool place to be and a way to really change the world.

Adam Kress:

Awesome. So Yemaya, you're at the intersection of aviation and AI here. So I want to know which came first in your career? How did you come to this confluence?

Dr. Yemaya B.:

Yeah, I got to aviation in a very maybe on-traditional way. I am an electrical and computer engineer. I have my undergraduate degree in electrical, a master's in computer science. Absolutely hated it and went and did my PhD in electrical and computer engineering on the semiconductor devices side. So I wanted to do something as deep into physics as I possibly could be without being an actual physicist because course they just do science and I went to be in engineering, want to do some good with it. But during that time I worked on high-performance polymers and composite systems for flight systems, material science work. And then after graduating I went to Intel Corporation as part of developing, continuing to develop my career in semiconductors and integrated circuits. And I find myself in computing systems for aerospace. So I was working on a lot of embedded systems in aerospace and I started our offering in safety-critical avionics.

Before I knew it, I was an engineer that had the expertise across the entire company in all things where to put a processor in a safe system. And through that I started working with a lot of companies, a lot of startups…

Adam Kress:

Taylor, what advancements and kind of trends specifically with autonomy are we seeing in aviation now and how have those evolved?

Taylor A.:

And so let's take a quick detour and I promise we'll get back on the highway, but let's talk about what's happening on the ground because here in Phoenix where I'm based and where Honeywell's headquarters is, we have a front row seat to the largest autonomous ride-hailing territory in the world. Many people are familiar with Waymo, there's others as well, and companies trying to move into Phoenix because of this technological sandbox approach. So what happened on the ground, if we think about how a car was driven 10, 15, 20 years ago, the driver for legacy vehicles fully controlled and operated that vehicle, right? Then technology came, right? Automatic braking system, lane avoidance, some speed control, and that technology took hold, right? Next you had that technology maturing into different forms, people became comfortable with it, and then the next level of technology came in the form of radar, LiDAR, cameras on autonomy suite, right? This is real technology coming to how the vehicle's being driven.

That technology was brought on board, it was matured, but still with a driver in that front seat, the driver's still driving the vehicle. Well over time we continue to prove that that technology can be a safe or safer than the human operation. So the next step was, okay, let's pull this driver off of the vehicle. Once we've turned it on, the driver sits in the vehicle and it's proven safer. The driver can now move out of the vehicle. That person becomes an operator, they go to a control station, and the next step would be now you can put a passenger in that vehicle. So going back to aerospace, I'm not saying the technology is going to be one for one the same. I'm saying that methodical road map is something very similar to what we're going to follow. And you mentioned in the introduction the continuum, right?

We're not flipping a switch and going from a fully piloted vehicle, a self-driven car with a driver to a fully autonomous air vehicle or a fully autonomous car. It's a very documented safety-first approach.

Adam Kress:

Yeah. Yemaya, I'm curious to know, when you look at systems and aircraft that have typically been automated, at least to some extent, where is the easy or easier transition from that into utilizing AI for it?

Dr. Yemaya B.:

Well, for sure we think about artificial intelligence. There are sensors like LiDAR and radar and cameras, visual cameras. Think about it in the same way how humans operate. Our eyes don't do the actual processing for us. Our eyes are a sensor that we can so that we can perceive the world, but we also need that sensor to have something that processes it and understands what the world is. And that's our brain. And so we can apply these sensors and these sensors can do things like I can take a camera, I can mount them onto an aircraft and then I can have some tablet or some kind of display for a pilot to be able to see, in those cases, that sensor might provide a human with the capability to see or perceive where else they might be blind.

So for instance, if I want to be able to fly through clouds or fog or where there's low visibility and I need to land the aircraft, well there are special cameras that are multi-spectral and those cameras plug into a HUD and a transparent display to give that pilot some visibility where otherwise they don't have that visibility. In those cases, the pilot still has to do the processing. The pilot still has to do the perception part. They have to be able to see that there is a runway there or there is something on the runway. Well, what we do with artificial intelligence is we want to take some of that processing part away from the human in order to assist the human and make it easier or faster for humans to respond to whatever they see or whatever the system is perceiving.

So one example in a pilot assistance example is throughout all national airspace, every aircraft in the United States has to carry a transponder, an ADS-B source to keep transponder. But of course there's non-cooperative traffic, there are birds, there are drones, there's hot air balloons, there's aircraft whose transponder might be broken. There's also transponders that may not be operating on the same frequency. And in all of those cases, the human is responsible for being that visible, that sensor and that unit in order to identify that traffic.

Well, what we do is we mount cameras onto the aircraft and we will scan the sky continuously and use artificial intelligence in order to identify any traffic by drawing a box around it and stating there's something there. Look up, it's over there. So it's this way that we can reduce the workload of the pilot so the pilot can focus on flying, continuing to focus on flying, reduce the workload of the pilot, but also provide that redundancy and dissimilarity in these cases, pilot's responsible for looking for this. Now we have a second system that can also do that, that doesn't operate in the same way.

Adam Kress:

So with advanced air mobility vehicles that are starting to come online, whether you talk about potentially air taxis or cargo drones, could be piloted, could be unpiloted. I'm curious to know, when it comes to autonomy and these sorts of vehicles, what are some of the challenges or maybe the

misconceptions that the AAM companies and the air framers are facing right now that they need to overcome?

Dr. Yemaya B.:

Misconceptions? I'll say, if we're talking about AI still, I think the biggest misconception, I alluded to this a little bit earlier, is this idea that AI is this wrapper around the aircraft and then suddenly the aircraft has a mind of its own and it makes decisions on its own and it makes execution or it executes maneuvers on its own. And in demonstrating or developing, implementing AI into these aircraft, it's really boring. When we say that we're implementing an AI-based system, we take the normal process of developing systems.

Anytime you are developing an aircraft, you start at the aircraft level, you break the aircraft down into its major systems, and then you break those into subsystems and you go all the way down in breaking these systems into subsystems until you get down to the components or the fundamental building blocks of the aircraft. These are things like pumps and valves on the hardware side, but on the software side, it's things like functions, individual if-then-else statements. So when we say we're implementing artificial intelligence, we're saying that we're going to replace some of those if-then-else statements with statistical models or models that learn and they don't learn in action while in deployment. We do all of the learning behind, in the background during development. And only when that model, that artificial intelligence model, only when it is at a performance level, a generalization level that is sufficient to meet the safety requirements, do we actually implement it and then it's locked.

Taylor A.:

And I think from a challenge point…

Taylor A.:

…this is hard and we have to get it right. And I'm not necessarily talking about keeping aircraft in the sky. We're really good at that, right? We've been doing that for a hundred years. It's the challenge is implementing and integrating this new type of technology in a way that's certifiable as well. Aviation is one of, if not, the safest mode of transportation. Even last year, I think the Bureau of Transportation put out a study that said that exact same thing. The point here is we have to maintain a level of safety while integrating new technology. So I think that's the hard part, putting the wrap around all of that. From a misconception point of view, I think there's many folks that believe this is ground that's never been taken before.

When you think about automation, for those of us that fly commercial, there's a lot of the stages of flight where the plane is flying itself. You have the pilot there, but that level of automation is not new at all. There's planes that can do auto land on their own if something happens. So I think what we're talking about is really that line that Yemaya was driving. We're moving some of these tasks that the pilot does to make them more efficient, to free up their time, to free up the brain space to be able to focus on the things that the humans do really, really well and take those things that the machine can do really, really well and have the machine do those.

Adam Kress:

Okay. Taylor, Honeywell works with all sorts of different advanced air mobility companies. I'm just curious to get your read when it comes to one autonomy and two AI in a general sense, where are their

heads at? How are they feeling about how quickly they want to implement one or the other? As many of them are building brand new airframes.

Taylor A.:

For the majority of the OEMs in the advanced air mobility space today, when you're thinking about air taxis, almost all of them say, probably one are thinking pilot day one, and then it's how do we prove that we have the technology to be able to take the pilot out of the aircraft? I think if you go down the other path and you start thinking about cargo operations, there's a lot of examples where there are solutions day one that don't have a pilot involved. It's key to think about that pilot or the human still being connected to the operation. So we may not call the person a pilot because we're doing a last mile or a middle mile delivery, but we may call them an operator because they still can be in control of the aircraft.

That might not necessarily mean that they have a side stick and they're flying it, but it means that back to my original example of a control room or an operational station, you know what's going on with the aircraft and you have the ability to intervene. So I think the cargo side is much more forward-thinking about autonomy and it's also a lower risk when we go back to the baseline always being safety and we talk about not having a human on an aircraft, that's a quicker path to market.

Adam Kress:

So cargo is a good example. Where else do you see autonomy helping solve some of these real-world problems with what are some other use cases?

Taylor A:

Yeah, that's a great question. We have what's probably the worst real life use case happening right now, and unfortunately that's the Ukraine war.

Drone warfare is having a moment right now. It's surging in technological advances because it has to, you have the best and brightest across the entire country working on one goal and using drones and autonomy as part of that has had years' worth of progress in a matter of weeks. And you can turn on the news and you can see examples of that. And it's becoming very, very prevalent I think about these types of missions across four Ds.

So dark, dirty, dull, and dangerous missions. And those are really where autonomy is best suited from day one. So think about power line inspection, railway inspection, hostile environments, whether that be weather or darkness or truly in a theater of war. There's those use cases where you kind of think about those adjectives that describe a mission and you say for one or many of those reasons, you don't really want a human to be on the ground or in the air with the drone. So if you pick a mission that kind of satisfies dull, dark, dirty, and dangerous, that's really a great use case for autonomy.

Adam Kress:

And Yemaya, I'm curious to get your take on this also and understand, I don't know if there's a customer example, one or two that you could give of someone who's implementing this now, this sort of technology.

Dr. Yemaya B.:

Absolutely. And in all these cases, I love the four Ds and I am totally stealing that. That's great, that's awesome. But in all these cases, what we're always trying to do for the operator or the end user, we

want to reduce cost. We want to safety, we want to enable them to expand their operations and make their operations more efficient. And so along any one of these vectors when we think about new technology implementation, we're trying to do probably one of those four things for the operator. And some other examples of this are in search and rescue, search and rescue. It's some of the toughest operations, particularly because generally when a helicopter is being deployed, it's because nothing else can get there.

And you have a critical situation that needs to be responded to immediately. And the airframe might be operating in some very hazardous environments such as along canyon walls, within in valleys on mountains. And so anything that we can do in order to enhance that safety for the search and rescue operator, they tell us that our worst is operating in the dark where there's no visibility and there are wires somewhere because we cannot see wires. They said we can't even see wires during the day. And so we use our technologies well to do things like identify wires such that the human pilot can focus on keeping the airframe in a safe state so that the rescue operators and the hoist operators can do their job effectively.

Adam Kress:

Yeah. Taylor, you mentioned the conflict in Ukraine and how that has forced some innovation around drone technology, anonymous technologies. Where do we stand in the US when it comes to the development of this sort of technology versus maybe competitors around the world?

Taylor A.:

Yeah, I think there's certainly a push. And as recent as June of this year, the White House released three executive orders with the intent of ensuring the US can lead in the future of aerospace. So that would include advanced air mobility, drones, autonomy, and even counter UAS. So I think if you consider where are we today, we're not leading. There's an example, less than two weeks ago, there was a two-ton all-electric autonomous cargo vehicle that flew 150 kilometers in about an hour. It landed on an offshore oil rig, delivered food, medical supplies charged, took off and went back. That's awesome.

Adam Kress:

And this was where?

Taylor A.:

That happened in China, right? China is leading in advanced air mobility because they have the full support of the government of the provinces from the top down, and they have dozens of companies that are doing this right now. And it goes back to how are we going to lead? It's having a similar type of momentum. So I think we're on the right path now. What we heard from the White House and what we're seeing from the FAA is there is an impetus to catch back up and continue to lead as we have an aerospace through history.

Adam Kress:

So you mentioned the executive orders from the White House. I'm curious when it comes to other regulatory hurdles, what needs to be overcome to see the industry have this step change and really take off where it needs to go, whether it be in relation to autonomy, AI, or both?

Dr. Yemaya B.:

It's always difficult for me to say regulators need to get on board because regulators, their customers are citizens. And citizens expect that regulators will think about citizens first and the safety of citizens first. So aerospace is incredibly, it's centered around safety, and we want it that way. We want it to remain that way. What we're looking for when we say innovation or when we say support investment, but also with regulators walking with us so that we can do things the right way, we can implement new technology in the right way. And of course, in many cases, and historically new technology has been implemented in areas where maybe there are not many citizens or in hazardous areas, but also still keeping citizens in mind. And so we might just see that some of the newest innovation in this next critical inflection point in aerospace will probably be in hostile environments particularly, or maybe on the battlefield.

Adam Kress:

Well, Taylor, like I said earlier, you talk with a lot of new advanced air mobility companies who are trying to launch vehicles. Part of the challenge that they need to overcome is public trust and acceptance. You mentioned the regulators need to look out for the public. What are the challenges that industry is most facing when it comes to building that public trust and the acceptance for just call he or she, the average flyer?

Taylor A.:

Yeah, I think maybe there's three big things that come to mind there. The first, and we've kind of talked about this word here a few times, is certification. That carries a strong element of trust with the public. They believe, as Yemaya was saying, the constituents best interests are in mind. So having the regulations in place to be able to certify a product to say it is now certified, actually starts to matter with the public, right? It's not just technology. It's technology that we know has been through the wringer and come out the other side approved safe.

Adam Kress:

But I would have to think when it comes to, you could tell the public, oh, this thing is certified, but if it's a very odd new-looking vehicle, that doesn't necessarily mean that they're going to trust that it's certified to the same level as a 737 or an A320. So do you think that there's an extra challenge within the industry that even though they could say it's certified to the same level, oh man, that looks different. I don't know about that.

Taylor A.:

Yeah, I mean, that's one leg of the stool, right? I would say the second is to be able to demonstrate value. So to your point, okay, it looks weird and oh, is this just a tool for the ultra-wealthy to make their lives better? Well, those are two strikes. How about we talk about those missions? How can it add value to the general public? When we think about underserved or under connected communities, how can you use autonomy and automation to better connect them? Think about how parcel parcels are delivered. Right packages go from a hub to a very rural site that happens once a day with a pilot who flies and sits all day long waiting to reload a plane and then fly back. If you have the pilot on the ground as an operator, you can connect that community maybe multiple times a day.

That's meaningfully changing the lives of the general public, not putting some billionaire above traffic to save 20 minutes. So the certification, the utility, the showing value. And I think the third piece of it, and you did a great job teeing it up. If we go back to Waymo just for a second, and I think about my first ride with Waymo, and I've had this conversation with a lot of folks. I think a lot of people share it. I was very

excited. I'm excited booking it. I'm excited when it pulls up and I get close to it and the door opens. I'm excited. I look in and there's no driver, and it says, "Hello, Taylor, please buckle your seatbelt." I'm really excited, really excited. I plug in, I sit down, I'm looking around and five minutes in, I'm not excited anymore. It's normal. It's blase.

Adam Kress:

Typical ride.

Taylor A.:

So to your point of it's this strange vehicle, no matter how it looks, if it becomes normal, we're not trying to do some sort of public stunt. It's not supposed to keep people excited and anxious. If you can make it normal after five minutes of using it, that's a key to unlocking a public acceptance.

Dr. Yemaya B.:

And so much of the public has to see things operate for a while before they even try it themselves. So with Waymo, for example, how long was it that they were driving with a human behind the wheel, and this is kind of sensitizing or desensitizing the public to this idea, this notion, and then slowly started removing humans from the car. And folks would get in and they're like, "Okay, it's the same." But first, many patrons, they would be in the back seat. There's a human there. Maybe the human never touches the steering wheel.

But this helped to desensitize the public and also gave the impression once there are so many around, human, no human, it gave the public the impression that it had many, many hours of driving time. And I think the same thing will happen here. And in fact, this is also a part of the safety case in many cases. You want to know, well, how much experience does it already have? And within that service experience, how many times has something bad happened? This is another way of desensitizing the public. This isn't desensitizing operators to putting humans on and putting patrons on in the future.

Taylor A.:

As you were talking, I kept thinking, boring is good.

Dr. Yemaya B.:

Yes.

Taylor A.:

We don't want something exciting.

Adam Kress:

When it comes to safety, absolutely.

Taylor A.:

Boring is great. And maybe the fourth piece of the public acceptance is communication and over communication. We had an event a few years ago when Congressman Graves looked across an entire room of stakeholders and said, "You guys really know what you're talking about, but I fear you're in an echo chamber." Yemaya and I and our peers, we know what's going on, we know the safety cases behind it. We have all of the background. We're very comfortable with this. If we're in that echo

chamber and we don't fill a communication gap that exists with the general public, then they're going to create their own narrative. And that can be really damaging because you fill the gap with potential untruths. So we need to ensure that as an industry, we are communicating here's why it's safe. Let me show you the certification. Here's the value it's going to add. Because if you don't fill that gap, it's going to be filled with narratives that probably don't support advanced air mobility.

Adam Kress:

And in your view, that's a shared responsibility across the industry. There can't really be one leader or can there?

Taylor A.:

I think you're going to have to have several leaders, and there's so much of the public that isn't keyed in to what's happening right now in the industry that it's necessary for all of us across the different ecosystem channels to message. There's an example, there's a company in Ireland that I went out to visit, and it's happening today type of thing. As part of that visit, I saw a coffee and donut get wenched down from a drone and dropped on a doorstep. But the CEO was telling me before we go into a city, we have people there on the ground. We're talking in the public schools, we're talking to moms groups, we're sitting in McDonald's and just trying to educate the public because there's such an element of if it's unknown, I become fearful of it. So communication happening across the board, but importantly in advance.

Dr. Yemaya B.:

And just to add to that, I mean the public needs to believe that we are all, the entire industry is setting and maintaining an extremely high bar. Think about why we trust commercial air transport today. Why do you trust your entire family to get on an aircraft for vacation? It's because we set an extremely high bar, 10 to the minus nine probability of failure per hour that there would be a catastrophic event. And because of that, it's not that the public just believes it, but we perform in that way. But then also think about when a catastrophic event happens, it really is damaging. Damaging to our industry, is damaging to the trust that the public has in us and regulators, and developers of these systems. It can be damaging to brands and take down entire companies. And so we must maintain that level of trust. And this is why we still go in every single time when we're introducing new technology and we're starting with safety and we're starting with ensuring that we will earn the trust of the public and then we'll maintain that trust.

Adam Kress:

Okay. Let's try to predict the future a little bit when it comes to autonomy in particular, and then also AI in aviation, let's try to take a look at the next five years and then maybe even the next 10 years, because I feel like there could be a significant difference between the two. Where do you see it all headed?

Dr. Yemaya B.:

I guess I'll start. People ask all the time about AI on aircraft and will aircraft be flying themselves with the AI-based brain in the next so many years? I don't think so. I think aerospace will continue to maintain that level. Aerospace will continue to build these systems in a very processed way, and we'll ensure that we take an incremental approach at what more and more license that we give to an AI-based system. Meaning that I can have a system that is AI-based, but that doesn't mean that I give it license to make a

decision, or that doesn't mean that I give it license to execute a maneuver without getting the approval of a human or ever execute a maneuver.

So as I think about how long it takes for let's say in our traditional commercial air transport market, that part of the segment, how long it takes to get any system certified and run through that rigor. Anywhere between two and 10 or more years. And so I think in 10 years we won't have an AI-based brain, but I do believe that in 10 years on our big aircraft, AI will be instrumental in supporting pilots through assistance and augmentation. And then I'm sure Taylor can talk a lot about where there are not pilots on the aircraft and what these will look like.

Taylor A.:

And I completely agree, right? On the commercial side, it's not a tomorrow thing and we won't be pulling pilots off the aircraft anytime soon. But to the previous point, drone operations are happening today in limited locations, but around the world, the goal now is to take those limited operations and let's expand those operations. Let's improve operational efficiency, let's add safety to the equation. So it's starting to scale what exists already in certain pockets. When we think about five years, I want to give a plug to where we are in Phoenix. We had Mayor Kate Gallego out to Honeywell Deer Valley last week, and her team said, "This is a technological sandbox. We want technology here." So if we think that this is the largest Waymo playground, why can't I walk outside in Phoenix and see this as one of the initial launches for we think about autonomy and advanced air mobility.

So I think within the next five years, you'll see key cities really start to adopt, and maybe Phoenix is going to be one of them. On the further out horizon. I think even 10 years from now, the goal is to never fully eliminate a human from the equation that that's never the intent, right? Maybe the word pilot will change what it means and it's more like an operator, but a human will always be part of this. And maybe that goes back to one of the misconceptions, whether we call it a pilot in the loop or a pilot on the loop or an operator. Maybe the operator's monitoring one aircraft to begin. Maybe it's multiple in the end, you're always going to have a human component of it. So this isn't a one day the machines will run the world. We always believe humans will be touching an element of autonomy.

Adam Kress:

Excellent.

Dr. Yemaya B.:

Absolutely.

Adam Kress:

Well, thank you both Taylor and Yemaya for joining me on the podcast today. It's fascinating just to think through what the future is going to look like, what the future of flight's going to look like, how AI and autonomy are going to influence both of those. As you know, we call the podcast Aerospace Unplugged. So when you guys unplug and you're not thinking about flight, if that's possible, what do you do when you unplug? Yemaya?

Dr. Yemaya B.:

I try to fly and to fun places with my family as much as possible. We recently returned from two weeks in southern Italy and enjoyed it. And we're waiting for, we can't wait for fall break so that we can head to Spain.

Adam Kress:

Oh, nice. Nice. Excellent. Taylor, what about you?

Taylor A.:

Well, when I unplug from work, it usually means plugging in at home with four kids and amazing wife taking time outside sports activities, having the ability to travel like Yemaya said, and try new things, whether that's seeing autonomous deliveries or going to Disneyland. We stay pretty busy and have a lot of fun.

Adam Kress:

Excellent. All right, well thank you again, Yemaya and Taylor for joining me today. And of course, like always, thanks to all the listeners out there for tuning in. We'll catch you all again soon on the next episode of Aerospace Unplugged.