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Attendees

Aarsh Thakker, ayuminor, Bonolo Mathibela, Davide Iafrate, Kimberly McGuire, Kimberly McGuire's Presentation, Luigi Feola, Manuel Roshardt, Mayank Joneja, Rhys Mainwaring, Ryan Friedman, SAMPATH GANESH KANDREGULA, Stevedan Ogochukwu Omodolor, VIBGYOR R SINGHVI, Yogesh Kumar

Transcript

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Kimberly McGuire: Welcome everybody. It's the discussion of developer meeting of November 22nd. 2013 so my name is Kimberly McGuire. But Ramon is Algeria, so it will probably join soon. so yeah, the agenda of today is going to be about 3D planning. So we're definitely going to have a lot of discussions about that. because the discussion meeting we're mostly going to have discussions. yeah, and then also kind of like a couple of announcements and the next meeting. And I'm going to already did an announcement now. I don't know if anybody noticed but the Ramones roscon talk is out about the difficulties of getting into error Robotics and the story featured. the

Kimberly McGuire: yeah defective figured that we've made up Mary going through the experience of getting to know about area reporting out to HD. Along, hashtag. We are married. Yes. We all know also, the error stack talk should be out as well our stick too. We had a presentation about that. I wasn't the first presentation that we had. All the way in April, I think so go check it out. I don't know if anybody else wants to share something or an event or announcements. Just put it in the Jets or say it out loud. Because if there's anything interesting to come out.

Mayank Joneja: I'll be speaking at Roscoe on Bangalore. It's not aerial reward its media. Anybody who's coming to come say hi. It's the first time Windows doing this and they should be fun. There's a lot of stuff about Ross stores, and some crazy stuff that people had acceleration and other places have done and I'm going to be giving a talk on why my company uses Ross when we don't even build robots. So I guess that might be interesting. For some more in business space. Yeah.

Kimberly McGuire: All right. Yeah. Thanks man, of course. Yeah Roscommon. India and I think also roscon Germany is also going to be soon as well. So it's a lot of exciting things happening. Okay, so just a very quick introduction to you if you're looking to really planning. to do of course, we know for the today navigation enough but a lot of Ross package are based on because they're for Grand robe was mostly and I guess what's real kind of thing is 3D planning, especially also important for other navigation also internification, of course, but especially for other navigation and kind of like a very Global thing the current planning package is simply won't do or perhaps now since we've had a lot of improvements But that's all we're going to talk about so.

Kimberly McGuire: This actually bit different to the topics that we've already discussed before because all the other topics we kind of were discussing okay what's currently wrong with it? What's going to potentially doing the future with 3D planning is a little bit different because we already had a head starts.

So that's great. We were moving too slow with the topic discussions, but that's fine. So Ryan's and mayank are kind of starting. with already a bunch of PRS the currents packages that are gonna have handles or configured to rust too and everything is terrainification, which is from Etc. Yeah, and I guess all of them are from the autonomous system Labs from Etsy so math miv communication and gritmapgio.

Kimberly McGuire: which is based on anabolic script map. So the packages of things are happening in right now. So there is a GitHub projects for three planning that we already made so it's false kind of fun. Cry outside to see how we can handle maybe Future Shop committees as well maybe in a similar way, but if you're interested, what is currently going on a pro? So what has been already done or things that you can still put in with I recommend you to look at the 3D planning. project file there. yeah. so thanks to Ryan here already gave a

Kimberly McGuire: some kind of status reports about the current state of trading navigation. So I guess just very short that a lot of navigation Solutions are not possible for fixed wings because fixwings are a little bit more difficult cannot stop emit flights fly for longer distance. So the curvature of the earth becomes important strictly Aerospace regulations the kind of in general it gets planning burden on the operator already out by Suites. And it's also kind of current issues with GPS for navigation that we have this course. Threats open so that's already has 38 responses.

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Kimberly McGuire: For Steve, it's a lot. Yeah, and I kind of like the current work currently growing on with the package that I've mentioned before. It's like boarding into rust suits talk about standardization to fix compatibility issues for different Oasis by Michel I like the docker contains and everything and to make real binaries. yeah, so these are kind of the discussion topics that I've kind of selected of course, like I must already say I'm very much an intern navigation. Yeah. There might be things that we would like to discuss that the more particular to Outer navigation, but we also have a topic about that. So perhaps that is where we can kind of draw the lines between two and I think this probably going to be enough for 45 minutes of discussion. So yeah, that's perhaps go ahead.

Kimberly McGuire: So one of the people that couldn't join I'm not exactly sure I've got his name, but they also kind of meant it was interested what our current existing 3D planning algorithms out there. It's kind of made a list here which are very indoor-based. I do realize I would perhaps ask anybody of the outdoor navigation community, of course like terrain navigation. But ETS York by Jay Young's research. That's a New package, so that's really cool. That's for our navigation. Is there perhaps any other packages that people can? share here that are perhaps more for alternification.

Ryan Friedman: So I didn't find any. go ahead Mike.

Mayank Joneja: Yeah. I just wanted to clarify that we should maybe draw a distinction between existing 3D planning packages and algorithms costly speaking the real navigation is aarsh 3 star, right and when people think algorithms there's a particular class of algorithms that they might be thinking of for planning either rrd or astar direct all of that classical stuff. So maybe packages is better heading but yeah, I agree with Ryan and I was hunting there wasn't too many even I could sign.

Kimberly McGuire: Yeah, I have changed the title. Thank you very much. Yes, that's indeed. And a

Kimberly McGuire: yeah, So it's currently my own Campbell Friedman's saying terrain navigation is the only outdoor navigation back just that's purely only for out there. I must say that Hector crossroader at

least in they had some kind of outer navigation, but I'm pretty sure that they haven't really thought about any type of Earth fixed coordinate systems and things like that and Things that I'm not super familiar with but that was Bradley's like the one that I was I think introduced to the most. I've also added maybe some ones that you wouldn't maybe think about with 3D planning for UV point of view. there's also the rose one 3D navigation, which is super old. We have move it, which is claimed to be a 3D planning packages pack a horse package, but this mostly for our arms.

Kimberly McGuire: I don't know if anybody tried to actually use a move it in for drones. when I talked to one of the picnic people at Roscoe last year, they looked at me like I was a crazy person but I don't know doesn't make sense to it is an existing person for 3D planning. I don't know, but I don't think anybody had experience right anything of that one out. So if these are kind of like the existing 3D planning packages, then let's move on to the next topic. Unless anybody has anything else to add?

Mayank Joneja: I just wanted to ask I haven't really used move it…

Kimberly McGuire: Mm-hmm

Mayank Joneja: but isn't it more for the verdict arms and multidorf manipulators? And in that sense, it does satisfy 3D planning in space. But is there already a distinction between path planning Beyond inverse kinematics for a fully mobile agent versus let's say an end effector. Or does it end up being the same problem? I don't know To know if there's a distinction but that's the background I have about move it and what it was intended for.

Kimberly McGuire: Yeah, it's definitely for …

Ryan Friedman: Look at this.

Kimberly McGuire: all the examples of I've seen are for robotic arms for sure. But I would say there's a distinction between the platform and the actual problem itself. They also have to move in a space which has that they have to kind of avoid obstacles and everything and do some planning and that's of course you have also 3D planning in the enough and not enough too. So I would say perhaps is better to kind of have maybe more of a clear Cuts between us, but are you able to make it clear culture or not? I don't know. But yeah.

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Ryan Friedman: I think there's definitely one of overlap because in terms of how you represent the world in a local coordinate frame because they can plan over in Octo map. Representation which is also used by indoor navigation for drugs,…

Mayank Joneja: that

Ryan Friedman: In some cases so that the map representation at the scales that robot arm works are on an order or…

Mayank Joneja: yeah.

Ryan Friedman: magnitude is similar to a drone in a warehouse? And so you look you can use that Cartesian coordinary for those.

Kimberly McGuire: Yeah.

Kimberly McGuire: Yeah, and I guess of course they have to also kind of assume to do planning with. of course the limitations of that arm or the degrees of freedom of that arm, but perhaps and Rubble in an aerial platform also it's own degrees of freedom. Of course, if you've got culture it's a little bit easier. What if you have a flapping Wing or fixed Wing in indoor space? Not sure if that's the greatest idea but I just kind of see similar and I'm kind of surprising nobody try to do it's like something like that for friends, but there was somebody that mentioned something on the chats. Aarsh is saying that we're rather close to enough to them the move it to I think I never seen being used for floating base objects and mobile base or drums. I yes.

Kimberly McGuire: I have seen a couple of Ross answers asking if they can use it for drones. But yeah, perhaps it's a crazy idea. But let's see. if there's No more comments about that and I suggest to the next part will let me just try to see if we can get this a little bit bigger. because it's a little bit small, I would say. Yeah, the promise…

Ryan Friedman: You want to present it?

Kimberly McGuire: if I actually present it, you don't actually see any notes that I'll be taking but they are for here to slide is already finished.

Ryan Friedman: alright

Kimberly McGuire: But this is this pretty readable. I would say. okay.

Ryan Friedman: Yeah, that's fine.

Kimberly McGuire: So then the next topic is the state of 3D planning implementation for U of each which pretty much was the discourse threatens you started Ryan. Which I assume everybody right?

Ryan Friedman: yeah, it's overall local Cartesian planning is more of a self problem.

Kimberly McGuire: Yes.

Ryan Friedman: There's definitely still challenges with that in terms of handling a dynamic environment, but I think that the technology Stacks are more of more available to Planning in that kind of domain right now.

Kimberly McGuire: Mm-hmm

Ryan Friedman: tf2, right is a Cartesian coordinate system. There's no TF2 for geo coordinates.

Kimberly McGuire: So TF2, yeah, of course. Yeah, I guess all although I had perhaps a topic about that that's was wrapped. 105 it's gonna kind of with an optional how to represent that. with uf2,…

Ryan Friedman: Yeah.

Kimberly McGuire: but I don't know what's that seems to be a little more complicated than just Earth map odometry. Yeah. I don't think it's probably a little bit more.

Kimberly McGuire: Yeah, it's more data and that sense.

Kimberly McGuire: all right, So planning is more of a software and more packager. For example TF2 is for condition. coordinates only

Kimberly McGuire: I guess if you look at the transforms or conditioned coordinates only. What is the like from any outdoor navigation package? how do they solve the solution? is there any Maritime type of rust packages that are able to handle these kinds of things or that just doesn't exist?

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Ryan Friedman: It's a good question. I think I don't know maybe recess.

Rhys Mainwaring: And now that I'm aware of it, I think again most of the work assumes are locally flat coordinate space. So small range TF2 and rep105 does have suggestions for kind of Earth and mapping between the systems. But there isn't really anything that implements that well and that's the difficulty. So if you want to move from one map to another keeping track of all the local flat frames and shifting between them making that easy to use is the bit that's missing. I think the sort of conventions are there but a package that actually deals with it all is not available. And so Maritime, I'm not aware of something there either.

Kimberly McGuire: So recently I am so I've seen that you've also kind of give from the presentation on. That's the maritime group like are you?

Kimberly McGuire: do you work with you a fish primarily or is it the combination between Maritime vehicles and Aerospace vehicles or perhaps you can kind of feel a bit more about

Rhys Mainwaring: I quad Plains landing on ships. So you've got sort of various vehicles moving. But again, all of that was all local Cartesian frame. So we're not sort of moving out of sort of a 50 kilometer kind of cube type space is what you're looking at and I think the stuff that we're interested in is where the edges of that you're going to be subject to curvature. and planning over larger distances then whether it's Maritime or aerial you have the same issue in terms of Switching between sort of local maps and…

Kimberly McGuire: alrights furious and I guess what's kind of businesses do we have…

Rhys Mainwaring: things like that. So yeah, as far as I'm a win easily accessible solution to that in the open source Community anyway for us.

Kimberly McGuire: what are we kind of thinking about it's like which you guys agree on that's the cover kind of like the curvature of the earth actually Makes sense to not take care to not focus on only the global coordinate system. Is that you said 50 kilometers or is that longer or shorter or should you actually always be aware of the earth curvature? this

Rhys Mainwaring: I think the thing we've seen sort of just in some of the discussions. it's to do with the datum that the terrain data might be provided in so it's a shame Jay is not on the call because he's really the expert in this and it's his work that we're kind of adapting at the moment to try and use but he sort of said a little bit that's on the Discord topic as So different countries will use different datum for their

Rhys Mainwaring: that for their terrain databases because I mean, I'm not a geolocation expert but there will be reasons that they'll have for using one particular coordinate choice for getting accurate data. And

so as you move from one place to another you have to be sure that you're using the correct terrain database for that and that the datum all aligned and that's really the problem. So you've got the size of the area that you moving over your subject to curvature, but you've also got the choice of date and for your train database and

Rhys Mainwaring: If there's any misalignment in there, then you can be out by quite a long way quite quickly. So that's the bet that we need to be sure about is that when we're specifying a local coordinate frame that the terrain database is mapped into that correctly to the correct item and that may shift as you move from one map to another one so managing all of that kind of automatically and easily is as I think the hard problem because at the moment you can do it. By hand, but if it's easy to make a mistake, so I think to make it usable the key is going to be understanding.

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Rhys Mainwaring: What local references we want for these frames and then making sure that as we kind of switch from one frame to another we handle the conversions correctly and that most users are not going to want to have to worry about the details of how all of this works in the same way that when you use teeth too for General Corner Transformations, it just kind of works.

Kimberly McGuire: okay, so that is a feature that doesn't exist into you,...

Rhys Mainwaring: It's sort of handles all the complexity for you and...

Kimberly McGuire: too, but it needs to

Rhys Mainwaring: that's what an extension that called and it should do I think anyway you So I don't run I don't.

Rhys Mainwaring: Not that I'm aware of. No. and because you've got Geo reference data that comes with it as well. So for the aerial Vehicles, you're interested in the terrain database and potentially different quality terrain data at different resolutions. So argue pilot has a Terrain database, but we might want more accurate data for certain cases.

Kimberly McGuire: All right. Yeah. I've sent a message to Jay very quickly...

Rhys Mainwaring: And I think that's where Jay's kind of using different Corner systems according to the quality of data that they have

Kimberly McGuire: if he was trying to join...

Ryan Friedman: He had something come up this morning, unfortunately.

Kimberly McGuire: but Yeah, It's also seems that Ramon is also occupied at the moment. so yeah, perhaps that's maybe some for if I've seen him answering on the thread. So maybe that will be a good thing again if you put on there. so

Kimberly McGuire: of course.

Ryan Friedman: And so what that means is it's an oblong sphere. and it's symmetrical and there's just a few parameters you use that you can just hard code in your firmware to do conversions between the

frames between that and Cartesian and so that's pretty easy to do on an embedded system and all the GPS is report in wgs84 pretty much…

Kimberly McGuire: Could you maybe spelled out for me?

Ryan Friedman: but the

Kimberly McGuire: It's like ASAP ETF. No, it's not something else, right?

Ryan Friedman: Yeah. Yeah, very WG said…

Kimberly McGuire: yeah. Yeah. Okay. Yeah.

Ryan Friedman: if wgs84. And so that's like what's on the wrap is hey if it's in wgs8 for our frame, then you can put that in the frame ID. So the problem is that That's not very accurate for the Earth and there's other coordinate systems. that use the gravitation field and they're not symmetrical about the Earth because the Earth is not symmetrically dense or the same width, so sorry about So that the difficulty is that some GPS receivers support some other datums. And you're trying database might not be in the same data.

Ryan Friedman: And there's not really a good library that we can Use for planning to convert between these datums.

Kimberly McGuire: all right, in a Then date and…

Ryan Friedman: They're

Kimberly McGuire: conversion if I'm running something wrong. I said. it's

Rhys Mainwaring: Ryan do you say does g down and…

Ryan Friedman: that's right.

Rhys Mainwaring: geographically not handle this sufficiently or is it more the fact that it's not wrapped up as a Ross package to use easily.

Ryan Friedman: I think there's two challenges one that Jay said was regarding embedded. this isn't something that the autopilot can do and really you want the autopilot to know where it is relative to terrain, so it doesn't run into it. There's a very few people right now that are doing a real-time Ross too and a safe Manner and they rely on the autopilot to do that. But if the autopilot doesn't know where it is, then you're sort of saying. All right, we're gonna trust our companion computer. Can do everything in the right amount of time and never crashes and for the rest code right now isn't. necessarily designed for critical even on small and mad drugs

Kimberly McGuire: Yes difficult to rely on campaign computer alone. So I guess it's okay and…

Ryan Friedman: yeah,

Kimberly McGuire: trust issue as well specially if you talk about regulation. Let's say then I guess they won't let something fly unless it's foolproof, let's say yeah.

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Ryan Friedman: Yeah, and so that's one thing is that it's not available usually for embedded because it's a lot of data like this device here is the Trimble px1. It's a gnss receiver that gives you one centimeter position globally. In Earth frame and it supports two different coordinate systems wgs84. And what's the other one? E egm96 and it has a database on it to how to convert between all those. But it only supports those two, right? So if you're terrain data isn't in either of those datums, then you can't really convert.

Kimberly McGuire: wow, that is

Mayank Joneja: yeah, I had a point it might be important to kind of

Mayank Joneja: Specify the operational envelope where all these concerns become valid what the resources doing? And what we're trying to do here is kind of very challenging for fixed ways. So you can't even arbit really position it in the Z access you need to do lighter maneuver design go up and down in height and mountainous terrain, but let's say somebody's working on a much simple use case of using a quadcopter which has an endurance of only up to a few kilometers. It might be important to draw the distinction that these are the factors of the use case that we considering which warrant these discussions or these design decisions and kind of this is the expansive operational because I think came already asked this sort of question that hey when does it become important that we consider the curvature of the earth? Maybe it's the order of 50 to 100 kilometers, or maybe it's X number of kilometers anyway, but yeah, it might be important to specify that because for several outdoor use cases, which are let's say just doing mapping of a farm.

Mayank Joneja: Which is a very small size one these concerns classically have not really come up. So I think for context when we're doing 3D planning, it does become very important to set the use case right as to why we're going into literally pushing the boundaries of the systems that exist today. Just for context for a lot of people who come across these packages and look at whether or not it satisfies their use case and whether it's relevant or not.

Kimberly McGuire: All right. Anybody else has something to add to this discussion?

Ryan Friedman: Yeah, I think maybe it's important to note a lot of the autopilots use a relative to home altitude. For all the mission management although when you do waypoints and argue pilot by default. You do the altitude relative to home because your GPS initializes and even if you're on a different data that's basically fixed offset for most of the application. So it doesn't really matter. And that's a way around the problem. It's just to use relative coordinates to where you took off from.

Kimberly McGuire: Yes, instead of absolutes. which is a lot more prone to these conversion errors. And yeah,...

Ryan Friedman: Yeah.

Kimberly McGuire: that makes sense. I guess in the navigation that's usually also relative. true

Ryan Friedman: Use case I give for concrete use case was drone delivery. Because you need to take off from a certain place precisely fly a significant distance and then go back down to the ground to drop something off. And unless you just say hey, we're a quadcopter and we're gonna descend vertically and use a Laser Rangefinder until we kind of terrain. Even if it's 100 meters different than what we thought it was we'll drop the package once we get, two feet from the ground. For planning purposes, the problem

that we're running into is airspace. So in the US for right now at least you're limited to 400 feet for commercial operations.

Kimberly McGuire: 400 for our kilometers

Ryan Friedman: yeah, 400 feet vertically, which is a hundred and 130 meters or something.

Kimberly McGuire: Okay, …

Mayank Joneja: Feet yeah.

Kimberly McGuire: Yeah because of four on it. I thought like you said 400ks. Whoa, that's a lot.

Ryan Friedman: Yeah. so I mean Yeah,…

Mayank Joneja: It's

Ryan Friedman: so you have 130 meters vertically that you can be from the ground and the terrain database that the autopilot uses has an uncertainty of plus or minus 30 meters.

Ryan Friedman: So you need to already fly 30 meters or I think it's 30 don't come in these numbers. I'll look them up again. yeah, so you cut that down by the uncertainty that you're trained database and then you take into account the operational constraints of your vehicle. Right that you can't climb as fast as you want. And so you're flying towards the mountain and you have this airspace and then the mountain gets really Steep and you can't go vertically so the only way To get around this is to start circling and fixing. And that's really what train navigation can plan for. And the autopilot can't do this because the math is too complicated.

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Ryan Friedman: So what the autopilot does is it does like a look ahead? And it says based on my climate. I need to start climbing when I get to hear so I can get above the mountain.

Ryan Friedman: But then it's going to breach your airspace. So we'll fly legally.

Kimberly McGuire: All right. Yeah, that's explains a explainable i.

Ryan Friedman: Yeah.

Kimberly McGuire: Yeah, I feel sympathy for you guys dealing with other navigation. This is one of those things that's just going on top of all their airspace regulations as yeah. It seems like indoor navigation for error…

Mayank Joneja: I link in the chat…

Kimberly McGuire: but much easier but yeah.

Mayank Joneja: what Ryan's saying. So from J's research which shows a very nice demo of various planner works and how it does allow item Maneuvers and all that which is listed on GitHub as well on the very navigation level. So if anybody wants to kind of get a feel for what Ryan's is described right now, it's a really nice video to kind of I think in the Swiss Alps, he's done a planning demo of how the companion

computer would be planning complex tragic trees which typically wouldn't happen on the side computer itself to handle this case of having a fixed Wing which gives you the endurance that you need but has a drawback that it's unlike a quad Cooper. You can't just position it arbitrarily you need to do certainly if you want to stop in one place or if you want to ascend or descend and…

Kimberly McGuire: Okay.

Mayank Joneja: change order to gracefully. So yeah those kind of constraints

Kimberly McGuire: All right. Yeah. Thanks for the link. I put it in the slides and cool Is there anybody else that would like to share? more about the current state of 3D planning for UVs We're going to have more topics later as well. So we're probably going to mention some of it.

Kimberly McGuire: If not, then I'll be going to We've been talking about the burd Of autopilot sweets already. So I've kind of moved this up because I think this might be a little bit more. Thing to talk about specifically what should be handled by the autopilot. And what should be handled by a compiling computer? And I guess we can already put in here these complex flights maneuvers. to avoids Illegal, or or obstacles

Mayank Joneja: Adding perception. They earn basic Optical flow. If you're doing anything which is like slang or intense perception stuff. I think that's usually the number one reason for offloading to the Banning computer because processing rgbd data or camera data for obstacle avoidance or anything like that. So anything which doesn't have to be real time to the order of actuator control, I guess down to microseconds but is important enough for let's say one second Horizon. I think that sort of falls in the purview of the companion computer as far as I understand.

Kimberly McGuire: Yeah, I think I've read a paper. But once that's At least the autopilot should be able to deal with things on. microseconds type skill, although couponing computer can do much slower perhaps Yeah, how do you say maybe a hundred microseconds or kind of really depends how quickly you want to have it? But yeah, can be a Let's say slower feedback loop.

Mayank Joneja: I think you had a nice light on that from Ramon stock as well. I came where the low level stuff is done by the fry controller and then a slightly high level behavior is on the companion computer and let's say if you happen to be in a luxurious environment where you have This link to a base station that even higher level behavior for Mission. Yeah did this stuff? I think this sort of covers it no.

Kimberly McGuire: Yeah. Yeah, yeah, I guess of course this is very broad. I would say for the difference like trajectory control on High level control. Yeah, it's something that can be handled on the coupon computer…

Mayank Joneja: yeah, because

Kimberly McGuire: but you can also have for instance directory control all happen on the fmu. So yeah, that's a bit of choose this

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Mayank Joneja: I think the exceptions start happening when you start hitting limits of processing or memory and things like that, Maybe they'll come companion computer is needed because the fmu just doesn't have enough RAM to hold the entire space representation in memory. You're talking about 3D now,

there are oxidative that play even if you're doing slightly lower resolution. It might not be reasonable to assume that you would want all that sitting on the fmu. Of course these sort of statements go out fast and…

Kimberly McGuire: No, yeah.

Mayank Joneja: really quick as soon as we go from an edge 7 to and I'm cortex a suddenly becoming Could and nfmu in let's say five years from now, but as Ryan increases Things become better and all of that but I think generally speaking is fair to say that data intense applications heavy compute, which may be requires embedded gpus or a lot of single instruction multiple data assembly kind of stuff is better left for computer companion computers while low-level stuff which is death or safety related is better offloaded to the fmu.

Kimberly McGuire: yes, although the safety is also sometimes also kind of really rely on the map data and what's like or what position you're in so I guess the fmu should be at least aware. of it and…

Mayank Joneja: Yeah.

Kimberly McGuire: it needs to be accurate if you're Flying in a space which has a geofence and due to perhaps you're comparing computers I'm here completely off and then suddenly there you have some other elements on your platform. it has some kind of trigger if you cross a geofence. It's fall of the yard and You're kind of screwed this so yeah.

Mayank Joneja: I think That's a very valid concern about interfering systems when it comes to fault tolerance of fault trees. what if the fmu says one thing and the companions is another do you have conflict resolution mechanisms, or do you have override mechanisms or some inherent priority? I think that's definitely a major discussion in safety because you can either have a hierarchical system of control or Battery fails type intelligence says Hey line now, but let's say if you're off by a couple of meters a geofence breach is not as bad as stuff catching on fire. So it's kind of like you need to have a hierarchio Falls, I guess.

Kimberly McGuire: Yeah. Yeah true. Although I think with you very depends on the country that you're in but in some usually have to two layers of to you fencing you need to kind of have something or go back and final geofence that you would just need to get. It will just shut off completely so.

Mayank Joneja: Yeah. Are they blast your Reagan?

Kimberly McGuire: yeah, that's also a geofence a bit more externally executed. Yeah.

Ryan Friedman: Okay, could we had a column for What's a burden of both sweets ideally and to me Both need to be responsible for having idea of the terrain as well as the airspace. or geofence

Kimberly McGuire: Wait soloons.

Ryan Friedman: because both need to know about Essentially the operational space constraints of the vehicle…

Kimberly McGuire: So it's for both.

Ryan Friedman: which was terrain airspace and geofence at least right now. Maybe there's other things later, but that's the key ones. that if you're

Kimberly McGuire: Yeah, what was the first thing you said terrain geofence and was one more thing. airspace constraints yeah

Ryan Friedman: there and airspace constraints right Yeah, which is similar to geofence just that once you control and one's controlled by your government.

Kimberly McGuire: Yes.

Kimberly McGuire: Is there any other burdens with both the Mau and…

Mayank Joneja: did

Kimberly McGuire: the companion should be aware of?

Mayank Joneja: is the velocity or acceleration usually something that is regularly?

Ryan Friedman: So yeah, They both need to know where the vehicle is in space.

Mayank Joneja: not just your localized but let's say I have a quadcopter at two kilograms it carrying some payload because crashes would usually come from the momentum of the crash like mass times velocity. So maybe it's not legally allowed to fly that 200 kilometers per hour you might have the capability to do so, but as a part of the operational envelope, they might be a maximum velocity in addition to just the geofence of XYZ of that long way and time as well. Yeah, certain geographers that I there a flight map gets approved only for a certain duration and things like that, but I feel like velocity might also be something that gets regulated.

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Kimberly McGuire: That's another kind of go around the operation space constraints, but I can add full of maximum velocity or something like that. I think that's usually what they are aiming for acceleration is not so usually what they put constraints on. But yeah velocity I can imagine.

Kimberly McGuire: So is there anything else that we can add us a burn of either the coupon computer or Or both?

Ryan Friedman: I think it's to be determined where the datum translation lives.

Kimberly McGuire: Yeah, I guess let's make another column on. let's say We're just the day that translation happen and…

Mayank Joneja: this is

Kimberly McGuire: do you mean with that? for instance the map conversions like what you have developer notification, or what do you mean with data translation?

Ryan Friedman: Yeah. the date datum with an m

Mayank Joneja: Adam

Kimberly McGuire: Datum, I was like data.

Ryan Friedman: Yeah.

Kimberly McGuire: Okay, date and translation happen, okay. So yeah.

Ryan Friedman: Because the GPS can do it the autopilot could do it or the companion computer could do it or all three?

Kimberly McGuire: And we're gets one All Rights Okay, I think that's probably good for now. Let's move on. We have about 10 minutes left. So that's Move on to maybe Perhaps I was supposed to make a bowl for this, but maybe people can just do. Yeah, let's say. and heart if you're born in their person a navigation person or a party thingy if you're other person kind of give an indication of so for instance I'm more of interperson hearts. So I see three hearts. there's no outdoor like the other party

Kimberly McGuire: one or the households. Yeah, Ryan is send it outdoor. Yeah.

Kimberly McGuire: All All right.

Kimberly McGuire: I see a couple of race hands. There was it for a question, or was it for indicating that your indoor outer?

Kimberly McGuire: So it seems to be a bit 50/50. I feel at this moment. Perhaps a little more indoor navigation people don't know so of course, I would just put what's Art of things that indoor people navigation have to worry about compared to outro navigation. I would already put in here we don't have to worry about the curvature of the Earth.

Kimberly McGuire: So that's an obvious one. and fixed wing vehicle that's usually not indoors. But what else if anybody can just learn something else in this brainstorm?

Mayank Joneja: Outdoors of GPS That's the biggest Advantage you have right?

Ryan Friedman: I'd say like that.

Mayank Joneja: How do people have GPS and that's also much indoor guys have to put 3x the amount of cameras and different sensors and Vio and slam and all that just to figure out where they are. And even then that's not enough and sometimes environments. Don't allow you to put Positioning Systems like let's say What's the popular one RX base Ultra wide band? Right? Uwv is not always on the table. You might have to do something with either a ruko markers or just with features and the warehouse and then suddenly you're staring at an empty wall and everything goes to s*** because they're not enough features in the environment. That's something that outdo folks didn't have to worry about they can fly over grass because they have GPS we guys look at grass and it all looks the same and copter crashes down.

Kimberly McGuire: Although I would rather have a grass than how do you say navigate through a hospital?

Mayank Joneja: Yeah for sure.

Kimberly McGuire: Gradually says texture that's more texting anything system in place. Yeah.

Mayank Joneja: Yeah.

Kimberly McGuire: so as they have different system, but it's also like rtk friends, but you have to kind of at that outdoor also has features for optical flow if you need that. more natural features

00:45:00

Kimberly McGuire: what are I guess this is found that just for outdoor is

Mayank Joneja: They have to deal with the Indoor usually went wind is not a concern…

Kimberly McGuire: wins

Mayank Joneja: unless you're working with crazy 5 I guess and you turn on that one fan.

Kimberly McGuire: The don't let the crazy fly to this the creation Lucky Block is very bad.

Mayank Joneja: Yeah, I mean…

Kimberly McGuire: Yeah, air conditioning is also very bad for gracefully.

Mayank Joneja: if you have something which is a couple hundred grams, yeah.

Kimberly McGuire: So I have to handle with winds. And I would say outdoor also has to handle with more regulation as well.

Kimberly McGuire: Tricks regulation. I don't think there's any regulation for Enterprise it's kind of up to the university or Institutes

Mayank Joneja: End of Lights usually are around people. So that's a big disadvantage our door flights. You can very easily clear the tree line or clear humans. You might have to worry about power lines and things like that, but it's not a valid concern that you might bump into people or things like obstacle avoidance is I think a bit easier and more conservative to the point of maybe path deconfliction when it comes to indoors. It's a very proactive and then essential element of your navigation stack that hey there's gonna be stuff you're gonna bump into is going to be wall effect. We're gonna bump into other robots.

Kimberly McGuire: more obstacles like, static and…

Mayank Joneja: And dynamic. Yep.

Kimberly McGuire: dynamic although it really depends a brand Electronics cannot really join the commercial airspace if there's any People just have to handle with planning with actual commercial airlines they'll probably say there's a lot of stuff in here. But of course, there's more. wiggle room.

Mayank Joneja: And at least slowly you need utms for coordinating all the drones in the air.

Kimberly McGuire: Let's say

Kimberly McGuire: yeah.

Mayank Joneja: But as of now where we are like going to be getting Is this harder indoors?

Kimberly McGuire: All right. Anybody else have more to add?

Bonolo Mathibela: I think one of the biggest challenges at doors is the risk of flyaways. And even…

Kimberly McGuire: yeah.

Bonolo Mathibela: if you have a geofence, there's always that small chance that something goes wrong and you're drawing disappears and you can't get hold of it. So I think people who work Outdoors have to have a lot of redundancy in the safety. So you have to make sure you've got an emergency stop that you can regain manual control. That your columns is always up and running that you have your geofence. You just have to have so much redundancy.

Kimberly McGuire: Yeah, that's up could be true. I've participated with some outdoor competition and I haven't participated but I watched outer competition for you of these. Yeah, I've seen something probably the government.

Kimberly McGuire: A low flyways, let's say not good. Yeah, so it's a risk fly away. It's a lot of redundancy say these steps anybody else wants to add something to this.

Ryan Friedman: I think indoor generally is more Dynamic environment. You have moving things that you need to account for whereas outdoor aside from other vehicles. Things are pretty static.

Kimberly McGuire: Yes, I think we already mentioned that before…

Ryan Friedman: Not a lot.

Kimberly McGuire: but it's also good to Death for outdoors indeed. Yeah.

Kimberly McGuire: I think it's fine for now because we getting a little bit. You should like to start finishing up five minutes before. Let's say we still have something about standardization because there was a mention it's very difficult to coordinate other autopilots for roast usage. So I guess the question also here is in terms of navigation where to apply standardization what needs attention. is there anybody that would like to comment on us to give some forces why it's so difficult let's say How you called the outer pilot agnostic navigation messages?

00:50:00

Ryan Friedman: Yeah, I mean I think gold communication is something that's not solved and how do you communicate and navigation goal from a high level? companion computer to a little autopilot It's not waypoints.

Kimberly McGuire: Yeah, so you're not What is then the difference in your opinion about between the goal and a waypoints?

Ryan Friedman: a goal so in navigation, if you look at what Jay did he has a panel that you can select it and location that you want to be at but it's a 3D vector and so we don't have a UI to do that right now. And there's not a standard Ross message for communicating. that I know of

Kimberly McGuire: And So Waypoint is it needs to go there no matter what it's not the end goal, but it's kind of part of the path planning.

Ryan Friedman: Yeah. Yeah.

Kimberly McGuire: Okay, yeah.

Ryan Friedman: It's different than a waypoint, right?

Kimberly McGuire: Sorry.

Ryan Friedman: It's sort of like a waypoint, but you might have a vector that you want to be facing when you get there. and I think it's just important to note that In arviz,…

Kimberly McGuire: Mm- Yeah.

Ryan Friedman: you have a 2d nav goal, but you don't have a 3D Naval. supported yet

Kimberly McGuire: Yeah. I think that's our office only 2D goal Available, but I guess that's also an aft to plug in. Let's say for only enabled that's

Ryan Friedman: yeah, sorry enough to yeah, and then another thing for me was the Assumption about datums right now and all the map link messages.

Ryan Friedman: They just say it's an absolute frame, but they don't say which one.

Kimberly McGuire: Yeah, okay. So that's from the MFE Messages but yeah.

Ryan Friedman: Yeah.

Ryan Friedman: and I think it's assumed you're in WGC for

Kimberly McGuire: It doesn't say which formats? And the last thing you said it's now standard for wgs 84. Is that what they assuming?

Ryan Friedman: Generally, yeah, but I don't think it's a great assumption. And at least needs to be documented better.

Kimberly McGuire: One moments. Let me say it's It's not Also not mentioned. Luckily. We have a transcript of this all because I'm a terrible notice. Let's say

Kimberly McGuire: All right, so it will be quite difficult to use 3D goal in office. There's no property of procession using in 3D. Yeah, that's indeed. An issue and I think Ryan has already left for the next meeting. So

Kimberly McGuire: so I think it will be good to kind of close things off in here because I think we've discussed. Plenty and at least we know kind of what is wrong and there's a lot of work have happening in at least the outdoor navigation parts. So let me just Do some final announcements for this meeting. But before I move on is there anything else that everybody just likes to? Add just one sentence. then

Kimberly McGuire: but also we have that nice threads of 3D planning that we can also add some of our ideas or comments as well. So let's kind of start to wrap up this meeting. we had a lot of developments in discussion meeting about different topics. And these are all the kind of like the ones that had done behind. It's the ones if we have already had a meeting about so the kind of looks like other body switch for

UVS Safety Management Systems legal legally and airspace access error of vehicle types, but let's see we have to of course start dealing with these

Kimberly McGuire: Yeah, probably next year because I think the last meeting of this year. I would maybe talk about what's next and it's already groups that we can start. So the upcoming for meetings is we only have three for this year 3D planning now, we have a presentation meeting ill next up in two weeks and the discussion meeting about just kind of a wrap of the So next meeting is going to be about autopilot and roast by Ryan. I hope you still available. But he said yes. So and that's on the six of December at 3pm Universal Coordinated Time. Also if you would like to

00:55:00

Kimberly McGuire: May add a presentation or give a presentation or just talk about the topic that you find important that we should talk about. Please send me an email or Ramona email so that we can kind of find you in foreign presentation meeting in the new year then it's going to be in general for sure. And we have a GitHub repository for those that don't know the GitHub organization where we have some information pages are that you can add yourself ads Community SM member and also as I said already showed before we have the projects pages of difference of topics that people are already working on for now just 3D planning. yeah, so that is pretty much I'm going to close the recording and I would like to thank you all for joining and participating with this discussion.

Rhys Mainwaring: Thanks Kimberly.

Kimberly McGuire: Yeah, thanks.

Meeting ended after 00:56:26 👋