SBIR Market Research Session 0 Flight Test and Measurements Techniques
June 30, 2015

Hello. Thank you for joining us. I'm Mike Dudley, the director of the NASA aeronautics research Institute and also the representative before the NASA SBIR. -- Small business innovative research. This broadcast is intended to provide interested viewers information regarding some of the technologies that NASA is interested in pursuing. This was intended to be an interactive session with the participants online hearing about NASA technology and providing their comments and observations and perspectives. Regrettably it appears that the publicity for this activity was not as good as we had hoped and I see the 2 participants online are listed as Bill and gray -- thank you for joining us. It looks like the primary purpose of the exercise is going to be to provide our speakers to talk about NASA technologies and this session will be recorded. If you are viewing this after-the-fact, we would encourage you to please respond to the email provided with your comments and suggestions and we will answer those and respond to those comments off-line.

With it that I will go ahead and introduce Starr Ginn, the representative who will speak today. Starr is at the Armstrong research center and coordinates and manages future goals that align with the NASA Mission directorate and Starr is also the center part point of contract for the hybrid electric portfolio and the aeronautics systems project at Armstrong. Starr has a BS in mechanical engineering and Masters from UCLA and she is a wonderful person and it has been a privilege to know her and I'm going to let her start to speak now. Please take it away, Starr Thanks. What I'm doing is -- I'm going to go over the particular sub talk at -- topic that I am managing. The flight test and management subtopic.

There are several subtopics. There is also one that is like a partner subtopic -- the ground test measurement capability. Both are similar in that they are looking to -- ideas to help support the flight test capabilities at NASA and other companies who have similar capabilities and hopefully through these activities of a finding these technologies that we are looking for there is not only a specific benefit to what NASA is working on but an opportunity to spin off those technologies to something that can get into the industry for all different kinds of applications. The flight test and measurement technology supports the flight research elements -- maturing technologies. They are being done in the fundamental research which includes developing test techniques that improve the control of in-flight test conditions, extending measurement and analysis methods, improving test data acquisition and management with sensors and systems that have fast response, low volume, minimal intrusion, and high accuracy and reliability.

The flight test measurements technology subtopics is funded under the IAFP program -- the integrated aviation systems program. Specifically the project under that program is the flight demonstration capability project which in itself supports a wide variety of flight regimes and vehicle types ranging from low speed, sub sonic electric propulsion, transonic civil transport and supersonic civil transport. This solicitation can cover a wide range of flight conditions and aircraft.

Nassau also requires -- NASA also requires measurement of airtime and get flight control and propulsion system characteristics. The data will be used to provide test conductors the information to safely expand the flight and test envelopes of aerospace vehicles and components.

Several of the specifics of this technology -- we'll get into this at the end. This is some of the motherhood -- the stuff we are talking about -- why this subtopic exists.

Recently there has been some independent review teams looking at the flight test demonstrations in capability portfolios and one of the quotes mentioned is the strident -- drive-ins FTP is a unique capability focused on enabling one-of-a-kind research flight projects the existing infrastructure unique location and export capabilities are national asset with no other NASA center able to provide capable -- comfortable capabilities.

This proposal should be significantly enhance the capabilities of major government and industry flight test facilities comparable to the following aeronautical test facilities: the Dryden aeronautical test range, support aircraft and maintenance operations, flight load lab and simulation lab.

Here we have a picture of how those all come together. They really aren't completely independent of each other. These facilities are used for the airworthiness process to get an airplane to flight. There are some isolated events that happen in each of the facilities. People can just tap into specific technologies they are trying to help. The overall purpose of these facilities is for safety of a flight for doing flight research and flight test and flight demonstrations activities.

You can see the picture of the test range and that provides the control and monitoring communication and special use airspace for the support aircraft and again the support aircraft are secondary aircraft used from a safety of flight perspective for the actual research aircraft but there is also test techniques -- flight test techniques we use them for to do in flight simulations for new research ideas were trying to explore before we get to a flight vehicle.

Then there is the [indiscernible] were we to all of the structural dynamic validation to update all the analytical models for going to flight so that we understand what the flight envelope is for that research platform. There is the test aircraft that I mentioned -- the center point for all of these facilities to help and the flight simulation is always a precursor to most of the flight activity that we to where we have a pilot in the loop -- flight simulation -- to give them the right system awareness of what they are going to be able to fly. It gives the researchers an opportunity to test their models to make sure there are the correct handling qualities for control. Taking down each of those test ranges shows the different capabilities that exist for that particular asset. These are used for tracking long-range telemetry communications. Some are used to help check the international space station. There is real-time data processing that has real-time is sensitive topic here. The data is within a millisecond of being real-time from what is happening on the airplane.

There is a couple of control group that we have here. All the disciplines like a row and structures and controls and propulsion's and the aircraft systems and instrumentation engineers can fit and monitor safety of a flight and mission critical parameters.

Next -- the support aircraft that we currently have -- three teams -- we have three [indiscernible] and T 34 and a G2 golf stream and each of these -- if I were to show a flight envelope each has a critical area that they support in the flight envelope depending on where the research needs to occur -- whether it is supersonic up to mock .2. Down to smaller UAVs or X 56 which is down in the 100 not or 120 not regime. -- The flight simulation lab has several capabilities. It uses engineering simulations which include nonlinear 6 degree of freedom real-time pelleted and that's capability and hardware in the loop capabilities which we refer to as iron birds. Several of the projects that we conduct will set up the actual relative systems that are in the airplane in the lab hooked up to the flight simulators so not only can we to verification validation of those systems or safety of a flight we also can use those systems as we test and find issues in flight and we can come down and troubleshoot those systems in the ground in the loop set up which saves a lot of cost and time instead of trying to troubleshoot in the air.

The lab is also used for design in-flight performance evaluations. We have a low boom simulator -- different companies are looking at the stability control of different elongated shaped supersonic airplanes and it is also interfacing with flight hardware as I mentioned. It can interface with standard 1553. AR Inc. for 29 ethernet and RS 232 and 422 and input and output and PCM streams.

Lastly, the load lab capability as I mentioned before you have structural loading. Thermal loading. We develop different kinds of instrumentation in the lab for uses that we can't find on the market. Then we can do structural of valuations like ballfield spatial information and Paul's tomography for nondestructive evaluations and acoustic emission sensing for damage detection. There's also a lot of off the shelf and homegrown data acquisition capabilities that we've developed that can record up to 2000 channels.

With the subtopic areas of interest that we have currently are looking at high-performance, real-time reconfigurable software techniques for data acquisition and processing associated with IP-based commands and/or IP-based data input and output streams.

So, besides telemetry -- that obviously is telemetry and we have different capabilities of doing that from the grant to the airplane or satellites to the airplane or airplane to airplane communication. Also exploring airplane to ground based network communication.

Another area of interest is high efficiency digital telemetry technique and/or system to enable high data rate, high-volume IP telemetry for flight test. Obviously our telemetry streams are limited on bandwidth and their frequencies we get in the range and so any capabilities to collect more data which engineers always want -- to be able to fit within the bandwidth of the telemetry stream is always of interest.

Another area is improved time constraint situation will awareness and decision support and integrated cloud-based services for real-time decision-making. We currently have a capability we are developing called virtual presence which allows for the real-time data on the airplane to go -- connect to the cloud-based Web services and now we are calling it near real-time. Any safety of flight calls are currently not allowed to use that because we haven't validated the time delays right now. They might be used one or two seconds. So, we are using as an extension of the control room to give other partners and other centers access to real time flight capabilities but obviously there are also other spinoffs that we can use that for to get instrument -- information across the country or for people on the ground to actually push data up to the airplane either just to get the airplane information or to try to control the airplane.

Another area of interest is intelligent health monitoring. There are many areas within the NASA portfolio not just in one project looking at electric propulsion and there are different capabilities being set up for different kind of test beds whether it is the round testbeds from single component technology to complex system integration testbeds as in the iron birds that I was mentioning where you have the hardware in the loop and flight simulator capability. And with that the realm of information that for such a new area doesn't exist for verification and validation of these systems in the input and output interfaces to manage the entire system. Control the entire system. The health of the system. So that a controller can manage that implied that the pilot noticing much is going on.

Another area of interest is a method for significantly extending the life of electric aircraft propulsion energy systems. As a complement to the previous one we talked about there is also test techniques for conducting quantitative in-flight boundary layer flow visualization, global surface pressures shock wave propagation surely are in the photography, near and far field sonic boom determination and atmospheric modeling.

We've had a lot of work over the past decades of coming out with the best ways in-flight test techniques and instrumentation to try to get closer to the Fidelity of the data and so it's a lot harder in-flight. You can't just take a wind tunnel instrumentation capability for flow visualization and take it to flight. This has to be very robust for those environments that you see and the opportunities where you have places to mount instrumentation to not affect the flow or cameras are imaging techniques that are out of the area of interest can be quite challenging.

Next -- more areas of interest are measurement technologies for in-flight safety -- in-flight study and unsteady aerodynamics, juncture flow measurements, propulsion airframe integration, structural dynamics, stability control and perform propulsion system performance.

As we move to future aircraft configurations we are moving away from optimizing single discipline technologies and looking more at multidisciplinary interactions and there is still a lot of work in the appropriate way to measure and record those types of configurations and how to juncture flows. This has become a new area with ideas with solutions that look like [indiscernible]. The wind tunnels are looking at how to understand how to record the flow of facts and so in the flight test and measurements technologies were also looking for how they are going to win tickets to flight.

This another area of interest for remote optical-based measurement technologies. Enabling simultaneous spatial temporal measurement capabilities in the infrared wave bands. Their desire to excess technology and propulsion efficiency and to evaluate impacts to the environment.

Second to last is miniaturizing fiber-optic fed measurement systems with low-power requirements. This is desirable and for migration to small business class jets or UA S platforms. There has been very successful technology transfers through the SBIR realm for fiber-optic sensor systems and they've gone from being desktop lab capabilities to handling the same sized systems going into an aircraft environment and regularizing lasers can be challenging and not very cost effective. There's been a lot of development work on how to make those places more robust and less expensive to develop and put into the system and of course at the same time we are always looking for ways to get more fiber-optic information into smaller packages for a variety of sizes of aircraft.

Last, the innovative techniques that enable safer operations of aircraft. Some examples would be work that we have in the flight load lab which is the nondestructive examination of composites through ultrasonic techniques.

There have been a variety different methods to do that and it's a good opportunity to work with -- it's one thing to figure out how to do it on small components but want to get into very large aircraft penetrating an entire aircraft it can be a lot harder and when we look at technologies that we are expecting to have some yielding or possible failures and flight three important for us to be able to turn around and get them back up in the air as fast as we can to keep proceeding with the flight research. Obviously, for a commercial capability you would need to have something that was a quicker turnaround for larger air or reread transport vehicles or something that you could have that is evaluating the in-flight in situ information feeding back to a health management system.

That's the last slide. I don't know if we had anybody been joined their wanted to ask any questions.

We can take those now.

It looks like we had a couple of people join. I don't know if you recognize the names in the list -- suspect you know Grade.

Yes.

I'd like to open it up to anybody just we are a small enough group -- if anyone is on the line -- if they want to speak up and ask a question or make a comment, feel free to do that.

Josh has a question.

I'm sure you can read this but I will read it as well. The question is, while it is technically a preflight activity is this subtopic most appropriate for innovation and ground vibration testing? The technology seems to focus on when to -- windtunnel technology.

This topic -- there are ground testing capabilities that people develop maybe to research different kinds of structures. What we use the ground testing for is a bases -- basic safety of flight. Once there is an analytical structure it becomes real -- what really is a being built up certainly has some errors for what we are hoping in the beginning and for us the ground vibration testing is a way to prepare the updated models so that we can reevaluate the flight envelope and get the flight. Obviously, faster ways to do ground vibration testing or less time or easier ways to do soft support systems and boundary conditions to get the flight is of interest. This is usually right on the heels of everybody waiting to get the flight and there have been slip in the schedule and everybody wants the next activity to make up the slip. We are usually under the heat during that timeframe to get things done. There have also been ideas that people of had in the past of how much of the flight testing could we possibly get done through something similar to a bound -- ground vibration test. This is been explored. I don't know if there has been any technology transferred from the small business on that topic but that is another idea of how to use this testing. Does that answer your question, Josh?

Yes. Thank you.

Anyone else on the line or on the chat that wants to contribute a question or comment?

I will take that as a know unless you are on mute -- if you are, unmute and speak up.

Starr, did you have anything else you wanted to add?

No.

Mike, can you please close this?

Again, thank you very much, Starr, for sharing this information. An excellent overview. We will post this on our Internet site and archive it. For future reference. This is so people can see that a later time. If you are viewing this at a later time I strongly encourage you to provide your comments, questions, observations to the email provided above in the chat window. We really would appreciate any feedback you could provide.

The intent here is to share the technology that NASA is working on and get a sense of what the general public thinks of our programs and in this case were specifically talking about the flight test measurement techniques and technologies. So, Starr, you've done a great job and I appreciate your time and effort to participate. Again, anyone viewing this at a later date, please strongly encourage you to participate in -- participate and interact. We suspect this will be the last online session. We have additional information posted on the website where people can go and read basically text descriptions of some of the other technology areas if you have an opportunity to do that and comment on any of those areas. We appreciate that. This has been kind of a pilot or experimental activity that NARI has engaged in to try to be an online or real-time interactive request for information from people outside NASA and we hope that we are able to do a similar exercise in the future and hopefully get the word out a little sooner or have a little more advanced publicity to get more participation. With that I wanted to thank everyone for their participation, especially you, Starr. Thank you so much. We will now bring the session to a close.

Thanks, Mike.

Thank you, Starr You're welcome.

[Event concluded]