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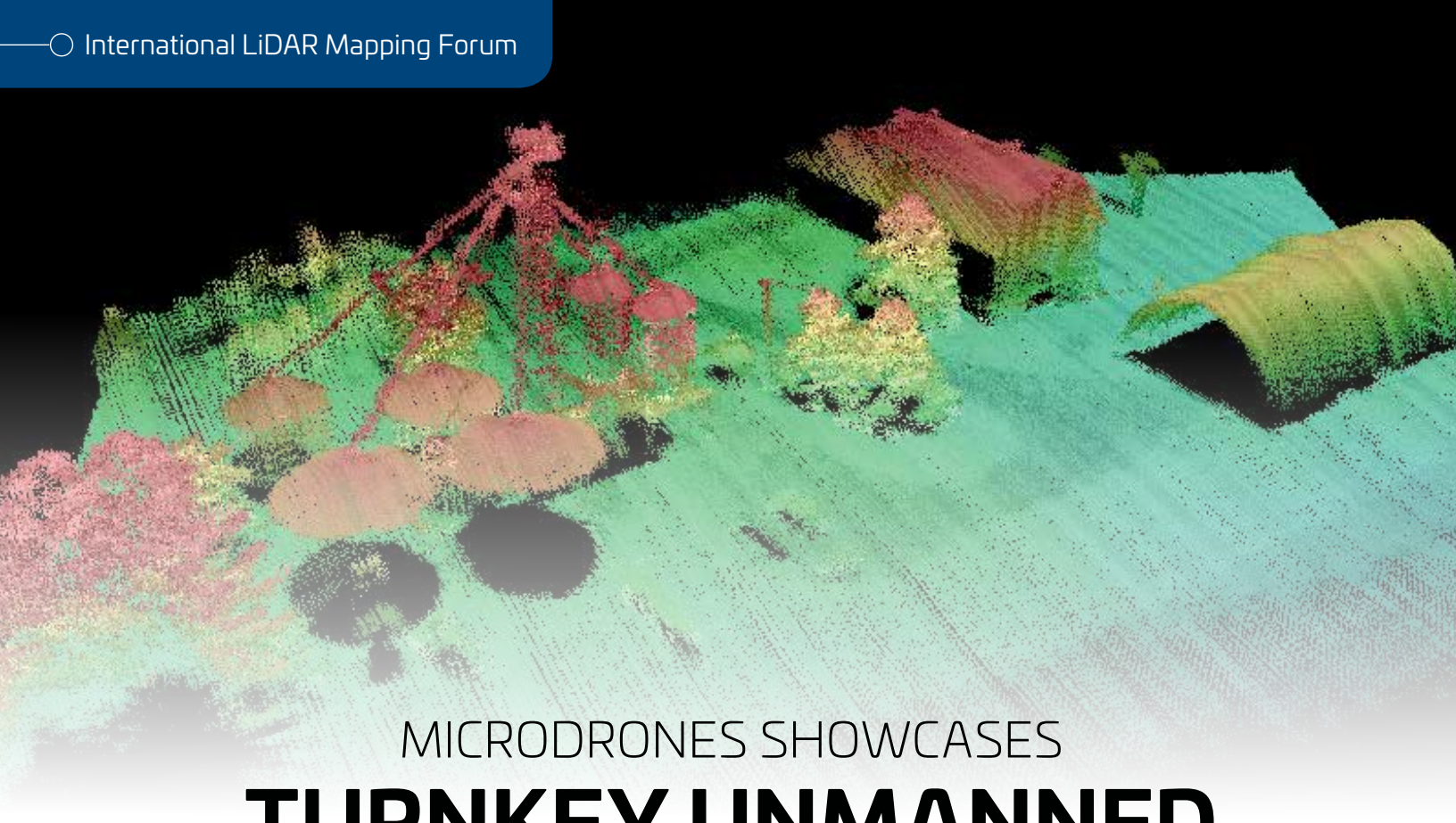


MICRODRONES SHOWCASES

TURNKEY UNMANNED AERIAL LiDAR SYSTEM AT ILMF 2018

A technical conference and exhibition showcasing the latest airborne, terrestrial, and underwater LiDAR, the International LiDAR Mapping Forum (ILMF) recently took place in Denver, Colorado. This premier event was co-located with the American Society for Photogrammetry and Remote Sensing Conference (ASPRS).

The forum and conference together provided attendees with a rich opportunity to see the latest in LiDAR mapping and complementary imaging and geospatial technologies. Hundreds of professionals seeking LiDAR to support transport, urban modeling, coastal zone mapping, utility asset management and more, had the opportunity to connect and learn at the event.

Microdrones' new mdLiDAR1000 system was the main showcase at the popular booth. Given the fact that it is a LiDAR system, this solution was extremely relevant to this audience. Microdrones also displayed its mdMapper1000DG system.

Dr. Mostafa, Microdrones Director of mdSolutions, presented "ASPRS UAS LiDAR Workshop – Unmanned Airborne LiDAR for Precision Mapping." at ILMF.

There was no need for anything attention-grabbing to lure people to the Microdrones booth, explains Mike Dziok, Marketing Director at Microdrones. "The fact that we are the first company to offer a field tested, field proven unmanned aerial LiDAR system," he said, "that is fully integrated with a drone, LiDAR sensor, software, workflow, and support was attractive enough."

The clear highlight of the event for Microdrones was the Microdrones-sponsored ASPRS workshop on Thursday, Feb 8th, titled "ASPRS UAS LiDAR Workshop – Unmanned Airborne LiDAR for Precision Mapping." Microdrones' very own Dr. Mohamed Mostafa, Director of mdSolutions was the presenter. Reviews following this workshop were extremely positive. One attendee said, "This was the best workshop in the entire event;" while another attendee added, "Dr. Mostafa's presentation was amazing. He managed to cover eight years of my professional geospatial schooling in one concise four-hour course."

We are the first company to offer a field tested, field proven unmanned aerial LiDAR system, fully integrated with a drone, LiDAR sensor, software, workflow, and support.

Microdrones also presented a special afternoon workshop demonstrating how the new mdLiDAR1000 system offers customers a fully integrated system. The steps in the system are easy to understand: PLAN. FLY. PROCESS. VISUALIZE. The team used data collected from a special demo conducted in cooperation with Microdrones dealer, Frontier Precision, earlier that week at a nearby golf course undergoing renovation to show the results achievable with this system.

The construction, surveying and geospatial sectors are eager for a turnkey unmanned aerial LiDAR system, and the Microdrones team has brought that to market. Demand will be high. **To learn more about the mdLiDAR1000, visit www.microdrones.com/en/mdsolutions/mdlidar1000/**

THE SHAKEDOWN

By: Patrick Egan @thedronedealer

Who doesn't love a good shakedown? Well, usually the person or group getting shaken down (the shakee) unless of course, they are unaware that they're getting shaken down. That is where we are today, and it is okay if you are because a good shakedown artist doesn't let on to the mark that they've been taken advantage of until after the mandate.

I'm going to run through some of the 2018 topics of relevance; Drone Integration Pilot Program, ID and Tracking, LAANC, Registration, and cell phone UTM. Now rest assured that these topics didn't just arbitrarily show up. They are all a figment of someone's business plan to scale some VC money on solutions for problems that don't yet exist or just merely move more hardware. There has been a rush to get in the air at all costs, and well, it has cost us a lot. Credibility is one of the major issues that beg for the limelight. Namely the idea that local municipalities should make rules for aviation. (Follow the VC money!)

Heaven help us if we start hearing the drone "advocates" and "experts" braying that we need some commercial end-user participation in the effort. The only part of that commercial end-user relationship will be a shill on the payroll to round out the "unbiased" influence and possibly a fall guy or gal to throw under the bus when things go pear-shaped.

I am going to warn everyone right up front that this one is in-depth and long, but it has got something for everyone. I'm throttling way back on the intellectual honesty routine, as all that accomplished was the mass alienation of the selfie drone devotees and snake oil peddlers. Feedback suggests that even the word pairing can put folks in a darker place than a 3D Robotics investor in fall of 2016.

Warning! If anyone reading has the slightest aversion to reality, they should just skip down to the solutions section to forego any possible feelings of consternation and or grief. (If you are a fanboy/girl, self described drone "expert", "advocate" aficionado, forecaster, skip chaser or anyone else needing blog stuff to fill in around the sponsored material you are in luck as you'll be able to poach and parrot this piece without attribution for the next six to eighteen months.

DRONE ALGEBRA

As a baseline, we must try and wrap our heads around the fresh crop of numbers. The latest estimates make that world's largest advocacy group telephone book stuff look like Nobel Prize-worthy science. The Pew research folks are now estimating that 8% of Americans own drones. That would mean we are north of 25 million +/- drones in the United States. The Pew Research Center is a highly respected for their polling methodology, but I say all polls are suspect and anyone that doesn't believe me, can just ask President Donald J. Trump.

I know, you're thinking what do these forecasts have to do with the price of tea in China? These forecasts as the basis for most of the crises based regulation, and what proprietary solutions are built on. If you have been around long enough you will accept at face value that the Flywheel, Shyster and Flywheel research group said there would be 1.2 (+/- 2.6%) million drones sold at Christmas. Then some middle manager or consultant is given leeway to gin up a crisis and tell folks that it means there will be 2.4 million and the sky will be black with drones and

we need a solution to stop rouge drones at airports. Here's where the scaling (aka shakedown) starts so let's fire up a committee or two and get a handle on this problem we've been nursing for 25 years or so. A few "experts" have made a career out of this committee and consulting merry-go-round.

If we go back to the Pew forecast, we have to postulate that either the numbers are bogus, or the FAA has a compliance issue of colossal proportions that may warrant revisiting the regulatory drawing board, square one or the wishing well. Hard to hype a program when success hovers in the single digits, and that is regardless of how good the intentions may have been at the outset or end. We have 70K +/- Part 107 pilots, and I know this is a heavy statement, but anyone who still believes educating the AMA hobbyist is the key to regulatory compliance is doomed to more of the same sighting numbers trend. Not that I am discounting the notion of education out of hand, just saying the choir may not be the biggest problem just the easiest folks to find.

A casual peruse of the numbers could suggest that current educational curricula and dissemination methodology is lacking a certain tangible degree of traction with the Big Box store flock. On a side note, the worlds largest drone advocacy group can't bust the 7500 member ceiling, so I'm not holding out much hope for an educational sea change there. Know Before You Fly not so much, and many doubt charging constituents a few hundred dollars for access to UASIO office personnel will do much to remedy the shortfall.

Forecast spoiler alert for those who may have already spent their share of the income from the 82 billion dollar market. Drones have always held value as tools for self-guided data collection and have been successful in augment existing businesses. The drones as a service model never really worked out as planned. Why train a guy/girl to be an expert in (insert profession here) when you the professional can easily learn to fly the drone? The barriers to entry are mighty low folks. If you can quantify the value they bring to the various industries and economy I am all ears, the rest is dartboards and click bait for the new annual crop of Christmas drone experts.

Return of Drone Registration

Information FOIA'ed as a result of the Taylor case indicated that registration wasn't a factor in any FAA enforcement actions, but hey why should that preclude us from pounding that square peg through the round hole again? The sighting numbers keep going up and depending upon what time frames you sample things can look scary. Couple that with the modeling ASSURE did and you have a recipe for another federally sponsored CYA disaster committee.

Warning! Assure Digression Alert!

I don't want to get too far off into the weeds on this one but will pause to make a couple of comments as anchor points for further discussions. I view models like polls, they are biases, and they don't call it the old "Monte Carlo Method" for nothing. I will say that I was disappointed that the research paper didn't even get the nomenclature in the acronyms section for the items researched correct. That doesn't bode well for the assumptions and one of the reasons why I've been beating on the OEM's to sponsor some third party independent research. (Really hoping this one gets poached sooner rather than later as the feelings based conjecture and birdcage grade white papers aren't cutting the mustard.) Does $250K for scientific research sounds like too much when they are talking about an industry purported to be worth eighty-two (or a hundred and twenty-four) billion dollars?

On the drone advocacy side, advocates, please do not talk about how the ingestion modelling proves that things aren't as bad as folks had assumed. Sure, it's not a guaranteed fireball on the wing, but fin breakage and shutdown will never sound like "no big deal" to members of the manned aviation community. Not

only do you look like a Jackass, but we as a community also suffer as they have no idea you paid lobbyists to get "you" on committees to represent your interests and not us.

DRONE INTEGRATION PILOT PROGRAM

DIPP shares many of the hallmarks of the Test Site boondoggle from the 2012 FAA reauthorization. First, wasn't most of what we are going to do in the Drone Pilot cities already supposed to be wrapped up at the Test Sites? Didn't Congress mandate NAS Integration by September of 2015? I see another round of good-old-boy cronyism without the pork happening here. (I've even heard the FAA has had people inquiring about when they can expect the check. LOLZ) Why else would anyone want locals creating ordnances and collecting fines on something with a steep learning curve?

Why would anyone in their right mind advocate for registration of the AMA member hobbyists? I can see the big box store and mall kiosk customers, but 70 plus years of a working program has to count for something, no?? Local Law Enforcement enforcing the FAR's and municipalities collecting the fines opens the floodgates for an asset forfeiture type of scheme. Even from my own experience where I knew I could legally fly, I don't make a habit of arguing with the dudes wearing the badges and guns. On the inclusion front, some segments of the population aren't actively looking for new and exciting ways to interact with the police.
Golly, how in the heck will droners stay out of trouble with local Law Enforcement? Maybe some guys with a heart gold and a stack of VC funding looking for a market for their product can come up with a cellphone app that keeps up with all of the new local rules and regulations. An enterprising dot IO could put local municipalities on an annual contract so they can update the rules for their revenue-generating totalitarian drone-quashing machine.

My favorites for the Drone Pilot winners are North Dakota, New Mexico, somewhere in the NUAIR sphere and possibly by sheer coincidence the new Amazon hub city. Heck, I wouldn't be surprised at all if in three to five years from now we'll learn that the Amazon airspace plan works like a freaking charm! ;-)

If you feel a little low and you are in need of some comic relief just go over and take a look at the FAA Drone Integration Pilot Program Facebook page. It is getting so wild over there that even the hucksters are taking a powder.

LAANC

Why do we need LAANC anyway? I know the 12 +1 anointed companies and the FAA have lauded this as the key to BLVOS and hear it is even rumored to help drones stay crunchy in milk. Some have their doubts that the 50 cities notion will put much of a dent in the waiver backlog. Furthermore, anyone who is counting on the FAA to build something from scratch in a timely fashion should Google NextGen and let me know how they think that has worked out.

Besides, we already have a flight services system that has been working almost everywhere in place for some time now. The system for fifty cities in a country the size of the U.S. doesn't smack of a "we're leading the way" stratagem. The www.1800wxbrief.com is one checkbox from being an already built, secure and tested LANNC without having to reinvent and pay for the new wheel.

The eighty-two billion-dollar questions are, why do we want the FAA to build something new when what we have isn't broken? Did anyone run all of this by NATCA, and if so is it part of the backlog problem? The waiver/authorization backlog is a testament to regulatory planning done in a vacuum and without qualified Subject Matter Experts (SME's). On a side note, during the brief government shutdown, LAANC was shut down, but Flight Services was not. I will leave it up to the reader to draw his or her conclusions on just who has red-headed stepchild status.

UTM

This one has me more concerned than the others and primarily because I don't want to build or subsidize the build of a system for billionaires under duress. Namely Amazon, Google and Wal-Mart. Why wouldn't we just have the flight services contractor incorporate that UTM map grid into the existing system?
You think the drone airspace and scheduling apps are all doing their haphazard work out of altruism, do you? Someone gave the cellphone companies the big idea that they could cure all of the ATC, ID and Tracking and collect fees off of their network if every drone had a sim card in it. There is enough revenue growth potential their for everyone to start coming up with solutions for the FAA in a jiffy. Is anyone talking to the ATO and air traffic controllers union? Anyone who thinks that implementation is going down without the nod from the NATCA folks is suffering from an acute case of wishful thinking.

Spoiler alert! Moving the graphics around on your next round of funding power-point slides or computer-generated animations to make your cellphone app look ATC- esque doesn't count as global UTM progress.

ID AND TRACKING

The fast track to riches, um, I mean for us to fly over people. While I think it is an excellent future goal we should stop and remember the no practical test for Part 107 and aircraft weighing up to 55lbs at speeds up to 100mph. That is only the first carriage before the dead horse example. Let's ponder what millions of drones look like on an ATC computer or cell phone app screen.

This industry has some engineering hurdles to overcome. Mainly Mean Time Between Failures (MTBF). Currently, I hear 1 in 25 hours mentioned, but we as a community have to consider that turbines average about one failure in 375,000 hours (according to the interweb). Of course, those numbers do not include inadvertently snapping fins off on some freshly ingested crunchy drones. The airline safety numbers are 10-9. That is about one in a billion, or in layman's terms, once in never.

While mussing about dark subjects, let's us take a moment and think about drone Quality Assurance and Quality Control (QA/QC). We are part of an industry built on the customer paying to do the product Beta testing. 3D Robotics instituted an ingenious post-sale crowd-sourced QA/QC program. It relied on DIY Drones paid moderators, company employees and fanboys mocking, shaming and finally deleting negative comments and threads on the IP generating community portal. Mocking your customers is one thing, but alienating your IP base is just freaking schnutz.

As a fair-minded person, I would find it hard to believe the American public is going to tolerate 28 million uncertified drones falling on their collective heads. I'm not sure flying directly over nonparticipants is the best idea until we have reliable equipment and more robust training. I have to respectfully disagree with anyone advocating for such nonsense without at least a 107 practical test.

The old how are we going to ID UAS question has been floating around for years. The FAA thought that they might accomplish this with N numbers. The picture accompanying this article is the fuselage (1 cm) of the Cracker Barrel circa 2008. It was done for the benefit of the FAA personnel during the sUAS ARC to highlight some of the drone ID realities.

SOLUTIONS SECTION

First and foremost, the process needs more daylight and qualified SME's. For some reason this idea gets folks all riled up, but the WaPo DAC story(s) confirmed that the stakeholder (bag holder too) and public deserve much better than the current low standards.

Install a Drone Czar - The Drone Czar cannot work for or consult with a company selling hardware or software. However, considerations should allow for a highly qualified person with a track record of self-funding and integrity. This person cannot maintain a leadership role or board position of an "advocacy" group. This person must be knowledgeable, honest and qualified with many years of empirical experience in the Unmanned Aircraft discipline.

Stop all (nonessential) actions for six months to do a forensic accounting of the current conundrum and identify any duplicate efforts or dead ends.

Establish 5 to 10 priorities for the next Federal fiscal year

Publish a project schedule of priorities with goals and timelines.

Establish special standards committee (operation teams) from the various standards groups including but not limited to ASTM, RTCA, SAE, etc. Each team is assigned a coordinator. The team coordinators would report directly to the Drone Czar.

- Participation limited to 5 to 10 people on each committee team
- Participants must be peer-vetted
- Ability to invite or interview SME's
- Findings vetted and peer-reviewed (no rubber stamps)
- No new rules, regulations or policy without being scientifically validated or at least independently peer-reviewed
- No product pedaling as part of the work

Make the entire country part of the Drone Pilot program. Start out in rural areas with lower populations and aircraft traffic. Develop some better training schemes and possibly add some endorsements to the Part 107 certificate, i.e. aviation radio, file a flight plan.

Add a Practical (flight) test to the Part 107 mix.

If the regulator wants to get a handle on the drones numbers Pew is talking about they can start by taxing and registering anything imported from overseas as aircraft. If that doesn't work, a point of sale registration and a handout that requires a signature proving that the purchaser at least perused and had been made aware of some of the rudimentary FAA rules, including not buzzing manned aircraft.

If you want more good stuff like this every day, you can follow me on the Twitter @thedronedealer

AEROVEL FLEXROTOR

The optional backpack on Aerovel Flexrotor can carry additional fuel or a payload.

Aerovel Flexrotor

Aerovel Flexrotor unmanned aerial system (UAS) is for day/night land-based and maritime operations. It combines the best of endurance, expeditionary capabilities and premier payloads in one state-of-the-art system. Flexrotor is designed by UAS industry pioneers with decades of experience and market success. Needing only a 20’ by 20’ area for launch and recovery, Flexrotor takes off and lands vertically (VTOL) and easily transitions into horizontal wing-borne flight. It flies completely automatically after takeoff, with no pilot intervention needed. Flexrotor quickly assembles for flight, can be rapidly re-stowed in its compact case for easy storage and easily transported on a small flatbed truck.

Aerovel Flexrotor has an expeditionary footprint.

FLEXROTOR

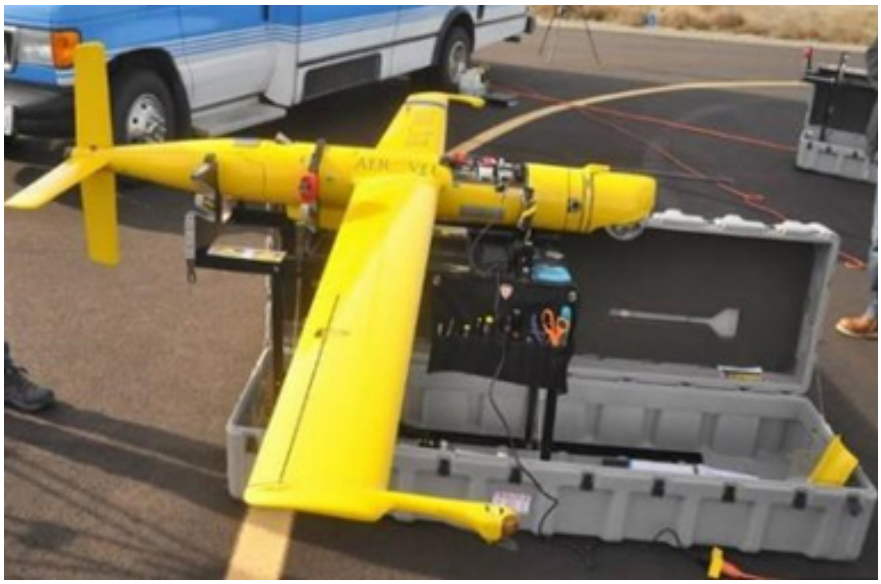
Boasting a flight endurance of more than 32 hours and a 100-kilometer range, this all- weather aircraft has operated in some of the harshest conditions on the planet, including off of various vessels in the Arctic and tropics.

A one-of-a-kind fixed-wing aircraft, Flexrotor requires no runway or launch and retrieval equipment. It is designed for observation, monitoring, intelligence gathering, communications relay, surveillance, reconnaissance, security and scientific data collection. It can be used for a diverse range of commercial, civil and military applications at sea and on land.

Aerovel Corporation was founded in 2006 by Dr. Tad McGeer, a designer of unmanned aerial systems at various companies for more than 25 years. Dr. McGeer co-founded The Insitu Group in 1992, where he was the primary architect of Aerosonde, SeaScan and ScanEagle. Flexrotor is the next evolution in Dr. McGeer's line of unmanned aerial systems.

Flexrotor has been proven in many flight-hours, including commercial deployments on client boats in the tropical Pacific, Atlantic and Arctic in 2015-2016. More details are below.

Three complete Aerovel Flexrotor UASs ready to deploy.



Aerovel Flexrotor storage case and integrated workbench.

- Pacific deployment in May 2015 with the Dalio Foundation to trial anti-poaching around Cocos Island.
- Mid-Pacific deployment in September 2016 to demonstrate commercial fish-spotting.
- Arctic deployment in July 2016 to guide ships through the Arctic ice, saving the company millions of dollars in ship time and icebreaking fees.

There has been significant demand for Flexrotor for both civil and government applications. It has been selected for numerous US government demonstrations and evaluations.

Additional videos about Aerovel and Flexrotor are at: www.youtube.com/AerovelCo

Various news coverage of commercial missions can be found at: http://aerovel.com/aerovel_in_the_press/

Flexrotor exemplifies the future of UAS technology and represents the finest operational capability in its class.

DROPCOPTER

One third of all food crops worldwide rely on bee pollination. Unfortunately, natural bees like the Bumblebee, Carpenter bee, and Squash bee are now considered endangered or threatened species, due to colony collapse. In addition, US beekeepers have lost an estimated 45% of their operations to this rapidly spreading disorder, and no cure has been found.

At the same time, demand for pollination is growing rapidly. Crops such as almonds, cherries, apples, pistachios and many others have more than doubled their planted space in the last 10 years. California's almond crop alone requires more than 75 percent of the entire US bee population to serve as pollinators during a very short two-week bloom season. If it rains or the temperature remains below 55 degrees, the bees won't leave the hive and there's nothing a grower can do. It's also expensive to use bees. For a 500 acre orchard, it costs $200/per beehive, and the industry standard of 2 beehives/acre, this is a $200,000 expense for the narrow two week pollination season.

Traditional crop pollination and supplements have remained somewhat of a dark art.

That's where Dropcopter comes in. The company's mission is to help address the global pollination crisis using drone aircraft to pollinate crops. Since 2015, Dropcopter has been testing automated drone pollination on almonds, cherries, pistachios and olives with positive results. Initial tests on almonds have demonstrated a beneficial increase in crop set by 15 percent, yielding a potential increase of hundreds of dollars per acre. "We want to deliver real data-driven value to the growers," said Matt Koball, CEO of Dropcopter.

Dropcopter buys surplus pollen from specialty suppliers. Their drones spread that pollen right above the trees over opened flowers turned upward to the sun during optimum bloom time, using their patent-pending

DROPCOPTER

"Worker Bee" pollinator. Dropcopter also provides one benefit bee can't match – nighttime operations. While bees do not fly during the night, the flowers of the trees stay receptive 24 hours. The use of drones effectively doubles the pollination window. If rains wash away pollen, there's twice the time to replenish it with drone dusting.

In 2018, Dropcopter was selected to participate in the Syracuse based "GENIUS NY" accelerator program, earning valuable recognition, as well as strategic, logistical and financial support. Over the next year, the program will continue to support Dropcopter's growth by pairing the company with industry mentors and additional opportunities for VC funding.

The program also provides Dropcopter with the opportunity to test its operations beyond visual line-of-sight (BVLOS) in partnership with the NUAIR Alliance, which manages one of six FAA-designated UAS test sites in upstate New York. Current regulations require a Pilot in Command (PIC) or visual observer watching the automated flight path of the aircraft, limiting flight operations.

Dropcopter has been conducting limited operations by placing pilots at the top of pruning towers and scissor lifts. This tactic allows them a "farmers aircraft control" and an obstructed view but it's far from ideal. They are planning daisy chain operations in New York state for the apple bloom season in May.

"We are incredibly fortunate to be working with GENIUS NY and the NUAIR Alliance," said Adam Fine, Dropcopter's CTO. "With their help, we will demonstrate a safe and valuable use case to the FAA. Imagine what Dropcopter could do for agriculture with BVLOS and a night time waiver."

Drones and plant mapping: A growing need for ground-truth

Gregory Crutsinger (PhD)
Founder of Scholar Farms
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Drones have become powerful tools for data collection and repeated measurements. Even low cost "consumer" platforms are being adopted to monitor the earth in ways unimaginable even a decade ago.

A commercial vertical that has been touted as particular promising for drone technology has been agriculture (as well as other plant-related fields). Some of this promise has been driven by the reduction in cost of multispectral cameras specifically designed for plant mapping. While still not exactly cheap, multispectral cameras are currently in the $3-5K price range, which is within reach of the budgets of many commercial operations, researchers, and public agencies.

The result has been an explosion of drone data surrounding plants and a renewed interest in vegetation indices, such as NDV (though there are many) for agricultural use. Plant indices have been around for decades in the scientific field of remote sensing and were first developed by NASA for satellite imagery in the 1970s. Sparing too much detail, a vegetation index is some basic math that takes a combination, or ratio, of different narrow bands of light that are of specific interest to plants. Some of this light falls within what humans can see, like wavelengths of red light, and some are outside of the visible spectrum, like wavelengths of near-infrared or red-edge light.

Outputs of this type of imagery are maps that can reveal patterns of plant productivity, chlorophyll content, and other measures that are correlated with the health of vegetation. Such patterns aren't necessarily visible to the human eye and can provide powerful insights into how crops are performing throughout the growing season. Therefore, drone data are being touted as highly valuable to farmers and commercial agriculture. Indeed, it is an exciting time for the plant sciences, whether you are a grower in the agricultural industry, an environmental consultant adding additional data layers to a report, or a scientist looking to capture higher resolution data than publicly available satellite data. But, with opportunity come real challenges.

Above all, the leading challenge for agriculture is in the interpretation of the vast amount of data being gathered. Drones can collect gigabytes of multispectral photos in a single flight. Those photos then need processed through a photogrammetry engine to create 2D maps documenting patterns of light reflectance off the plants. From there, different ratios need to be created and visualized in a way that documents vegetation patterns in the field. Ultimately, these maps need to be shared with customers, colleagues, or consultants to make enough sense of the data to take some sort of action.

The reality is that interpretation is not always straightforward. Not all drones, sensors, flight methods, photogrammetry engines, or visualization tools are created equal. With each methodology comes the potential for noise and error, much of which is either unknown and/or not readily shared by venture-backed companies creating the tools. Moreover, once the data are produced, there are gaps in our understanding of how different vegetation indices align with different varieties of different crops growing in different areas at different times of the season. Consequently, considerable work is needed to interpret all of these data, first into the alignment with crop performance and subsequently into actionable decisions.

As a result, there is a growing need to ground truth drone imagery for vegetation mapping. Ground truthing is the process of taking direct measurements at ground level, rather than indirect interpretation from aerial imagery. Logistically, ground truthing translates into the manual collection lots of samples and measurements of everything from the soils plants are growing in, to the amount or quality of their leaves (and other parts), to end-of-season yields. All of these filed-collected variables can then be plotted against different vegetation indices or light reflectance values collected by the drones to explore the relationships statistically.

As with vegetation indices, the concept of ground truthing is not new. In fact, people have been ground truthing in the plant sciences for as long as aerial imagery (satellites, manned aircraft, and unmanned systems) has been available. However, what are new are the high resolution, frequency, and affordability that drone data can provide, combined with the rapid pace of technological development. It is for those reasons that there is a pressing need to accelerate the pace of ground truthing for plant data as it relates to agricultural needs.

Drone technology is changing continuously with new vehicles, sensors, processing engines and analytics emerging on a weekly basis. As such, there is a parallel need for more rigorous testing and dissemination of results of this technology from an unbiased perspective. Academic institutions, such as universities and agricultural cooperative extension centers, typically provide such perspectives. However, the current process of grant funding, research, and peer-review are painfully slow. Realistically, it takes at least a year and more likely two or three before an academic paper weaves its way through the process and is made available. In comparison, three years in the drone industry may as well be a decade or more. Several years could mean the rise and fall of many of the very companies whose technologies are being used for testing, rendering publications outdated

The question is then what is the path forward? Its actually fairly straight forward but requires greater fluidity and transparency than the current research establishment is set up for.

First, we should take advantage of existing research infrastructure. There are already many agricultural experiments and test plots established across the globe containing known, controlled, and replicated variation within and among crop varieties and species. A significant step in the right direction would be to systematically fly, process, and analyze drone data repeatedly throughout the growing season on these existing experiments. Moreover, many of these experiments already have historical data associated with them that could be used to correlate and ground truth drone imagery.

Second, new field experiments could be established that are designed to test and calibrate drone imagery. These could be tests plots that manipulate both the genetics and the environment of different agricultural varieties mimicking current and future agricultural management practices. Repeated drone flights could then determine how well differences on the ground align with drone-based color (RGB), multispectral, and thermal imagery over space and time.

Third, the dissemination of the science must be more real-time and made available to a broader community than the readers of academic journals. The drone industry is moving at an incredible pace, which means new drones and sensors need to be tested quickly and the results made available to the community at large as they are generated. If academics wait until the end of a graduate student's tenure and/or for the scientific peer-review process, then its highly likely the results will be outdated. Admittedly, the challenge here is in the high value academia places on publication records in top journals over blog posts, webinars, and social media posts. Getting academics to think out of the box and take strategic risks could prove difficult, but arguably these rapid venues provide also provide more real time community feedback to move the science. The two approaches are certainly not incompatible.

Finally, the future is in public-private partnerships. With some notable exceptions, schools and universities are slow when it comes to adopting the newest technology. Graduate students are also too poor, relying on grant funding that is currently very lean for the sciences (at least in the U.S.) and testing methodologies is not the most cutting-edge science for publication. Academic institutions need more partnerships with the drone industry to keep them on the cutting edge of the technology. This might come in the form of technical expertise, hardware donations, or foresight into what is coming next down the commercial pipeline. The drone community has a lot to offer and many in the industry have close ties to the academic community to make these types of partnerships successful. The universities, community colleges, and cooperative extension centers need industry involvement if they are to track the fast pace of innovation and prepare the next generation for the jobs of today, let alone tomorrow.

At the same time, universities and cooperative extension programs provide the research infrastructure and rigorous testing methods the drone industry needs. They are set up to vet the technology in a range of ways and across disciplines. They also can help curtail some of the (over) hype of well-funded marketing teams. Academic institutions tend to be more trusted and unbiased sources of information compared to the private sector that is trying to sell their product or raise more venture funding.

Taken together, it remains an exciting time to be both in the drone industry and assisting in the digitization of agriculture. We have come a long way very quickly in drone technology, and now have some catching up to do when it comes to understanding what the data mean. Without proper ground truthing, the interpretation of drone data for agriculture will remain elusive. And without simplified, actionable interpretation, drone technology will fail to see mass adoption as an everyday tool for farmers. The good news is the research infrastructure is there in the academic sector. It will be the exchange of ideas between the academic and the private sector that can help fill the gaps.

DroneSinger: Edutaining K-12 Youth with STEAM Education

Victor Villegas
@OSUExtTech

The future of drones is invariably tied to the future of our children. After all, you can't have a high tech industry without a skilled workforce to develop and sustain it. One of the more unique ways Oregon State University's Victor Villegas has been educating kids is through his persona as DroneSinger: the "Weird Al" of drones. You may know him as the creator of parody songs about drones, but his true passion is education, specifically youth education. Villegas uses drones, music and humor to inspire kids and get them interested in STEAM education. STEAM stands for Science, Technology, Engineering, Art and Math. Villegas believes Art is an important addition to traditional STEM education, as creativity is increasingly seen as a valuable skill by employers. It also is valuable in communications, marketing and education. Something tech companies can not do without if they want to succeed.

Over the past three years, Villegas has provided over 50 "Drone Education" learning experiences. He provides hands on workshops were kids learn about aeronautical principles, the basics of how drones fly, the technologies they use, such as IMUs, GPS and various sensors which drones use to gather data. Participants learn how drones are used in research, search and rescue, and commercial applications. They also have the opportunity to fly a virtual drone through use of a computer flight simulator and get to experience FPV (First Person View) flying. Throughout his presentations, Villegas sings "drone songs" and even uses puppets to not only entertain, but also discuss drone regulations, privacy, safety, and responsible flying.

Last year, Mr. Villegas' educational efforts led to an invitation by the USDA (United States Department of Agriculture) to participate in the 2016 Science and Engineering Festival, the largest children's STEM festival in the US. Villegas has been invited again this year and will be exhibiting and performing at the 2018 Science and Engineering Festival being held in Washington, D.C. in April.

Villegas also provides education via exhibits, demonstrations and presentations, including webinars and video conferencing sessions with K-12 classrooms across the US. He collaborated with Oregon State University, the Oregon Department of Education, SOAR Oregon and various industry leaders to provide a series of "Drones in Education" webinars which culminated in a three day workshop for K-12 educators. Participants learned about using drones in the classroom and heard how researchers are using drones in their studies. They also received instruction to prepare for FAA Part 107 certification. The workshop was attended by 26 educators, four of which obtained Part 107 certification soon after. Another workshop is being planned for July of this year.

A skilled workforce is essential to the future of drones and Villegas' brand of education is certainly a unique way of preparing children for the world of tomorrow. He states, "I urge folks in the industry to become involved with their local K-12 schools and help inspire and teach the next generation." A sentiment we here at sUAS News wholeheartedly agree with and support.

New Rig Camera Alignment & Exposure Balancing Software for Quickly Handling Drone-Based Rig-Camera Image TIFF Files on a Local Computer

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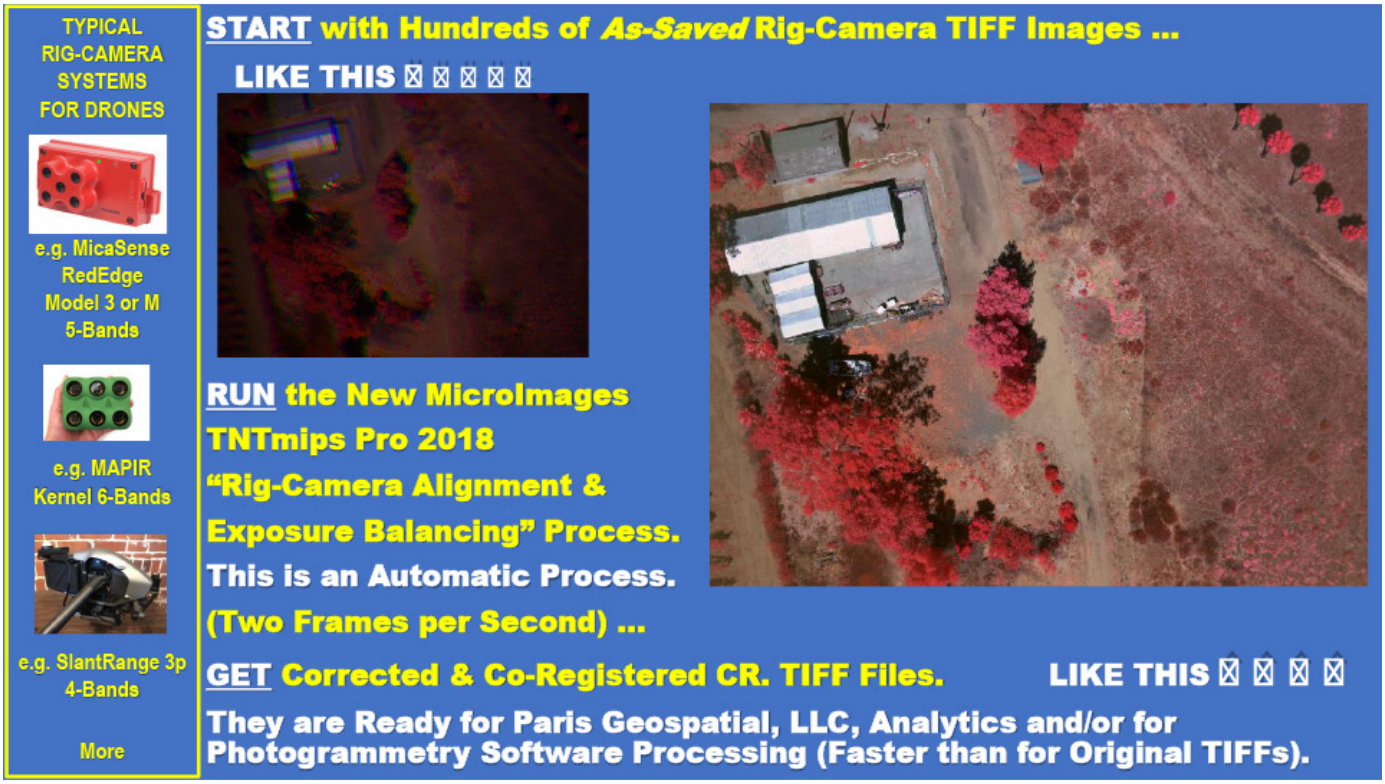
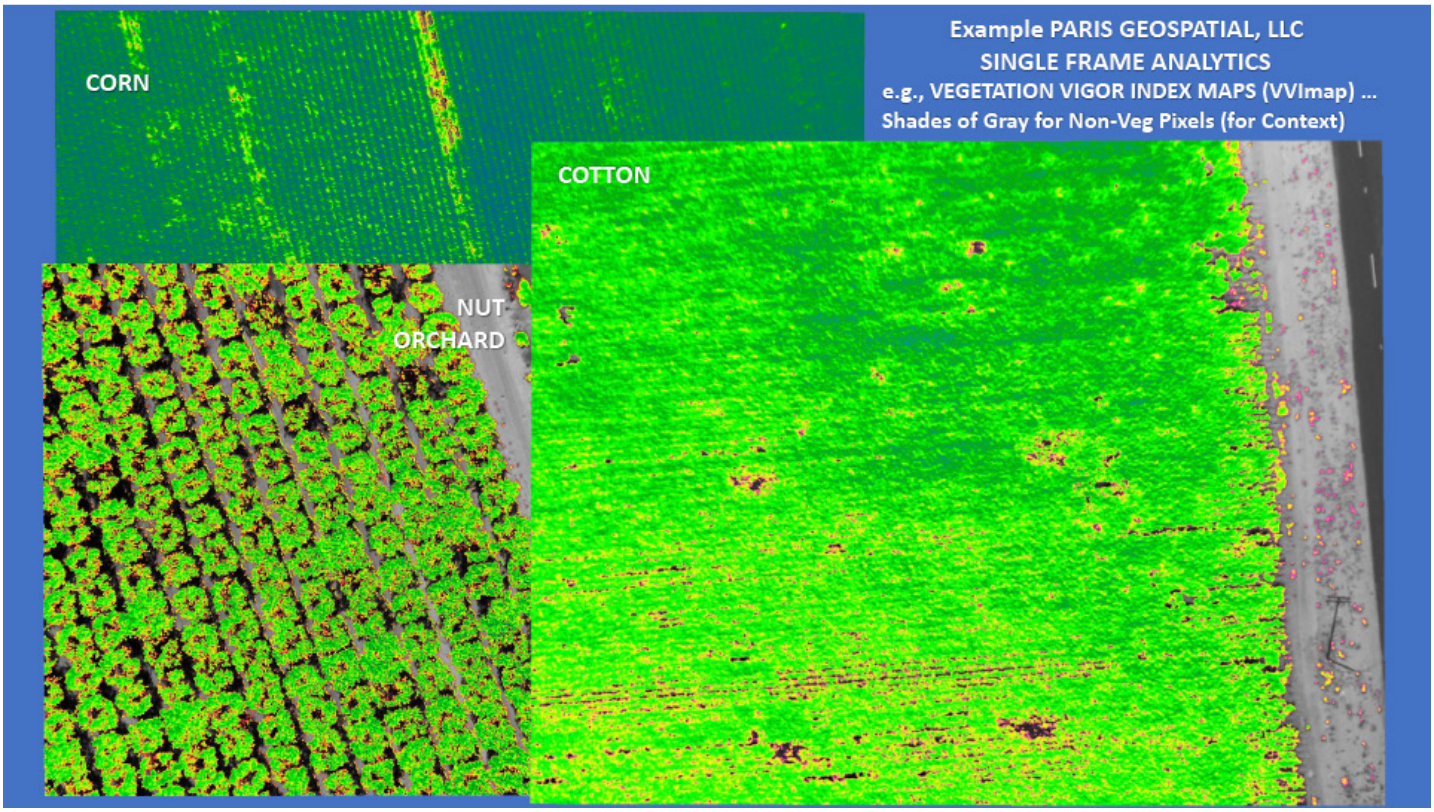
MicroImages, Inc., Lincoln, NE (www.microimages.com) has added a new process to its TNTmips Pro software (released as of January 17, 2018). This is called the "Rig Camera Alignment & Exposure Balancing" process. It quickly handles multispectral image TIFF files such as saved by a rig-camera system, e.g., a MicaSense RedEdge Model 3 system, a MicaSense RedEdge Model M system, a SlantRange 3p system, and one of several of MAPIR rig-camera systems. The TNTmips process runs on a Windows or Mac computer. TNTmips Pro 2018 can be leased on a monthly basis or longer basis or purchased outright. One useful option is to take a laptop to the site where a drone-based mapping mission is being carried out. Then, right after the drone lands, the as-saved TIFF files can be processed quickly … at the rate of about two frames per second. Rig-camera TIFF files have four or more spectral-band specific images. Each image is affected by vignetting and by exposure times and/or ISO settings which vary from frame to frame. The as-saved TIFF files have metadata that include GPS data as well as exposure time and ISO data. And, the several as-saved TIFF images are not co-registered to each other. So, in the past, users of such rig-camera imaging systems have had to submit the as-saved TIFF files to photogrammetry software in order to get mosaics of the several spectral band images for the entire project area. In some cases, this requires that the as-saved TIFF files be uploaded to the camera-maker's Web site for processing … an action that can take hours to do from a rural site. And, the resulting mosaics may not be delivered back to the drone operator for a day or so. Often, the resulting mosaics have poorer spatial and radiometric qualities than which exists in the as-saved images. So, attempts use such mosaics for mapping and monitoring purposes are compromised by the mosaicking processes.

The new TNTmips Pro 2018 process addresses this situation and allows the user to immediately correct the as-saved TIFF images for the effects of vignetting, of exposure time variations, and of ISO variations. It also produces new co-registered multi-component TIFF files with metadata. These new files are ready for either single-frame analytics and for more efficient processing by photogramme-





try software. The TNTmips process is totally automatic. It also includes useful QAQC options such as immediately viewing a map of the waypoints of the drone, immediately viewing corrected, enhanced, and co-registered images in any combination, immediately viewing histograms, and immediately viewing scatterplots. Options also exist for generating new or better models for co-registration automatically. And, there is an option that deals with the effects of variable sky and sun conditions even if the system does not have an irradiance measuring device. The resulting new TIFF files also are processed faster by photogrammetry software since co-registrations have already been done. And, the image brightness values are consistent from frame to frame.

Paris Geospatial, LLC, has additional proprietary processing scripts that run under MicroImages software, e.g., for producing calibrated index maps of vegetation vigor, leaf pigmentation, soil reflectance, and/or soil pigmentation. And, Paris Geospatial, LLC, has processing scripts for special situations such as making maps of emergent-crop stand-counts, plant-size distributions, and detecting weeds … all on a frame by frame basis. For row crops, these special scripts can also estimate the heading of each image and determine the scale of each image so that the images are approximately georeferenced at the frame by frame level of processing.

THE UAS PILOTS CODE: BEST PRACTICES IN A DISRUPTIVE LANDSCAPE

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The National Airspace System (NAS) has seen over a century of improvements to flight safety, but it now faces profound changes. There is a massive, accelerating influx of unmanned aircraft systems (UAS), and new, inexperienced UAS pilots and operators, that must effectively—and safely—integrate with manned aviation. There is, of course, only one NAS. We all share it, and our lives and safety depend on its integrity.

These new UAS operations reflect unprecedented levels of experiment and innovation. Novel aircraft and applications are entering the NAS, and UAS are rapidly advancing toward operations beyond visual line-of-sight, semi- or fully autonomous operations, and the carriage of passengers.

UAS integration to the NAS is proving disruptive to long-established safety practices, and poses ethical, technical and regulatory challenges. This environment underscores the adage that the law lags behind technology. There is a need for clear and fundamental guidance for the UAS community as it strives for operational safety and professionalism.

In response, the Aviators Code Initiative and University Aviation Association recently released the UAS Pilots Code. The Code offers recommendations to advance UAS safety, airmanship, and professionalism, providing guidance for new UAS aviators who may be unfamiliar with aviation safety culture and practices.

The Code is designed to foster a common understanding across a highly diverse user community, guiding UAS pilots and operators toward an understanding of established aviation safety practices, informing manned pilots of the basics of unmanned aviation, and assisting regulators and flight safety organizations. The UAS Pilots Code is also forward-looking, anticipating development of new, more complex and automated operations and systems.

The Code offers broad guidance—a set of values—to help UAS pilots confront real-world challenges. It will help pilots and operators develop standard operating procedures (SOPs), effective risk management, and safety management systems (SMS). Because UAS pilot certification typically does not require formal flight instruction, there is an acute need for non-regulatory operational guidance. The Code emphasizes self-training and education under the guidance of experienced UAS pilots or mentors.

The UAS Pilots Code presents safety, training, risk management, and technology as principles in seven sections: (1) General Responsibilities of UAS Pilots, (2) Manned Aircraft and People on the Surface, (3) Training and Proficiency, (4) Security and Privacy, (5) Environmental Issues, (6) Use of Technology, and (7) Advancement of UAS Aviation. The principles are illustrated by sample recommended practices that provide extensive guidance to aid in implementation. The Code is customizable so that it can suit any particular operation.

The UAS Pilots Code is offered in three versions: an annotated version intended for managers, policy administrators or instructors, a condensed version intended for pilot use, and a one-page introductory abbreviated version.

The UAS Pilots Code is a unique, timely and authoritative tool, the product of extensive research and expert peer-review. It should serve as a model for developing UAS standards and safety practice. We recommend that you evaluate and adapt the UAS Pilots Code for your own operation. It is available without charge at secureav.com/UAS.

The UAS Advocacy Network: A Pain Reliever

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The Unmanned Aircraft Systems (UAS) industry is not starved for technology. Drone technology is maturing at unprecedented speeds. The industry is also not starved for viable business applications…for UAS are truly disruptive technologies that promote safety and efficiency gains in hundreds of use-cases. The industry is also not starved for licensed talent. In fact, the barrier to entry is so low you could literally trip over it. However, operating with a license does not assume QUALITY talent, which requires far more demonstrated skill and regulatory compliance than simply buying a consumer drone and passing a 60-question, multiple-choice exam with a score of 70% or better. That said…Those who know and follow the rules understand the pains of restrictive legislation. Economically friendly regulation is the bottleneck that has hindered mass adoption, and the industry desperately needs a pain reliever that will promote a culture shift toward widespread acceptance of the technology.

The UAS industry is starved for economically friendly regulation as well as education for the masses, which go hand-in-hand. That is why my colleagues and I started the UAS Advocacy Network (www.UASAN.org). The UAS Advocacy Network is a public-private organization of UAS experts, enthusiasts and professionals serving as a unified voice for advocacy, education and outreach in support of UAS, and we are looking for passionate leaders in the UAS industry to help us solve the industry's biggest problem... education.

There are 3 camps of operators in the UAS industry that the UAS Advocacy Network is targeting for uniformity:

1) Operators who know and follow the rules, many of whom are finding it difficult to make a living due to economically unfriendly regulations and lack of education among the general population.
2) Operators who know and willingly violate the rules to make a buck. These operators undercut camp #1 because they know that enforcement is a resource-limited, difficult task resulting in minimal coverage.
3) Unlicensed operators who use UAS in support of business and are unaware that regulations exist. This camp includes the similarly naïve general public whose knee-jerk (and often vocal) reac-

tion is naturally negative (binded by privacy concerns) and void of an understanding of the economic benefits of UAS.

That said, the UAS Advocacy Network is leveraging the expertise and leadership of camp #1 to open up economic opportunities by influencing local and federal legislation while simultaneously obliterating camp #2, shaming them into compliance or out of business, and converting members of camp #3 into members and/or supporters of camp #1 through education. This is no easy task, but the UAS Advocacy Network was built for this undertaking, and we are mobilizing community and industry leaders to fill an educational need that is currently unmet at the local level. Afterall…When citizens report mischievous drone activity that potentially infringes on their reasonable expectation of privacy, they don't call the Federal Aviation Administration (FAA), they call local law enforcement, and that is why UAS, many of which are flying cameras, cannot be treated simply as aircraft governed solely by the FAA.

The FAA's Congressional charge is SAFETY, not ETHICS, and since ethics is more of a local issue, very little can be done nationally beyond a one-size-fits-all UAS Code of Ethics. In fact, many associations such as AUVSI, AOPA and AMA are doing very noble work in advocating for drone safety at the national level, but there is an unmet need that the UAS Advocacy Network was designed to fill. We educate people about safety and ethics at the local level where drones actually fly, and as such we are creating a culture shift toward positive acceptance of UAS by explaining to law makers and the general public the economic benefits of UAS in an effort to mitigate economically unfriendly, knee-jerk legislation and dissolve "Big Brother" stereotypes. In fact, many similar individual efforts are underway. Some states have created "Drone Task Forces" for UAS education, and we created the UAS Advocacy Network to leverage those activities in way that brings structure and uniformity to the industry.

Specifically, the UAS Advocacy Network has partnered with FAA Safety Teams and Municipality Leagues to assemble a grass-roots organization of UAS operators, experts and enthusiasts that is educating legislators and communities on UAS ethics and safety issues at the local level. We have standing committees for state leaders to replicate the successful educational model that we developed in Wisconsin. States leaders are tasked to carry out this educational model by working with the UAS Advocacy Network leadership, FAA Safety Teams and Municipality Leagues to organize, promote and execute free UAS educational seminars on a quarterly basis around their state. Some states will have more than one committee (e.g., Northern and Southern California), but every committee has the same mission…Elevate the industry as an influential leader in advocating the value of safe and ethical UAS operations.

In forming the 501(c)(4), we intentionally avoided the traditional chapter model because we knew that we needed to avoid the political and administrative overhead to move quickly and solve yesterday's problem, so getting set up as a state leader is very easy. Simply contact me. We will get you connected and hosting seminars within 1-2 months.

We also have standing committees for industry verticals. These committee leaders are charged with working with UAS Advocacy Network leadership to organize, promote and execute quarterly teleconferences to drive industry-specific operating standards. This is another major unmet need and no small undertaking. However, again, the UAS Advocacy Network is taking a grass-roots approach toward connecting the smartest people in each industry to carve out these standards. Some industries such as public safety and utilities that do not compete will be more willing to share operational practices than other industries that do compete such as insurance and construction; however, ALL INDUSTRIES require standard safety and ethics protocols, and the UAS Advocacy Network has the answer.

We are looking for people who know and follow UAS regulations to join the UAS Advocacy Network. Those who join the cause are helping solve the industry's biggest problem that has hindered wide-scale adoption. We all feel the pain, and those who help spread the cure are simultaneously enjoying new business opportunities, partnerships and connections with influential leaders while growing the economy around UAS. We need all the help

we can get to educate the masses, and we are interested in connecting with passionate UAS operators who feel the same pain we feel in an under-standardized, over-regulated, budding industry. Please contact me directly to learn more about leading the UAS Advocacy Network in your state and/or industry.

FALCON FOUNDATION UAS L.L.C.

Rob Thompson

My name is Rob Thompson, and our team at Falcon Foundation UAS L.L.C. is committed to making your voice heard on Capitol Hill. Like you, I want to play an active role in making the Unmanned Aircraft Systems industry, a commercial and business oriented sector, a better place to interact between government and citizens who participate in commerce, by forging a future filled with unlimited potential in UAS. Falcon Foundation UAS L.L.C. was loosely formed in 2016 and officially underway in 2017 to bring change to the industry. We have helped businesses to secure Part 107 waivers to operate BVLOS by providing technical and policy consulting. We also totally changed the regulatory landscape of counter drones by broadening the (NDAA) National Defense Authorization Act 2018 to provide more than 40% expanded usage for the military domestically within the US homeland to use drones on bases and for national security to include nuclear and dignitary movement.

Some of the core issues we have focused on are the FAA Reauthorization, Part 107 waivers such as Beyond Visual Line of Sight (BVLOS), Night Time Operations, Flights Over Crowds, Inspection, UAS Standardization, Part 107 Regulatory Compliance of Unmanned Aircraft Vehicles, Certification of Equipment to meet Airworthiness, New Categories of Aircraft, and Aircraft Type Certificates.

Falcon Foundation also provides civil representation for clients in the Unmanned Aircraft Systems (UAS) industry. We are an experienced team with proven expertise and we understand that UAS, above all, is an aviation industry enterprise. We embrace that fact. Commercial aviation is a complex and diverse market environment. Thriving players have lobbied in DC for decades, but the landscape is evolving rapidly as disruptions in technology and policy continue to emerge. A bold, innovative, and adaptive approach to lobbying on Capitol Hill is crucial for UAS specialists.

Notably lacking in the UAS industry is decisive leadership founded upon sound scientific consensus, validated data, and resilient logic. To move forward, stakeholders need to formulate sustainable and competitive strategies designed around long-standing professional aviation values, safety standards, and sound operating principles, not idiosyncratic amateur or hobby user practices. Standards for aviation professionals are deliberately and exceedingly high. Rigorous application and compliance to strict guidelines are fundamental requirements. We embody these principles and we support their application as a matter of intellectual and ethical integrity.

We provide teams and partners with strategic and tactical support to pursue legislation conducive to advancing significant UAS industry interests. Our approach realizes untapped potential in long-term relationships with aviation professionals across the spectrum of industry and regulatory governance.

Our mission is to establish your strategic philosophy from the ground up to ensure that your contribution to unmanned aviation industry will fly safely, securely, and successfully for generations to come.

Falcon Foundation UAS L.L.C. provides leading advocacy efforts in the unmanned aircraft systems industry by managing government relations committees of association clients, executing legislative and regulatory strategies. We work independently on advocacy issues, educating the clients on public policy issues quickly, by engaging team members to facilitate successful results. Client policy issues will include aviation regulation, unmanned aircraft systems safety, the regulatory process, and industry safety concerns. Client groups include aviation professionals, unmanned aircraft systems, and operators, both commercial and hobbyists, and non-aviation business sectors, including small busi-

ness service and manufacturing sectors.

Primary Service Offerings:

- Research, analyze and summarize legislative and regulatory issues impacting the client associations.
- Represent client associations on Capitol Hill, before federal agencies, and in industry coalitions.
- Monitor state issues and act as a liaison for organizations of state and local officials.
- Support to compliance programs and development of compliance resources for regulated sectors, including content for rule making and federal programming.
- Manage grassroots activities for client associations.
- Provide primary staff support to association committees, leading committees and volunteers towards strategic goals and measurable outcomes.
- Regularly communicate with association volunteers on industry and association issues.
- Oversee and coordinate Capitol Hill and agency visits by members of client associations.
- Produce regular advocacy updates for client associations newsletters, publications, and websites.

CUAS COALITION

What is the CUAS Coalition?
The C-UAS Coalition was formed in 2017 by Falcon Foundation UAS, advocates for public affairs and public policy the voice of the CUAS technology stakeholders in Washington.

Why was the CUAS Coalition formed?

The CUAS Coalition was formed to help industry stakeholders engage government to forward the usage of CUAS technology and policy surrounding the counter drones industry. The global counter drones market is anticipated to reach 1.85 billion dollars by 2024. Part of the problem with this forecast is that drones for civil use is currently illegal in almost all cases the operator of CUAS equipment would be held liable for damage incurred by using the equipment even in some cases of nefarious actors.

What is the purpose of the CUAS Coalition?

The coalition's purpose is to serve as a thought leader in the CUAS ecosystem to provide its expertise on how CUAS technologies should be regulated and technology developed to combat threats. Members of the Coalition appreciate the need for regulation to be balanced and CUAS technology appropriately used, and as a defensive measure to protect people and assets while still promoting safety and innovation.

Voice on Capitol Hill

The CUAS Coalition is your voice on Capitol Hill for the CUAS industry representing manufacturers, asset owners, equipment owners and operators, researchers in the field of CUAS and counter terrorism. Our members have positioned themselves to bring value and experience on legislative and government affairs for the unmanned aircraft systems industry.
Procurement | Research
The CUAS Coalition offers a variety of individual government consulting services for our members seeking government entities regarding all aspects of government contracting practices, Improved methods to increase contracting with minority and women-owned businesses. We also help create opportunities for startups and DIY garage builders.

Advocacy

We are experienced and well equipped to speak with any agency specific to your scientific based research and equipment as a manufacturer, asset owner or owner operators. Our knowledge and understanding of the many government funded programs and experience with technology makes for a smooth transition into the government procurement process.

Industry Intelligence

Technology has to remain cutting edge for counter measures to be effective, as the market increases those who have science based programs will ultimately prevail over those who have not learned the most evasive technologies in CUAS. We partner with only those who have compelling technology that can win challenges and technology reviews.

Business Development

We provide business development opportunities from our list of trusted contacts in the public

and private sectors. The CUAS industry is considered to be in the pioneering phases when it comes to the protection of civil assets. We assist equipment manufacturers, stakeholders and owner operators who want to operate legally and protect their assets from rogue drone pilots.

Compliance

Our coalition was formed to create industry standards and to help those that need CUAS equipment navigate the complex legal landscape that surround the use of CUAS. Standardization and compliance of equipment operators will help in advocacy and creating a pathway for private usage in a growing market.

The 2018 Small Unmanned Systems Business Exposition is brought to you by the following sponsors.