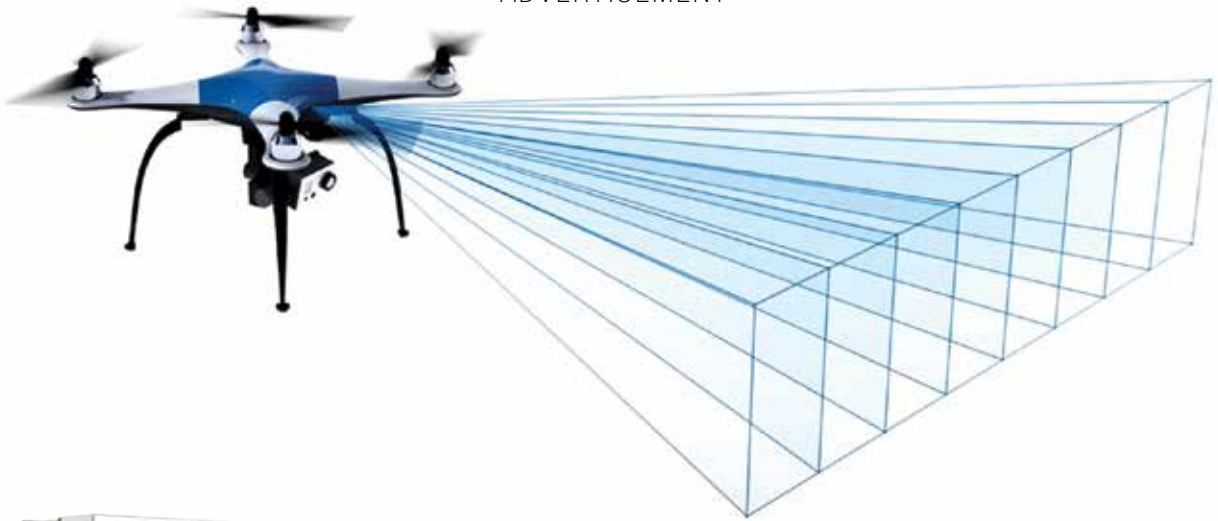# UNMANNED
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UAS Collision Avoidance: LeddarVu Solid-State LiDAR Platform Opens New Possibilities

Recently launched by LiDAR specialist technology provider LeddarTech, the new LeddarVu platform brings a whole new spectrum of possibilities for drone and unmanned vehicle detection and ranging applications. With its long range, its compact format and a robust, modular solid-state multi-segment design, the affordable LeddarVu will be the core technological platform that drones and UAVs will all rely on for safe and reliable navigation in the near future. Here's everything you need to know about LeddarVu.

LeddarVu is the new buzzword in LiDAR sensing these days. Can you tell us what is so special about this platform?

LeddarVu is the platform for the new generation of sensor modules. Simply put, LeddarVu enables the design of high-performance, affordable, and compact solid-state LiDAR sensors. Sensing devices developed on LeddarVu are very cost-efficient, providing very reliable measurements in all kinds of environments: bright sunlight, night, rain, snow, or dust. LeddarVu also has a very high degree of modularity to suit all kinds of applications, with components being easily customizable.

The first module developed on the LeddarVu platform is the Vu8. What are the benefits of this new sensor for drones and UAV builders?

The most interesting benefit of the Vu8 for unmanned aerial vehicles is without question its very compact and modular form-factor. At only 75 grams, it can be integrated in a wide range of products, from high-end consumer drones to military-grade UAS. Furthermore, the Vu8 gives the manufacturer complete freedom to fit the sensor into its own specific design since the emitter, receiver and carrier board components can be integrated as separate physical entities.

The laser (emitter), lens (receiver) and carrier board can be integrated as modular entities with LeddarVu.

Additionally, the Vu8's range and resolution enable the design of sophisticated navigation and collision avoidance applications. Depending on the sensor's configuration and target reflectivity, a drone leveraging the powerful LeddarVu technology can detect objects at up to 200 meters, which is more than enough for fast and accurate sense-and-avoid systems. The Vu8's 8 independent detection segments and powerful signal processing allow it to detect and locate multiple objects simultaneously, and even demerge multiple targets that are close to each other, an action that ultrasonic detectors cannot do as well.

LeddarVu excels at multi-object detection and target demerging.

LeddarVu provides superior performance in extreme ambient light conditions and features a high tolerance for inclement weather and particles. Since most UAVs are used outdoors, this is an invaluable advantage for reliable operation in direct sunlight, rain, snow or otherwise unpredictable and changing conditions in which most vision cameras fail.

Finally, it is worth saying that the LeddarVu platform has been designed to follow the evolution of the next generations of LeddarCore ICs. As previously announced with the company's development roadmap, upcoming iterations of LeddarCore ICs are expected to deliver even greater ranges and fields of view, up to full matrix LiDAR sensing. The Vu8 is only the beginning.

What are the target applications of LeddarVu sensors for drones?

LeddarVu brings unique added value for applications that require a high level of spatial awareness in complex environments, such as cities, woodlands, indoor structures or any other area that presents high risks of collisions.
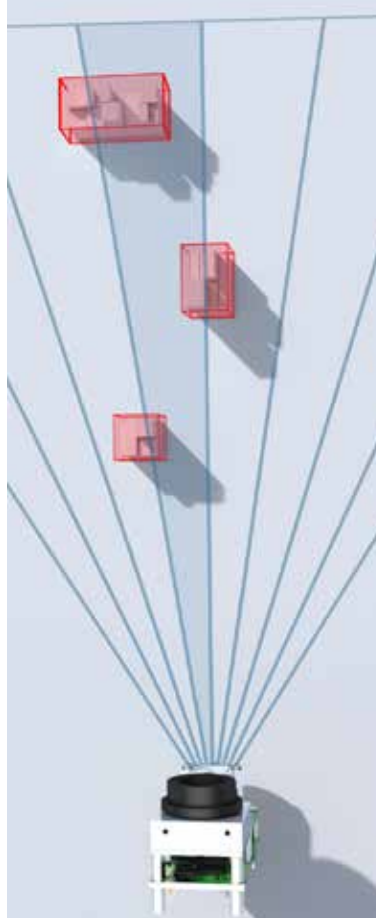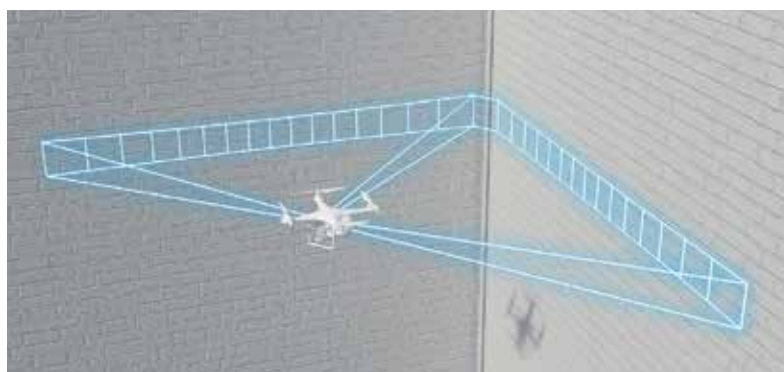
Most of today's drones fly without much visibility of their surroundings, which represents one of the key challenges for the UAV industry. Outdoor navigation brings a constant threat of collision with structures, objects and people. Indoor navigation, with which GPS and barometric pressure sensors become unreliable, also require constant spatial awareness for the drone to safely and successfully complete its flight mission.

Besides the obvious risk of collision related damages, the industry realizes that even a few high-profile incidents involving drones risk seriously damaging the industry's public image. These incidents could even push regulatory bodies toward more stringent UAV safety rules and flight restrictions. Therefore, new sense-and-avoid solutions, such as LeddarVu can improve drones' awareness of their environment and are a priority for most drone manufacturers.

The use of UAVs for the inspection of a variety of structures, such as buildings, large airplanes, bridges, dams or wind turbines, also is a rapidly growing field. Yet, existing drone sensors are still unable to provide sufficient and reliable positioning information to ensure precise and safe navigation in proximity of these structures. As a result, successfully completing an inspection that may require specific distances or positions from the inspected structure can prove to be a challenging mission.

As the smallest and lightest LiDAR sensor for drone sense-and-avoid currently available, LeddarVu can be used as a standalone technology or integrated as part of a sensor-fusion solution for complex navigational tasks, such as the ones required by fully autonomous UAS.

Source: LeddarTech Inc.

Brian Wynne
President and CEO

> **'** **AUVSI projects that the expansion of UAS technology will create more than 100,000 jobs and generate more than $82 billion to the economy in the first decade following integration.** **'**

UAS Industry Poised for Incredible Growth

From inspecting pipelines to surveying bridges to filming movies, UAS help save time, save money and, most importantly, save lives. It's no wonder why thousands of businesses — small and large — have already embraced this technology.

We now have initial regulations governing civil and commercial UAS operations, which means even more businesses are cleared for takeoff. While these regulations have been in effect for just over a month, there is strong evidence that the commercial UAS market is poised for significant growth.

On Aug. 29, the Federal Aviation Administration implemented the small UAS rule. The rule established a flexible, risk-based approach to regulating UAS. This new regulatory framework helps reduce many barriers to low-risk civil and commercial UAS operations, allowing businesses to harness the tremendous potential of UAS.

It's clear that businesses are eager to take off. On the first day the rule went into effect, more than 3,300 people had already signed up to take the aeronautical knowledge test, a requirement under the new rule. Of the more than 530,000 people who have registered their UAS with the FAA since last December, about 20,000 have indicated they are commercial operators. The FAA expects that more than 600,000 UAS could be flying for commercial use over the next year.

AUVSI projects that the expansion of UAS technology will create more than 100,000 jobs and generate more than $82 billion to the economy in the first decade following integration. After witnessing the growth of the industry over the last few years and now with the small UAS rule in effect, I am confident those numbers will go even higher.

In addition to the implementation of the small UAS rule, Congress passed and the president signed an FAA extension which will advance UAS research, expand commercial operations and enhance the safety of the national airspace for all aircraft — manned and unmanned.

Government and industry collaboration is critical for keeping up with the pace of our industry's innovations. Key stakeholders in industry and government have successfully fostered a working relationship that has led to a more flexible and nimble approach to regulating UAS. It was in this spirit that the new Drone Advisory Committee held its first meeting on Sept. 16.

AUVSI is hopeful that the sustained efforts of all parties will help pave the way for a true, holistic plan for full UAS integration that includes beyond line of sight operations, flights over people, access to higher altitudes and platforms above 55 pounds.

The final small UAS rule is a great start, but there is still much more work to be done.
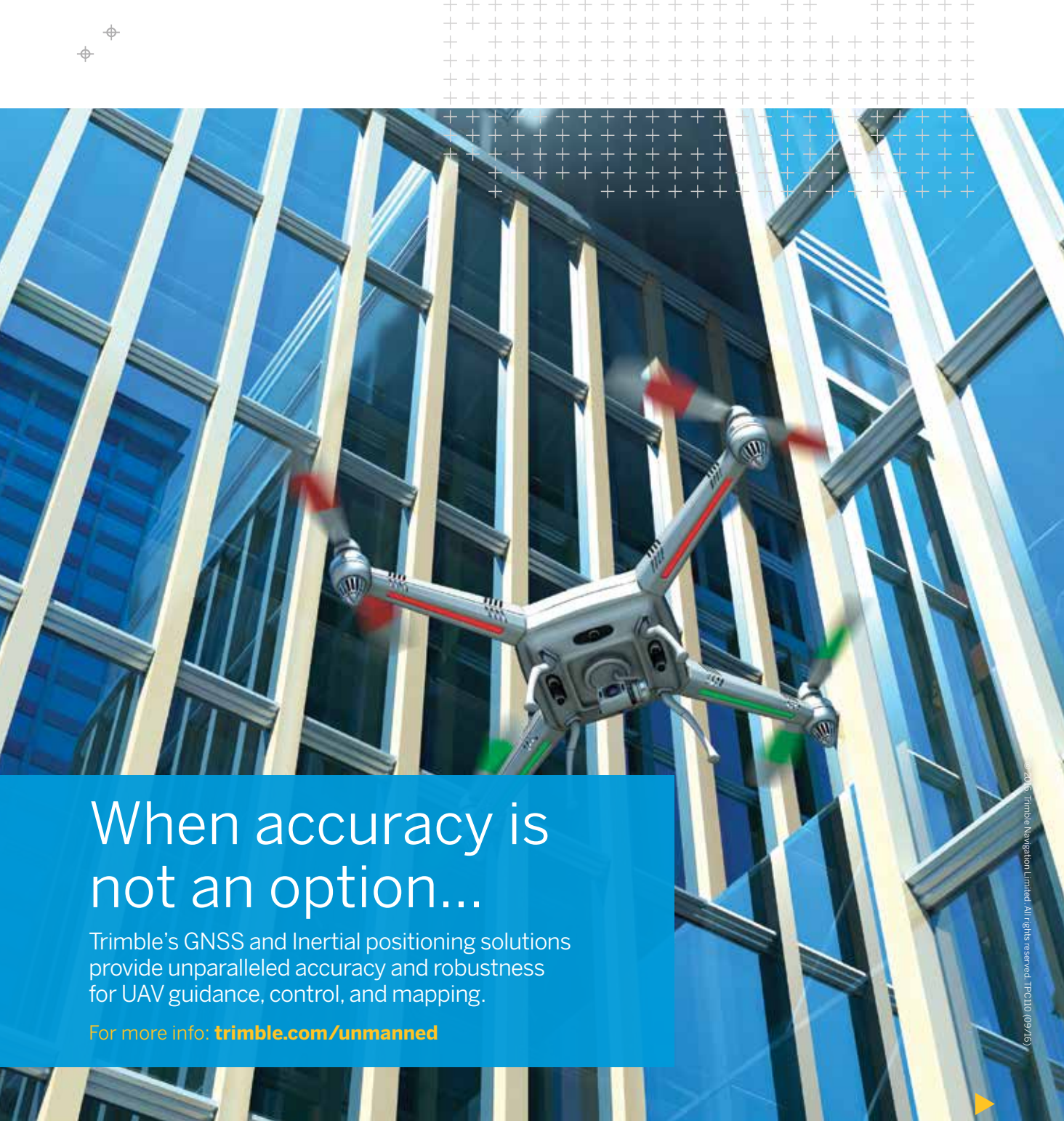
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ASSOCIATION
EVENTS

FEATURED EVENT

Know Before You Fly: How to be a Responsible Drone Pilot

Nov. 2, 2016, 3:00-4:00 EST

Precision Agriculture in the Drone Age
Dec. 7, 2016, 3:00–4:00 p.m. EST

XPONENTIAL 2017
May 8–11
Dallas, Texas

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Logos Debuts Kestrel KS-200 WAMI Sensor

Fairfax, Virginia-based Logos Technologies debuted its new Kestrel KS-200 wide-area motion imagery (WAMI) sensor at the U.S. Army Association's annual meeting in Washington.

The KS-200 is a smaller, lighter WAMI sensor than the previous Kestrel system, meaning it can be deployed on smaller and lighter aerostats.

However, due to improvements in components, it delivers slightly better performance than the older system, and for the first time is exportable as well.

"It has a little better resolution, a little larger area of coverage, and we cut the weight in about half," said Doug Rombough, Logos' vice president of business development.

The earlier Kestrel had six cameras, three day and three night; KS-200 has eight, with four electro-optical and four infrared. The infrared cameras are not the highest specification ones available, thus allowing for the system's export, but the company could upgrade them for U.S. customers if desired.

Logos Technologies' new export-ready Kestrel KS-200.

Lockheed Martin recently launched a Vector Hawk drone from a Marlin MK2 underwater vehicle.

Lockheed Martin Launches Drone from Underwater Vehicle

Lockheed Martin recently launched a small drone from an autonomous underwater vehicle with an assist from an unmanned surface vehicle, which company officials said marked a milestone in robotic cooperation.

The demonstration, announced in late September, occurred in August at the Annual Navy Technology Exercise Activities. In it, a small Vector Hawk UAS launched from a Marlin MK2 underwater vehicle.

A third unmanned system, the Submaran USV developed by Ocean Aero, helped with the launch of the Vector Hawk and also supplied surface reconnaissance and surveillance in combination with the other two systems.

The Submaran USV transmitted instructions to the Marlin AUV from a ground control station through underwater acoustic communications. After this, the Marlin was able to launch the Vector Hawk from the surface of Rhode Island's Narragansett Bay using a specially designed canister. Once in the air, the Hawk went on its planned flight path, and all three unmanned systems communicated with the ground control station without errors.

"This effort marks a milestone in showing that an unmanned aircraft, surface vessel and undersea vehicle can communicate and complete a mission cooperatively and completely autonomously," said Kevin Schlosser, chief architect of unmanned systems technology at Lockheed Martin.

Korean Air, Boeing Team to Create Unmanned Helicopters

Korean Air has signed a memorandum of agreement with Boeing to work together to create new 500MD unmanned helicopters.

As a part of the MOA, Boeing will supply Korean Air with technical support for flight control and test evaluations. The two companies will also conduct a joint marketing program overseas.

The new helicopters will advance upon the technology of the ROK air force's retired 500MD helicopters, which over the course of two years from 2014 to 2016 were transformed from manned helicopters to unmanned helicopters. Korean Air will soon begin turning these unmanned helicopters into unmanned, armed aircraft, with an expected completion date of 2017.

DJI's new compact UAS, the Mavic Pro.

DJI Releases Compact Mavic Pro UAS

DJI released its compact new Mavic Pro unmanned system at a press event in New York City in late September.

Able to perch in the palm of a hand, the Mavic Pro comes equipped with DJI's FlightAutonomy system, which is responsible for guiding the flight, planning routes and making sure that the UAS stays on course and avoids objects and other perilous circumstances. The system includes five cameras, GPS and GLONASS navigation systems, a pair of ultrasonic range finders, redundant sensors and 24 powerful computing cores.

Other unique features incorporated into the Mavic Pro are a 4K camera, a 4.3-mile range capability, and the ability to land safely back at its initial launch point even if it loses touch with its controller.

"DJI has spent a decade making it easier for anyone to fly, and by rethinking everything about how a drones look, we have created an entirely new type of aerial platform for anyone to explore their creativity," said DJI's CEO and founder Frank Wang.

PrecisionHawk, Skyward to Create One-Stop Shop

North Carolina-based UAS and software company Precision-Hawk and Oregon-based drone operations management company Skyward announced a new partnership in September, which they said would give customers a one-stop shop to plan, map, manage and analyze their work with drones.

As a part of their partnership, PrecisionHawk's Lancaster UAS, DJI Smarter Farming package and DataMapper function will be equipped with Skyward's flight operations system. Precision-Hawk's LATAS (Low Altitude Traffic and Airspace Safety) safety platform will also be equipped with Skyward's airspace intelligence tools.

"This partnership with Skyward allows us to provide a complete commercial drone offering to the market," said Precision-Hawk cofounder and President Christopher Dean. "We are excited to partner with Skyward and bring this holistic offering to our customer base."

Textron Unveils Synturian; Part 107 Helps

Textron Systems Unmanned Systems announced its newest set of ground control station tools, the Synturian family of products, in early October.

The systems are Synturian Control and Synturian Remote.

They are intended to simplify training for operators, and can handle multiple vehicles at once, and not just air systems — Textron's Common Unmanned Surface Vehicle can be used with Synturian as well.

In testing Synturian, Textron used the new Part 107 small UAS rule from the Federal Aviation Administration to speed its time to market.

Gregg Shimp, vice president of engineering for unmanned systems, said Textron bought three different small, commercial-off-the-shelf UAS to help validate software for Synturian.

That allowed testing to be done at the company's Hunt Valley, Maryland headquarters, rather than traveling to its Blacksburg, Virginia, location, near the Mid-Atlantic Aviation Partnership, the state's FAA-approved UAS test site.

Textron Systems' new Synturian ground control station.

UAS, UGVs Deployed in the Wake of Italian Earthquake

Unmanned technologies were used to assist in the relief efforts in Amatrice, Italy, after a massive earthquake hit that town and surrounding ones in late August.

The TRADR (Long-Term Human-Robot Teaming for Robot-Assisted Disaster Response) project is providing the technologies that helped inspect two badly damaged churches, the San Francesco and Sant`Agostino.

Using two UGVs and three UAS, the TRADR project was able to create 3-D textured models of the churches. Both buildings were in a state of partial collapse, so the technologies were used to help the process of shoring operations and seeing the conditions of valuable objects within the churches. The UGVs traveled inside of the churches, while the UAS provided coverage from both inside and outside of the churches.

According to people involved, the use of the technologies was very successful. They provided enough data to construct the 3-D textured models, and that information will be given to the Italian Vigili del Fuoco and the Italian Ministry of Culture. The TRADR project was also able to deploy the technologies to the town within 48 hours of receiving the request for help.

FlyCam and US Nuclear's radiation-spotting UAS.
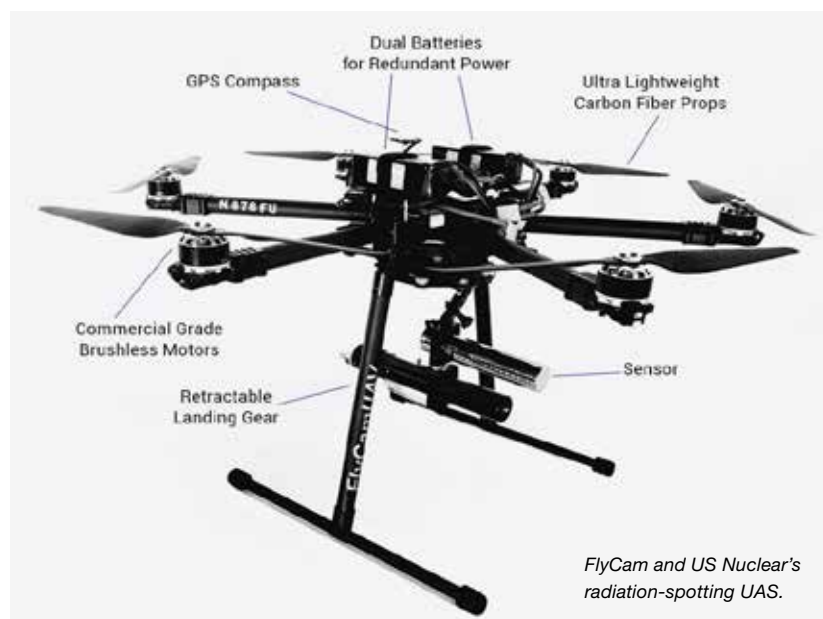
Companies Team to Create UAS for Detecting Radiation, Chemical Leaks

FlyCam UAV and US Nuclear Corp. have combined to create two unmanned aircraft capable of detecting radiation and chemical leaks.

FlyCam's Cypher 6 hexacopter and the all-weather NEO octocopter are designed to carry US Nuclear's DroneRad system, which can detect alpha, beta, gamma and neutron radiation. A gas collection option can be used for radiological, chemical and biological detection missions.

"Sensors mounted on UAVs is the perfect marriage of two technologies that will be a game changer for a variety of different industries," said Jeri Donaldson, CEO and owner of FlyCam UAV. "In addition, the need for security is at an all-time high and our technology can remove the human element from a potentially dangerous situation. The practical and potential applications of the Cypher 6 and Neo with US Nuclear Corp.'s DroneRad sensor package are enormous and we have yet to see all of the use cases of the devices."

The two UAS are capable of transmitting data to operators in real time. The data can be tagged with GPS coordinates to tell exact locations, and that information can be stored onboard, with the option to view or download it after a flight.

EUROCAE Approves New UAS Working Group

The EUROCAE Council has approved the creation of a new working group, WG-105, which will be responsible for creating standards that ensure UAS operate safely in the air, regardless of the circumstances.

The WG-105 will feature six different focus teams that will work in the following areas:
• UAS traffic management, including geofencing and identification
• Command, control and communication, including security aspects
• Detect and avoid, addressing conflict management for all conditions of operation
• UAS automation, covering automatic takeoff and landing, automatic taxiing and automatic/emergency recovery
• Design and airworthiness standards
• Specific operational risk assessment

The establishment of WG-105 comes one year after the European Aviation Safety Agency passed the A-NPA 2015-10, new legislation that established laws for UAS based on the type of flight and risk that is involved with that flight, instead of making laws based on the type of unmanned aircraft being flown.

AUVSI's Brian Wynne chats with Rep. Cresent Hardy before the hearing.

Small UAS Rule a Good First Step

The release of the Federal Aviation Administration's small UAS rule is a good first step toward boosting the growth of the unmanned systems industry, but it remains to be seen how fast and flexible the rule's waiver provisions will be, several industry representatives told members of Congress in late September.

AUVSI President and CEO Brian Wynne noted that AUVSI's economic forecast calls for more than 100,000 new jobs and $82 billion in economic impact in the first decade following the rule, and he added, "after witnessing the growth of the industry over the last few years and now with the small UAS rule in effect, I am confident those figures will be even higher."

Wynne and other industry representatives testified before the Small Business Committee's subcommittee on investigations, oversight and regulations, whose chairman, Rep. Cresent Hardy (R-Nevada), said he wanted to know how the small UAS rule is impacting businesses and their future plans.

Gabriel Dobbs, vice president of business development and policy at drone startup Kespry, said the rule, also known as Part 107, is "a huge improvement" over the previous exemption process used by the FAA.

However, he said it's not clear whether the waiver process will be sufficiently speedy at the FAA, and said a micro UAS classification, which would allow virtually unrestricted flights of very small systems, should have been included in the rule.

Wynne said that the recent FAA budget extension passed by Congress includes a call for the creation of a comprehensive UAS research and development roadmap, and also extends the exemption process to allow for beyond-line-of-sight operations.

"While this measure will provide some short-term stability through September 2017, it is critical that Congress pass a long-term bill next year that will set the industry and the country on a glide path to reap all the benefits of UAS," Wynne said.

Nokia to Test Unmanned Aircraft Management System

Cellphone company Nokia plans to develop and test a UAS traffic management system on unmanned aircraft in the Netherlands.

Using a variety of technology including an LTE modem, GPS transceiver and other telemetry modules, Nokia will provide unmanned aircraft with flight automation, no-fly zone control and beyond-visual-line-of-sight capability. Nokia will also provide UAS operators with an app that allows them to monitor real time air information. The system is expected to be adaptable to different regulatory standards of each country.

The testing will take place at Twente Airport, a regional airport in the eastern part of the country near the cities of Enschede, Hengelo and Oldenzaal.

British Navy Hosts Unmanned Warrior Joint Exercise

In October, the British Royal Navy was slated to host the first ever Unmanned Warrior joint exercise to test unmanned, unarmed surface, underwater and aerial vehicles.

The U.S. Navy was to be a part of the event, scheduled for Oct. 8-20, along with other members of the naval science and technology community.

"Unmanned Warrior provides a unique opportunity to showcase our technical and operational autonomous technologies, while simultaneously strengthening our international partnerships with all participating nations," said Rear Adm. Mat Winter, U.S. chief of naval research.

Rules of the Road

DOT Guidance on Automated Vehicles Aims to be Flexible

In July, speaking at AUVSI's and TRB's Automated Vehicles Symposium in San Francisco, Secretary of Transportation Anthony Foxx promised a federal automated vehicles policy that would "prepare our ecosystem to integrate these new types of vehicles into the bloodstream of American infrastructure."

In late September, the Department of Transportation released that policy, which provides guidance on monitoring and reporting vehicle performance, a model policy for states to avoid having a patchwork of regulation, and some new regulatory tools that will help regulatory agencies stay ahead of the new technology.

Speaking in front of a lineup of automated vehicles, including an Audi, Toyota and Cadillac, Foxx said that "in the 50 years of the United States Department of Transportation, there has never been a moment like this. A moment where we can build a culture of safety as a new transportation technology emerges that harnesses the potential to save even more lives and that will improve the quality of life for so many Americans."

Brian Wynne, President and CEO of AUVSI, said in a statement that the policy is "another example of industry and government working together to advance innovations. The guidelines create a flexible framework that is critical to safely accelerate the deployment of automated vehicles and accommodate future innovations. By defining the federal and state responsibilities in regulating automated vehicles, they also provide the regulatory clarity necessary to foster the advancement of this emerging technology."

Most of the document focuses on highly automated vehicles, ones that can take full driving control in at least some circumstances, which is defined as Level 4 automation according to SAE International.

The policy leaves it up to automakers to determine the automation levels of their vehicles — where can they operate, under what conditions, and at what speeds — along with a fallback to a "minimal risk condition" if the automation should fail. That doesn't necessarily mean giving control back to a human driver, who could be sleepy or impaired, but could mean just bringing the vehicle to a stop.

Automakers are to voluntarily provide reports on their systems and their adherence to the guidance, although the policy notes that this reporting could be made mandatory in the future.

If manufacturers make extensive hardware or software changes to a vehicle, such as ones that increase its speed or expand the types of conditions in which it can operate, the manufacturers would need to submit a new safety assessment for those new capabilities.

Automakers also need to have a documented process for testing, validating and collecting crash data or data on other road incidents, which can be used to establish the cause of any problems.

That would include "positive" incidents, where an automated vehicle successfully avoids an accident.

Vehicle makers will also need systems to allow vehicles to share data, such as on road conditions, but without violating the privacy of vehicles owners.

"Data sharing is a rapidly evolving area that requires more research and discussion among stakeholders to develop consensus on data standards," the policy says.

Manufacturers also need to pay careful attention to the human-machine interface, so drivers know when the system is doing the driving and when they need to take over. Drivers also need to be educated on how the systems work, and DOT suggests giving them on-road or on-track, hands-on experiences.

Model State Policy

To avoid having more than 50 regulatory schemes across the country, DOT "strongly encourages states to allow DOT alone to regulate the performance of HAV technology and vehicles," the policy says.

If a state goes ahead with its own rules, it should consult with the policy and with the National Highway Transportation Safety Administration. However, federal performance regulations will trump state rules, the policy says.

States can use their authority to set up highway safety programs, driver education and testing, vehicle inspection programs and other related policies.

Among other things, the model framework calls for states to set up a lead agency responsible for consideration of any highly automated vehicle testing, and should determine liability rules for such vehicles. If an automated vehicle crashes, who is liable?

"For example, states may determine that in some circumstances liability for a crash involving a human driver of an HAV should be assigned to the manufacturer of the HAV," the policy says.

New Tools

While NHTSA already has a substantial number of regulatory tools at its disposure, it sometimes needs new ones as new technology arrives, the guidance says.

This could include pre-market approval authority for some HAV systems, the way that the Federal Aviation Administration uses it to pre-approve autopilot systems on commercial aircraft and drones.

Under that scenario, rather than having manufacturers self-certify to standards, "NHTSA would test vehicle prototypes to determine if the vehicle meets all such standards," the document says. That could contribute to public confidence in the vehicles, according to the DOT.

Foxx said the proposed guidance isn't the last word, and the agency expects significant input from the public.

"We do not intend to write the final word on highly automated vehicles here," Foxx said in the document's introduction. "Rather, we intend to establish a foundation and a framework upon which future agency action will occur."

He also noted that it will be updated yearly, and said, "we very much look forward to the dialogues that will emerge in the coming weeks and months and thank you in advance for helping us."

▲

Secretary Foxx promises an automated vehicles policy at the AUVSI-TRB Automated Vehicles Symposium.

Industry, Regulators Look Beyond Small UAS Rule

Kicking off the 2016 Interdrone conference, Federal Aviation Administrator Michael Huerta predicted there could be as many as 600,000 UAS used commercially in the first year after the enactment of the small UAS rule, also known as Part 107.

At the conference, industry and regulators alike discussed how UAS could move beyond the restrictions of Part 107, which was barely a week old at the time of the conference in early September.

Part 107 includes a waiver provision where companies can be granted approval to fly in ways that go beyond what's allowed in the rule. By mid-morning of the first day it took effect, Aug. 29, Huerta said the agency had already approved 76 of them, and is continuing to grant several a day.

Many of those had been in the works before the rule debuted. Speaking later in the day at the same

conference, the FAA's Marke "Hoot" Gibson, senior advisor on UAS integration, said the current waiver approval time is around 90 days, but the FAA is trying to shorten that.

One thing it is doing is urging companies to study waivers that have already been granted, so theirs can be approved more rapidly. Gibson said the bulk of the requests are for flights at night, with flights beyond visual line of sight running a distant second.

"I think it's really going to move the industry along," Gibson said of the waiver process.

More rulemaking is on the horizon. The agency expects to have a proposed rule for flying over people out by the end of the year, with another for beyond-line-of-sight flights coming next year.

"This is laying the foundation for more numerous and more complex drone operations," Huerta said.

Two companies who are pushing

for more complex drone operations are Amazon and Intel. Amazon has its Prime Air project, which Paul Misener, vice president of global innovation policy and communications, speaking at an afternoon session, said currently includes the testing of several prototype drones at development centers in the United States, the United Kingdom, Austria and Israel.

"We anticipate a family of prototypes and operational vehicles," he said.

Amazon is also testing a variety of new flight methods in the U.K., including beyond line of sight, multi-vehicle operations from a single pilot and sense and avoid technology, which will be crucial.

Misener said the company wants its delivery drones to be autonomous like a horse; you can crash a car into a tree or a bush, but "try making a horse run into a bush or tree. It won't do it."

The FAA's Marke "Hoot" Gibson discusses the growing commercial UAS market at CTIA Super Mobility.

The Wireless Connection

Interdrone was happening at the same time in Las Vegas as CTIA's Super Mobility 2016, the wireless industry show. Speakers at both conferences said wireless industry can help take unmanned aircraft to the next level, even as unmanned aircraft help make the wireless industry safer and more efficient.

Chris Anderson, CEO of 3D Robotics and founder of DIY Drones, said at the Interdrone conference that cloud and cell phone connectivity will enable drones to get smarter faster, so they don't have to remap the world just for themselves every time they move through it.

Borrowing from the automated vehicle industry, drones can instead tap into maps that are updated by millions of users to learn about their environment.

"When you start thinking about cloud architecture you think about fence and avoid. Sense and avoid says I know nothing, I am groping my way around," he said.

With the concept of fence and avoid, "I walk in a room, and say, hey, has anyone been here before? Get a map, and then use my eyes to focus on any change."

It's a shared world concept familiar to players of Pokemon Go, where different phones interact with a real world that has additional data displayed on top of it, he said.

The same thing is happening in the automotive world, through apps like Waze, where drivers report changing road conditions to a shared database. Cars equipped with cameras are starting to scan the roads and share that information as well.

"We're sharing this with the autonomous car world," Anderson said. "We're in the same business, we're solving the same problems, we're go-

ing to solve them the same way."

Speakers at CTIA agreed that the wireless industry can help take unmanned aircraft to the next level, while unmanned aircraft help make the wireless industry safer and more efficient.

AUVSI hosted a panel discussion at Super Mobility on the use of drones in the wireless industry and AUVSI President and CEO Brian Wynne took part in another panel focusing on use cases for drones.

In the first panel, industry representatives discussed their connectivity needs and how they use drones to make their work safer and more efficient.

Cell phone networks need cell phone towers, and cell phone towers are things that currently are mostly inspected by having climbers go up them. Art Pregler, director of national mobility systems for AT&T, said his company has 65,000 cell tower sites, with "people on our towers daily."

That means about 15,000 workers climbing cell towers almost every day.

Sean Cushing, president and COO of Hazon Solutions, said his company also wants to reduce the number of tower climbers needed, although he said drones wouldn't replace all of them.

"Climbers have their place. I believe the last climber has not been born yet," Cushing said.

However, drones could be used to help reduce the number of climbs that aren't necessary, he said.

"The metric may never really be known, but if we can see over time a reduction in the number of unnecessary climbs, hopefully we'll see a reduction in injuries that comes from that," he said.

Drones are getting easier to fly, as evidenced by Intel's RealSense technology, which puts a sense and avoid package into a tiny tube. However, speakers on the panel said that

operators will still need to be highly trained rather than just relying on that technology.

Cushing noted that his 16-year-old son is old enough under the new small UAS rule to fly a drone, but said he's not mature enough to operate it without safety backups, such as geofencing that would keep it from flying too high or in places it shouldn't go.

"The improvements in technology are why we can have these discussions," he said. "It wasn't too long ago that the safety and the controls really didn't give us the confidence to perform these acts. Now that we have that we cannot forget the training aspect of it."

During the second panel, representatives from AT&T and Qualcomm discussed their recent announcement that they have teamed to fly drones using AT&T's LTE network. The companies have had more than 500 flights so far, said Qualcomm Executive Vice President and Chief Technology Officer Matt Grob. They're doing the testing to understand the capability and the effect of such use on the network.

Matt Walsh, director of business development for AT&T's IoT Solutions, said the partners are studying the effects on the network of adding drones to the network, although it already handles millions of cell phones so should have enough capacity.

"That's what we're looking at now," he said. "What does it look like when you're not just flying one drone but when you multiply that by 100 and do it in a single area?"

Situational Awareness

Mapping Helps Keep Drones out of Trouble

By Karen Aho

Firefighters were battling a Utah wildfire this summer when a helicopter's water bucket nearly hit a little drone. Officials immediately suspended air operations.

"If a drone blends blades with a helicopter I am piloting, I am dead. Period," one helicopter pilot commented on a Wall Street Journal story. "Losing the main rotor blades means my aircraft is completely uncontrollable and falls like a streamlined anvil."

By mid-August, stoppages had occurred on a dozen wildfires across the West after UAS sightings, despite a government public relations blitz aimed at hobbyists and, in California, $25,000 rewards offered for information on interfering drones.

"Most people who are doing this may not even know that they're presenting a hazard," says Adam Lisberg, corporate communications director for DJI North America.

Soon, most won't have to know; their drones will. DJI, which supplies an estimated 50 to 70 percent of the global recreational drone market, has added a new feature from AirMap, software that DJI already uses for its geofencing, that can, for the first time, map out active fire areas immediately, in real time.

"One drone flying in an unauthorized area in a way that could endanger firefighters is one too many," Lisberg says. "We want our customers to operate responsibly; we think the majority of them want to."

AirMap provides intelligence and navigation services for unmanned aircraft. Since launching in 2015, the Santa Monica, California, software company has focused on mapping permanently restricted airspace, around places like airports, prisons and nuclear power plants. Now it is adding dynamic maps based on real-time data to alert pilots to transitory risks: wildfires, manned aircraft, even the temperaments of weather. It provides the map on Know Before You Fly, a drone safety website that is a parternship between AUVSI, the Academy of Model Aeronautics and the Federal Aviation Administration.

"One of AirMap's objectives in everything we do is to make drones a part of everyday life," says Ben Marcus, CEO of AirMap. "And to do that you've got to make other stakeholders happy." First and foremost, it means making people feel safe.

For the wildfire maps, AirMap teamed with the Department of Interior to obtain data straight from the firefighters' central incident command system. AirMap's application programming interface links the data in real-time to a drone's geofencing app. Only those authorized by fire officials can unlock the geofence.

"So if you're flying a DJI Phantom and you're in proximity to a wildfire, there will be a geofence that will prevent the drone from flying in that area," Marcus says. "Any wildfire in the country shows up in this system and we have immediate access to that, so there's no delay."

Previously, drone pilots had to wait for the Federal Aviation Administration (FAA) to issue a Temporary Flight Restriction (TFR), a bureaucratic process that can take so long that some fires have been fought — with aircraft — and extinguished before the order was ever released. Nor can drone operators always spot a wildfire, which could be smoldering under a tree canopy or burning on the other side of a ridge beyond view. "It's not always obvious," Marcus says.

In another new partnership, AirMap has teamed with The Weather Company to provide real-time, hyperlocal weather data, which will be available via AirMap's app for IOS and apple Watch and via AirMap's APIs for developers.

Part 107 regulations require drone pilots to assess local weather conditions before flight, but weather can be a complicated affair. Matt Taylor, The Weather Company's director of business development for aviation, thinks that today's drone operators approach weather in the same casual manner that manned aviators first did, decades ago: We'll fly it when the weather seems right, and if the weather seems bad, well we might fly it then, too.

"When you're out there operating that drone it's not always clear how the weather is above the surface," says Taylor. Clear-air turbulence is one example. "You just can't see it, so you've got to have some weather foresight." At present, it's this low-altitude weather data that's missing in typical weather applications.

The Weather Company, an IBM business, churns out weather forecasts every 15 minutes for 2.2 billion locations worldwide. That's 26 billion forecasts daily uploaded to its cloud-based platform, enough to provide a good sense of the temperature, precipitation, wind speed and visibility for a specific flight location and time. The information should help pilots prevent accidents and assist in scheduling survey and photography work.

For the first stage of the AirMap venture, The Weather Company will focus on surface conditions, a critical layer

due to the sensitive nature of take-offs and landings, and close enough to the flight zone "to make a reasonable proxy for low atmosphere," Taylor says. "We need to prove that's a good use of data" first.

The company can also integrate weather data with the terrain to adjust conditions — a cliff that might create a wind shear, for example. "These computer models are getting more sophisticated," Taylor says. "If it's a minor terrain feature, we do our best. But we do have the platform to make those adjustments."

Also this summer, AirMap announced partnerships with uAvionix, creator of the Ping ADS-B sensor used by many manned aircraft, and PASSUR Aerospace, Inc., a secondary surveillance system of radar transponders that's used by many low-flying aircraft.

"It's still not all aircraft, because some aircraft don't have any transponder at all," says Marcus. "But we're getting many more than if we were doing ADS alone.

"It's all about helping drones understand when there's a manned aircraft coming close," he says.

AirMap also provides a telemetry service that lets drone operators voluntarily broadcast their position to other aircraft.

"Today you look in the sky and there are relatively few drones flying, but we all know that that's changing," he says. "Pretty soon drones will be everywhere. As the density of drones in the airspace increases, we feel it becomes increasingly important for them to share information with each other about where they're operating."

Scan this code with your smart device to see AirMap's page on Know Before You Fly, a drone safety site.
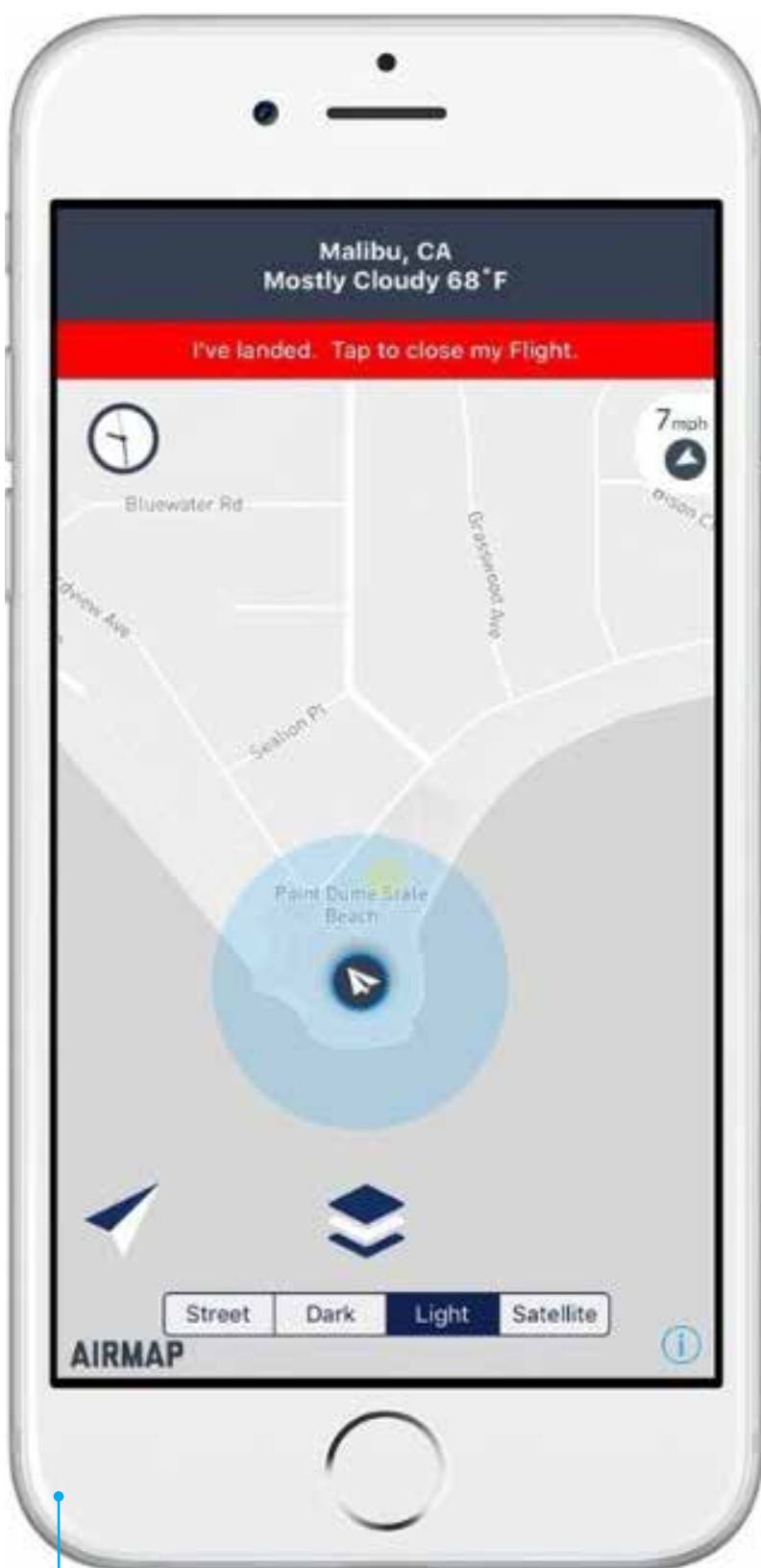
The Weather Company will be working with AirMap to deliver real-time hyperlocal weather data directly to drone operators. Drone operators will be able to access the weather data from The Weather Company via AirMap's app for iOS and Apple Watch as well as AirMap's APIs for developers.

Detect, Scan and Send Them Packing

ApolloShield joins the counter-UAS fray

By Jessica Reyes Sondgeroth

The tech-savvy cofounders of Apollo-Shield built on their experience in an elite espionage unit of the Israeli Defense Force and with startups in Silicon Valley to develop a device that not only detects uninvited unmanned aerial systems, but commands them to return from whence they came.

ApolloShield Chief Technology Officer Gilad Beeri describes the hardware as "a system that detects drones and makes them go away."

Beeri and ApolloShield Chief Executive Nimo Shkedy completed and released version one of the product in August and expect to release a second version by next year.

While Shkedy and Beeri polish up version two, version one is currently being commissioned by a law enforcement agency in "one of the biggest U.S. cities," Beeri said. ApolloShield said it could not identify the organization because the agency wishes to keep that information confidential due to security reasons.

Each unit is about the size of an Internet router and covers a range of up to two miles. Depending on customer needs, ApolloShield can integrate other detection devices including radar, cameras and acoustic sensors. A command center, available with an internet connection, allows the user to monitor the

ApolloShield's counter-UAS device, intended to force rogue drones to return home.

device's readings as it detects and scans drones in its vicinity for their unique user ID. The device gathers that information and uses it to send the UAS a "return home" command.

Beeri said because the device does not jam, or disrupt, communications systems, it is perfectly legal in the U.S., although the company's website touts its ability to offer jamming, interceptor and physical net-launching device add-ons.

Beeri added that ApolloShield does not detect encrypted data that is typical of military drones. And while it's reasonable to understand how the device collects identifying information for commercial UAS, hobbyist drones present a greater challenge.

All drones have some kind of unique identifier, sometimes it's part of their protocol, or the hardware, and sometimes it's just fingerprinting the way they communicate," Beeri said. "If two drones have the same ID, two people with them won't be able to fly them nearby because their [remote controls] won't be able to differentiate between the drones."

But UAS technology is evolving rapidly and one of the biggest challenges for ApolloShield is keeping up with those advancements. This is where Shkedy and Beeri's experience in Israeli Defense Force unit 8200 comes in handy. Unit 8200 is like the Harvard of cyber espionage, on par with the U.S. National Security Administration. That made Silicon Valley a natural transition, where Beeri worked as a consultant and Shkedy a project manager, each for a handful of tech startups.

Keeping up with technological advancements is also where the small company's allocation of funding and resources to research and development will make or break it as competitors emerge and vie for the same customers.

At this moment, ApolloShield has

no known rivals that can offer a product today that detects and sends a "return home" command to civilian UAS, but that doesn't mean similar projects are not in the works. The company's closest competitors offer slightly different services, like the add-ons ApolloShield will accommodate, including jamming devices or a net-launcher that captures UAS and parachutes them to the ground, or they are specifically designed for military activities.

At a rate of about $30,000 per unit, varying by model and customer demands, ApolloShield is targeting large-scale civilian customers, including public event venues like stadiums, prisons and critical infrastructure like refineries, data centers and power plants. These kinds of customers might require four to six units or more and customized software. ApolloShield also hopes to oblige celebrities trying to deflect paparazzi drones from peering into their private estates.

Shkedy and Beeri came up with the idea about a year ago when Israeli supermodel Bar Refaeli declared her wedding with billionaire Israeli businessman Adi Ezra a no-fly zone with the exception of a fleet of UAS commissioned by Refaeli and Ezra to record and photograph the special day. But on that special day, the hired unmanned systems were not alone; they were joined by paparazzi drones.

This got Shkedy and Beeri thinking, "What if we could just make them go away?"

Since then, the two have raised more than $500,000 to fund ApolloShield, and with version 2.0 in the works, they're working on raising more capital and building stronger customer relationships.

But like most of the talk around UAS and UAS-detecting technology, there are questions of legality and

airspace jurisdiction. ApolloShield says its device operates within the parameters of both. The Federal Communications Commission, for example, prohibits the operation or sale of any type of jamming equipment.

"There may be violations of the FCC power limitations. Because the 2.4 GHz and 5 GHz bands used by most drones are shared, unlicensed spectrum, there are FCC rules limiting the power any device can use to broadcast its signals," U.S. communications and UAS attorney Mark Del Bianco said. "A device whose signal can affect drones up to two miles away might be exceeding those power limits and potentially interfering with other devices in that two mile radius, such as home Wi-Fi networks."

Beeri said ApolloShield's device complies with those regulations and doesn't interfere with any wireless networks, not to mention other Wi-Fi networks.

"We are going to comply with FCC regulations, and we're going to transmit the same power as the drone remote control uses, which is FCC certified, so it complies with the rules," Beeri said.

ApolloShield's device relies heavily on UAS transmitting information, but Beeri said they're not too worried about "kamikaze drones," i.e. UAS systems designed to simply complete a task without communication or data transmission to detect.

"Commercial drones flying in autonomous mode still transmit data and have a channel for accepting commands," Beeri said. "So while our system indeed needs the drone to have communication and be accepting commands, that's the situation with all commercial drones, so it's not a real-life issue for us."

ADVENTURES IN BLOS

PrecisionHawk's Lessons Learned Can Inform the Next Set of Regulations

By Rich Tuttle

Now that three companies have received waivers from the Federal Aviation Administration to operate unmanned aerial systems in ways that will help it better understand how these systems can transform the way businesses operate, UAS advocates are focusing more strongly on development of regulations that will ultimately lead to routine use of drones in U.S. national airspace.

BNSF Railroad, CNN and PrecisionHawk got waivers from the FAA on Aug. 29 to use unmanned aerial systems to inspect hundreds of miles of railroad tracks, gather news over people, and fly over vast farmlands.

Information gathered from these three distinct research areas "can inform the next set of regulations," says Thomas Haun, executive vice president for PrecisionHawk, a UAS manufacturer and aerial data processing and analysis company based in Raleigh, North Carolina.

"What are the requirements to fly beyond line of sight" over large farms? "What are the requirements to fly over people? What are the re-

quirements for one-way flights" over great stretches of railroad tracks in rural areas?

"We're all looking at different pieces but it's one pie," Haun says, "so our collective goal is to unlock that next set of regulations for the industry."

Award of the waivers followed more than a year of work by all three companies under Phase 1 of the Pathfinder program, an FAA initiative to speed the early introduction of low-altitude operations for small unmanned aircraft into the National Airspace System.

Phases 2 and 3 will move into implementation on a broader scale, Haun says. Instead of issuing waivers, the FAA would formulate specific regulations. Assuming a UAS operator complied with the regulations, it could, for instance, freely operate beyond visual line of sight in commercial operations.

That's important for agriculture because an operator could go from flying one field at a time to flying a whole large farm. The benefits are obvious.

"Your efficiency goes up, the amount of data that you capture in a small window of time goes up, which really makes your decisions that much more knowledge-rich and responsive," Haun says.

In Pathfinder work leading up to the Aug. 29 granting of waivers, PrecisionHawk studied operations at extended visual line of sight, or EVLOS — the maximum distance at which a solo UAS pilot in command could see an intruding aircraft. The company quantified EVLOS as two to three nautical miles for non-technology assisted UAS operations. But it showed that it's possible to safely increase this "up to 12 times what is achievable within line of sight," a potential boon for a number of operations.

Haun says the company did "over a year's worth of research on the challenge, which is, if visual line of sight is the restriction, how do we ensure the equivalent level of safety yet operate beyond visual line of sight? We demonstrated how that can be done."

Technology is one way, as is the way in which operations are conducted. "What are you doing in advance when you're planning [an] operation? What are you doing during that operation?" he said.

"There are many things that we have learned from operating beyond line of sight under our research program, and those things — those practices, how you prepare, what you do during an operation — we're trying to codify as much as possible, and obviously we want to share that," Haun says. "Our goal is equip everybody with this capability. We want to share that, whether it's training, whether it's technology — any of the above — to make sure the industry is progressing responsibly but expeditiously forward."

Now that its waiver has been granted, PrecisionHawk can fly its UAS beyond visual line of sight, or BVLOS, during commercial operations.

"We still need to abide by everything else, but that specific restriction is freed up," Haun says. The company also has the green light to train people who want to offer EVLOS flights as a service.

Big farms aren't the only places that would benefit from EVLOS operations. In addition to vast agri-business tracts, Haun cites "forests, mining operations, public utilities and other rural industries [as] examples of where extended operations are needed." And to meet the need, he says, PrecisionHawk "has been actively exploring operational and technology solutions."

Since many UAS can be flown with smart phones, tablets or laptop computers, and since their flights are programmed in advance, they can be controlled even though they may be beyond visual line of sight.

But what if other low-flying aircraft, manned or unmanned, such as a UAS being operated by a neighboring farmer, are in the area but also beyond the UAS pilot's sight? And what about tall structures, like trees or high tension lines, that may also be beyond sight?

PrecisionHawk's answer for its own operations is LATAS, or Low Altitude Tracking and Avoidance System. LATAS, an airspace display technology, tells an operator about things in the air and on the ground that should be avoided, and is an example of the technology part of the solution to questions about BVLOS flights, Haun says. PrecisionHawk's LATAS partners are Harris Corp., Digital Globe and Verizon.

PrecisionHawk also has joined with Skyward of Portland, Ore., which supplies commercial UAS software.

The companies say the "partnership provides a one-stop shop for customers to plan, map, manage and analyze their assets using a drone platform." Skyward, among other things, "has very up-to-date, auditable airspace maps, so if the FAA were to put a temporary flight restriction" over a certain area, Skyward's maps would automatically reflect it, Haun says.

So, in addition to monitoring things in the air and on the ground with LATAS, "we're actually talking about the air itself and how it is designated and what those rules are."
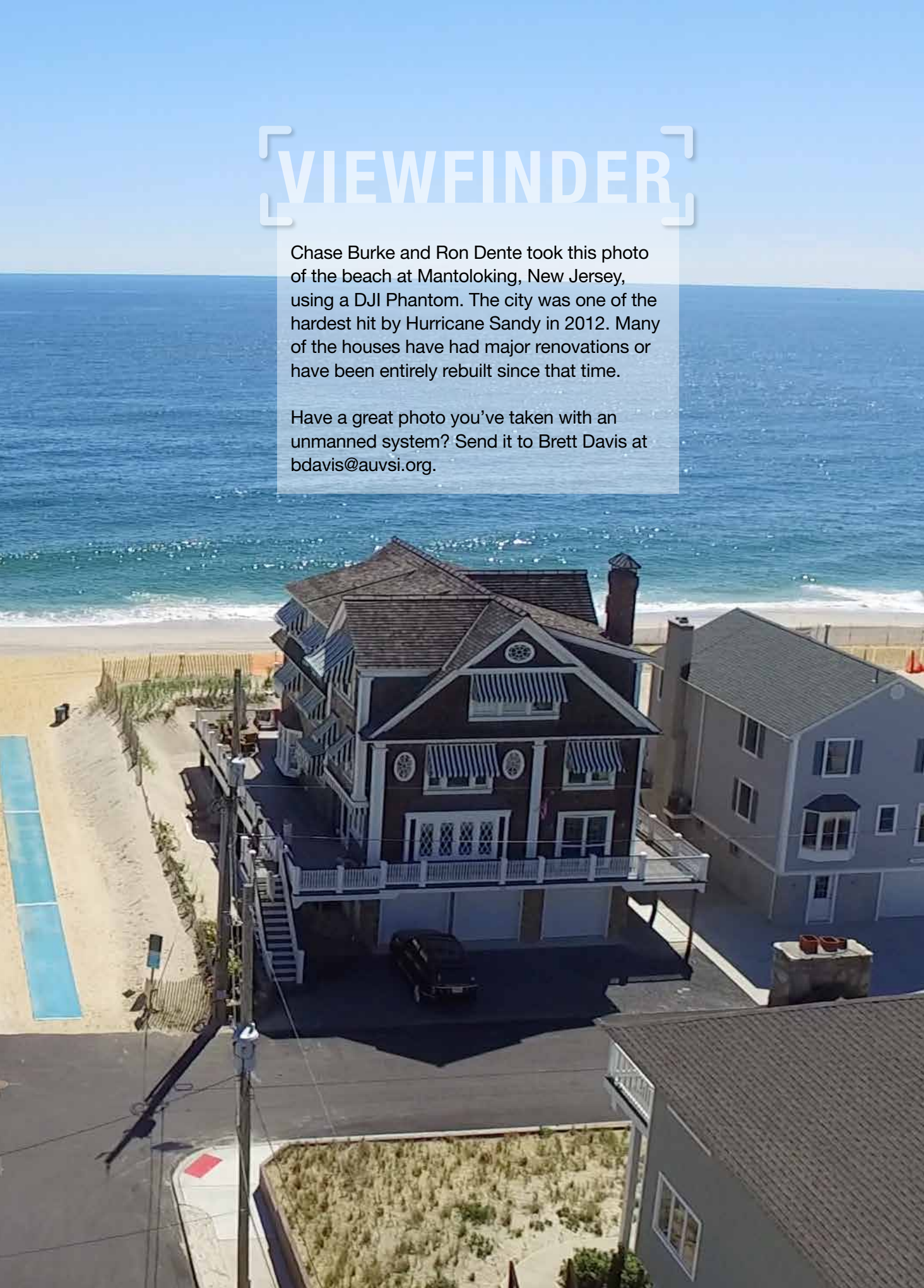
VIEWFINDER

Chase Burke and Ron Dente took this photo of the beach at Mantoloking, New Jersey, using a DJI Phantom. The city was one of the hardest hit by Hurricane Sandy in 2012. Many of the houses have had major renovations or have been entirely rebuilt since that time.

Have a great photo you've taken with an unmanned system? Send it to Brett Davis at bdavis@auvsi.org.

TO LIVE FLY

AND IN LA

One Story of an Improper Drone Flying Location and the Legal Battle that Took Los Angeles by Storm

By Clark Perry

Last December, Arvel Chappell had no idea he was about to become very newsworthy in the field of unmanned aircraft. He was simply doing something that lots of Americans that holiday season would do: demonstrating his store-bought drone to a curious friend.

Chappell, a 35 year-old filmmaker and aerospace enthusiast, stood beside the concrete basin of the Los Angeles River and piloted his DJI Inspire 1 into the sky. His friend watched in wonder as the drone, backlit by a burnt orange sunset, rose against the city's jagged skyline.

But something else was in the sky, too: a helicopter operated by the LA Police Department. Less than a quarter-mile away from Chappell's location sits Hooper Heliport, the LAPD Support Division's base at Piper Tech in downtown Los Angeles. As soon as Chappell saw the helicopter, he quickly landed his drone. Though there was little chance of a near-encounter — the helicopter was 300 to 400 yards away, and the LA River is draped with thick power lines a helicopter wouldn't dare approach— Chappell didn't want to take a chance.

Photo: Clark Perry.

Chappell had noticed a loud party in a nearby warehouse and assumed the aircraft had been sent to monitor that situation. "I get the drone taken apart in its case and put it in my car, and that's when I notice the helicopter's light was shining on me," recalls Chappell. He and his friend wondered if the helicopter pilot believed they were connected to the nearby party. "Once I got in the car and left, I saw the light was following me and I thought, 'Oh crap, this is not good.'"

Chappell pulled over and promptly called the LAPD to inquire why the helicopter was following him. Before Chappell could be connected with anyone who could help him, ground units in patrol cars showed up. The officers informed him that a sergeant from the nearby LAPD heliport was rushing to the scene.

Chappell recalls the sergeant arriving in a very agitated state.

"He told me that LA had just passed this new law and they had to confiscate my drone. He tells me he's going to report this to the Federal Aviation Administration and he has another officer write out a citation for a misdemeanor charge."

As an officer handed him the citation, Chappell watched numbly as the case containing his drone was loaded into a patrol car.

Two months earlier, the LA City Council had unanimously passed an ordinance severely restricting the operation of drones within the city. These rules prohibited the flying of an unmanned aircraft within five miles of an airport without permission, flying it 400 feet above the ground or within 25 feet of another person, or flying beyond its operator's visual line of sight. Violators faced misdemeanor charges on all counts. This ordinance had been in effect for just two weeks when Chappell was charged with violating it.

Despite the frosty reception from the heliport sergeant, Chappell received some warm advice from the police on the scene.

"Other beat cops are telling me: Arvel, we're sorry that this happened, just go to the judge and be the nice guy that you are and everything will be fine. What happened to you could happen to anybody. And then they started asking questions about drones because this was around Christmas time and they're all considering buying drones for their family members and kids."

Chappell's hope that he might escape these charges was soon dashed when LA City Attorney Mike Feuer issued a press release trumpeting the criminal charges that had been filed against him.

"An air unit coming in to land allegedly had to alter its path in order to avoid the device," Feuer claimed. "Operating a drone near trafficked airspace places pilots and the public at serious risk." Under the ordinance, Chappell was facing up to six months in jail and a $1,000 fine.

The press picked up the story and ran with it.

"Once they issued the press release, that's when the craziness started. It was in the LA Times, it was on National Public Radio, it was all over the place," he recalls.

Chappell quickly sought legal counsel from Terrence Jones of the LA-based law firm Ballard Spahr LLP. Jones had some experience with drones, although it wasn't exactly positive.

A former federal prosecutor, Jones often took on civil division cases to recoup the cost of fighting fires caused by negligence of construction companies or developers. While monitoring one in-progress wildfire, Jones saw several fire-fighting aircraft forcibly grounded because a private citizen flew a drone into the area.

"My first introduction to drones was sort of a negative one," he says. But a member of the U.S. Forest Service insisted to Jones that someday UAS might replace helicopters — and save lives in the process.

Although news publications such as The Hollywood Reporter claimed the LA City ordinance was in sync with rules issued by the FAA, Chappell and his lawyer quickly realized a fatal flaw behind the LA City Council's action: it violated the well-established rule of federal preemption.

"In the order of superiority here, federal law is the big dog and you can't make ay type of law relating to aviation because that's the sole purview of the FAA," says Jones. "That has long been the law as articulated by the Supreme Court. The Court has said the FAA and the FAA only is solely responsible for creating laws related to airspace."

In response to the federal preemption motion filed on behalf of Chappell, the LA City Attorney quickly and quietly dismissed all

of the charges. But the case wasn't over yet. The city filed a new motion charging Chappell with flying his drone in a careless or reckless manner. It was a last-ditch effort from the city to save face on a well-publicized case that had backfired, according to Chappell's attorney. By claiming their definition of "careless or reckless" was based on the FAA's definition, the city clearly sought to sidestep federal preemption.

"We really couldn't challenge that charge because they said, 'The federal law will be our law,'" says Jones.

So Chappell now faced a jury trial on this one remaining charge. According to Jones, he and his client were heartened when the jury selection process revealed citizens who were either well-informed or at least curious about the use of unmanned aircraft.

Jones was able to convince the jury that Chappell had not operated his DJI Inspire in a careless or reckless manner.

"We wanted to convey to the jury that this wasn't some teenager or some idiot who has a toy that he's using recklessly. This is a professional, educated person. When he's operating this aircraft, he's not going to do it in a way that puts other aviators in danger," Jones said.

Despite the testimony of several LAPD helicopter pilots, the facts of the case were clear.

"The helicopter never got closer than 300 yards from the drone," says Jones. "That's three football fields away. The pilots were hard pressed to try to convince the jury they feared for their lives from something that was three football fields away."

"The litmus test for recklessness is about safety," Chappell points out. "Could this have caused harm to people or property? It didn't have to cause any harm, but could it have potentially caused any harm?"

The jury concluded the prosecution's charges had failed this litmus test. Chappell was found not guilty of the charge, and his confiscated drone was returned to him. The LA City Attorney's office could not be reached for comment.

Ironically, on the day the jury reached its verdict, the FAA issued its Small Unmanned Aircraft Regulations (Part 107) providing its final rules for the commercial use of drones.

The experience and resulting media exposure left the filmmaker a bit shaken but also firm in his resolve as a proponent for UAV technology.

"I feel that there's a lot of common ground between what the LAPD wants, what the city wants, and what reasonable people in the community want. I even sent the LAPD a proposal which is basically a community policing program for drones. It's about being more proactive. Instead of passing a law that criminalizes everything under the sun, why don't you get out there and educate the public by participating with them?"

Chappell estimates that the city spent millions of dollars prosecuting his case.

"From all the hearings we had, the trial, the time off work — they had at least eight police helicopter pilots testify — I just feel like if that kind of resource was spent on creating a website and having a community event with drones and helicopter pilots, that could be used to get kids interested in aviation. It could be used for a whole multitude of other pro-active positive things."

Chappell's proactive stance offers a path forward for cities and munici-

palities who will see more and more UAVs in their skies. According to the Consumer Technology Assocation, sales of drones in the U.S. will top 2.3 million in 2016, a 149 percent increase over last year's total.

Among the many film projects Chappell has in the works, the one closest to his heart is about a young man who sees aviation as a way out of the dire circumstances of his childhood.

"I wanted it to be a coming of age film about aviation and social mobility. It's about stuff I saw growing up in Compton and seeing how different people handle the pressures of the city and how they decide to vent out or get through it. The protagonist wants to fly and has a criminal court case that prevents him from flying."

Chappell shakes his head and laughs, adding, "Yes, the screenplay was written prior to all of this happening." ∎

Editor's Note: AUVSI takes no legal stand on the charges leveled against Arvel Chappell and does not condone flying anywhere near manned aircraft, especially helicopters. This story was printed because it highlights a range of issues that will likely play out in other courts, including where people can fly drones and the issue of federal preemption of state and local law. To make sure you're not flying in a contentious area, consult Know Before You Fly, (www.KnowBeforeYouFly.org) which includes AirMap's real-time graphic map of legal and illegal flying locations.

Hard to
Reach

A CyPhy Works PARC vehicle delivers an inhaler to an island in Massachusetts in a demonstration with UPS.

Caregivers Turn to Drones for Delivering Medicine to Remote Locations

By Nick Adde

To Dr. Kerry Palakanis, telemedicine is emerging as the only practical method of providing health care to patients in remote areas on Maryland's Eastern Shore.

A significant number of her patients are elderly and often find it difficult to arrange transportation to and from appointments or drug stores. The task of getting the care they need can be particularly daunting.

While telemedicine offers an obvious solution, there are issues that remain unresolved. While family practitioners like Palakanis can make diagnoses remotely, treating patients can be tricky.

Delivery of medication and medical supplies, in particular, is a challenge. For Palakanis' patients on Smith Island, situated nearly 10 miles across Tangier Sound from her clinic in Crisfield, Maryland, such deliveries are almost impossible once winter weather sets in.

The problem soon will be resolved, Palakanis believes, when arrangements to use unmanned aircraft systems to deliver the good are finalized.

"We're trying to close the loop for local communities that lack health care," says Palakanis, a family practitioner by training, who has been actively involved in telemedicine for two years.

"We can take care of somebody remotely and make a diagnosis, for example, [like] bronchitis. That's one portion of the care. The next step is delivering medications to them, [and] devices such as a nebulizer to help with breathing treatments," Palakanis says.

Clinicians like Palakanis are buoyed by an initiative rolled out by the White House this summer, which is directed toward advancing the use of UAS to deliver health-care services more efficiently to places in need.

During the White House workshop, clinics, humanitarian agencies, health-care delivery firms and drone developers alike demonstrated the potential for using unmanned aircraft to deliver blood, medicine, and medical supplies to Nevada and Washington state, as well as Maryland.

In Palakanis' case, she is in the process of teaming with Ellumen Inc., of Arlington, Virginia, a health and information-technology company, and Zipline Inc., a Silicon Valley manufacturer of fixed-wing

A Zipline UAS, built by the California company of the same name, which is intended for humanitarian deliveries.

UAS that is specifically geared toward health-care services.

The relationship began when Ellumen's John Kornak approached Palakanis, while he was director of the University of Maryland Medical Center's telehealth department.

"It was hard to get health care to these people [on Smith Island] because storms would get rough, or ice would build up and they'd have to run an icebreaker boat out to them," Kornak says.

"We thought, what about using drones to get supplies to them? We basically wrote up a white paper, which was presented to the White House, for the opportunity of doing a demonstration project with the FAA [Federal Aviation Administration], White House and Smith Island, to see how medical drones could deliver supplies and other types of pharmaceuticals to [the] island," Kornak says.

Ellumen is positioning itself as a company to apply its corporate business expertise into building and supporting the infrastructure side of the telemedicine equation.

The company built its business base largely by serving the U.S. Defense and Veterans Affairs departments, and is making the logical transition into telemedicine in recent years as their two biggest federal clients continue to explore its possibilities.

"That's where we see our niche in this arena – not really doing the drone testing and delivery, but providing the general-contractor stuff and putting it into production," Kornak says.

"We're seeing in telehealth that while it's not glamorous, the job of integrating innovative solutions into a community is complex and

CyPhy, UPS Team for Medical Supply Delivery in Massachusetts

Delivery giant UPS and Massachusetts-based drone maker CyPhy Works also recently successfully medical supply delivery, this time off the coast of Massachusetts in September.

In the demonstration, a CyPhy Persistent Aerial Reconnaissance and Communications (PARC) model successfully flew from the town of Beverly to Children's Island, about three miles off the coast, delivering an asthma inhaler to a child at a camp that couldn't be reached by car.

"Our focus is on real-world applications that benefit our customers," said Mark Wallace, UPS senior vice president of global engineering and sustainability. "We think drones offer a great solution to deliver to hard-to-reach locations in urgent situations where other modes of transportation are not readily available."

UPS and CyPhy Works demonstrated the delivery of medical supplies to an island off the coast of Massachusetts in September.

Photo: UPS

time-consuming and requires a lot of expertise," says Ellumen's Mary Vogel.

The plan, Vogel says, involves coordinating technologies, people, and regulations. In the case of delivering health care to Smith Island from Crisfield, the task at hand includes making sure the FAA and the local populace are vested in the process – a job, she says, that has not been easy.

"It's important to take this as an opportunity to listen to everyone's requirements and validate that this technology would support the people of Smith Island and not interfere with other entities," Vogel says.

During the meeting with the FAA, it became apparent that the agency was interested in using demonstration projects like Smith Island to create standards that would apply both in the U.S. and around the world, Kornak says. The FAA is well aware of potential ramifications associated with introducing potentially heavy drone traffic into an airspace already populated by piloted aircraft and natural wildlife. They want to help, the FAA told them, but there are a lot of ramifications that must be addressed first.

Zipline's role began not long after Kornak approached Ellumen with the idea of using telemedicine to help the Crisfield clinic. The five-year old company had made inroads in using its drones to assist telemedicine activities in developing countries – long on need and direly short on infrastructure, says Lawrence Williams, who is responsible for business prospects in the Half Moon Bay, California-based company's U.S. market.

To date, Zipline has made considerable inroads toward establishment of health-related UAS delivery, and is poised to assume the mission of all blood delivery in Rwanda.

"Right now, Rwanda relies upon blood banks. A lot of health-care clinics there are in remote areas, where [conventional] deliveries can take months," says Williams. "Blood, blood products and plasma platelets are difficult to store. In most cases, they can only be stored for 30 days or more," he says.

In emergency situations, such as when a new mother experiences postpartum hemorrhaging and needs a transfusion, quick delivery of blood is a matter of life and death.

Using a fleet of 10 to 20 unmanned, fixed-wing aircraft developed entirely in house, Zipline is able to deliver roughly 3.3 pounds (three kilograms) of cargo virtually anywhere within a 46.6-mile (75-kilometer) radius, Williams says.

The aircraft, called "Zips," have wingspans of roughly five feet and are powered by lithium ion batteries. They fly at cruising altitudes up to just under 500 feet (150 meters) – below the minimum altitude for piloted aircraft, and high enough to avoid collisions with most ground-based structures. Once each aircraft

approaches its destination, it descends to an altitude of 33 feet (10 meters), and deploys the cargo safely. Each Zip then re-ascends to cruising altitude and returns to its distribution center, company parlance for a modified shipping container operators use to launch and recover vehicles.

Williams says the company upgrades hardware and software regularly, on a schedule akin to the computer giants it calls neighbors.

Meanwhile, Ellumen and Zipline intend to begin initial telemedicine service between Crisfield and Smith Island sometime this fall, with a pilot program fully underway by early next year.

"We already have the telemedicine devices, and the ability to provide visits, in place. The only piece we're working on finishing [is] the actual drone portion," Palakanis says.

For the Rwanda project, Zipline will use its Quail series of UAS. Which iteration of UAS that would fly the Maryland mission will be determined by the final arrangements Ellumen, the clinic, Zipline and the FAA settle upon, Williams says.

As of publication deadline, Ellumen and Zipline were working on a non-disclosure agreement.

The Smith Island-Crisfield scenario is not unique. Plans also are afoot to start similar programs. Teams are working to establish delivery services from the Reno (Nevada) ASD Healthcare Distribution Center to the Pyramid Lake Tribal Health Clinic, which serves the Paiute Tribe population, and the VA-operated Sierra Nevada Health Care System. Bloodworks Northwest's Bellingham, Washington, facility intends to establish a delivery protocol to serve the Lummi Reservation Tribal Health Center and the nearby San Juan Islands.

Flirtey, a Reno, Nevada-based drone manufacturer, is teaming up with the International Medical Corps to develop lightweight containers that would protect delicate medical cargoes from the elements – ultimately to be used in delivery to hard-to-reach clinics and patients.

And, The University of Maryland UAS Test Site and the University of Maryland Shore Regional Health recently completed a successful delivery of simulated medical cargo using an UAS on the Eastern Shore, using a UAV Solutions Talon 120LE fixed wing aircraft, which flew 12 miles, launching from Lusby, Maryland and landing in Cambridge.

"Looking at the big picture, at the end of the day, drones [are] another platform for providing a service," Williams says. "Under the current logistics system, with roads or aircraft for longer distances, we're talking about last-mile delivery to a clinic or individual." ∎

Drones and Good Jobs

Two Companies Team to Place Vets in the Commercial UAS Industry

By Rich Tuttle

Two companies have joined in a unique mission: training and placing military veterans in jobs in the commercial unmanned aircraft industry — and charging the vets nothing.

One of the companies, DroneBase of Santa Monica, California, provides veterans identified by the other, Drones & Good of San Francisco, with free training and makes sure each vet gets one job at no cost.

In an Aug. 2 listing of "new commitments to speed the safe integration of unmanned aircraft systems" into a variety of commercial endeavors, the White House notes the enablement of "job placement for veterans with free drone pilot training" and says the partnership provides transitioning vets "with training programs and apprenticeships to start a career in the commercial drone industry."

It says Drones & Good qualifies the vets and sends them to DroneBase, which gives them "10 hours of free in-person and remote training in basic and advanced commercial drone tasks on the most commonly used unmanned aircraft systems, and will commit to providing each Drones & Good team with one real-world commercial job in their area with waived fees."

DroneBase uses unmanned aircraft for real estate and construction jobs. Here, one of the company's DJI Inspire One vehicles inspects a construction site.

DroneBase and Drones & Good began their partnership about a year ago. DroneBase CEO and cofounder Dan Burton says he reached out to Drones & Good because it's a good fit with his company. DroneBase was already working with experienced unmanned aircraft operators who had been in the military, and Drones & Good was identifying veterans with an interest in unmanned aircraft. DroneBase needed a more reliable way of contacting vets, and Drones & Good had already established a pipeline.

DroneBase is "probably the biggest drone service company in the United States, working in all 50 states" and abroad in real estate and construction, says Burton. He says his company aims to "provide every business in America with their own personal air support" and be "like Amazon for drones."

Typically, a customer books a request for imagery and/or data with DroneBase, which does the flying and then edits and produces the result in a few days. The customer pays only for the bandwidth it uses. "If the airspace is clear, we can get to basically any address in the United States in under a week," overnight in some cases, and do the job "for under $500, sometimes much less."

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DroneBase pilots are a little like Uber drivers, but with an emphasis on "steady, reliable work," Burton says. "For example, we're based in Los Angeles and the TV-film industry is a good potential user of drones. That work tends to be good on a per-day or per-hour basis. But it's very lumpy. You may work on a film set for a day or two, but then you're off for three days. We're much more interested in work that's repeatable, recurring and reliable." Real estate work, for instance, "tends to be very high volume."

For Burton, linking vets and drones is a calling. "It's a passion of mine," says the former Marine Corps infantry officer. He empathizes with "a lot of the enlisted folks" who leave military service and may not have "a perfect plan for what's next."

Burton says that as the military operation of unmanned aerial systems migrates increasingly to smaller units — the Marines, for instance, are planning to give the job of UAS operator to an assistant squad leader — the opportunity for vets in the commercial world is increasing.

"I'm really eager to get folks on an accelerated career path, or just get them started in the burgeoning commercial drone space," Burton says. "What we want is for people to be able to build this as a profession, to have a business, to be able to support themselves and their families by working for DroneBase."

DroneBase's ultimate goal, Bur-

ton says, "is for people to build a business and a career solely on our platform. That would be my goal for veterans anywhere on the continuum of people trying to build a side business to having this as a whole profession."

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Similarly, vets are the focus of Drones & Good, a unit of a 501c3 nonprofit enterprise called Calso that, through several divisions, trains the unemployed for jobs in high-demand industries. Calso describes Drones & Good as "a workforce development program" for vets. "We capitalize on the high potential growth of the commercial drone industry to empower unemployed populations and provide

career paths to the ones in need," says the company's website.

"We strongly believe in the power of new technologies to tackle the unmet social and environmental challenges of the 21st century and improve the lives of millions," the site says. Nicolas Hazard, Calso's founder, says Drones & Good's "social mission" is part of Calso's DNA.

Hazard says there are two parts to Drones & Good's business. In the first, it uses its own funds to train those who are struggling. In the second, companies support these people in externships during training, and also pay for job placements.

Burton says DroneBase isn't a nonprofit, but even with free training for vets from Drones & Good, the com-

pany "will be fine." Just putting vets into the job market is satisfying, "and makes our end customers happy."

DroneBase always gets good results with vets, he says. "They're reliable, always on time and always do an excellent job." They are "happy to work in rough, austere environments, know how to use sophisticated gear in harsh conditions and have a good sense of how to report things and how to pass data back and forth."

Drones & Good "is a good partner for us because they put a lot of thought into identifying people, getting them started and getting them in our pipeline. That's why this makes total sense."

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Drones & Good says that while there are about 22 million men and women who served on active duty in the U.S. Armed Forces, more than half face a period of unemployment within 15 months of separation, according to the Department of Veterans Affairs. It adds that it's "committed to making former and transitioning service members valuable assets in the civilian economy."

Quoting AUVSI, Drones & Good says the number of UAS jobs in the U.S. — in agriculture, energy, utilities, mining, construction, news and media, and film production — is estimated to hit more than 100,000 by 2025.

California is expected to generate the most total jobs, more than 18,000 by 2025. Under a pilot program in the first nine months of 2016, Drones & Good placed jobs for 20 vets in several industries at $20 an hour in California's Bay Area.

"It's really a booming industry and it's very important" to have a partnership like the one with DroneBase, says Hazard. He says it "gives you the ability to spread the word that there is a future in this industry, first of all for the veterans, of course," but also for the industries that will hire them — that the advent of commercial UAS is serious, and that well-trained operators will allow them to safely and productively use the vehicles. Hazard plans similar partnerships on "the American model" in other countries with local partners. He is launching two such operations in France.

Burton says the whole commercial UAS industry is in its early days, so while vets, even those with extensive military experience, may have an edge, they are still in a sense just starting out. "This is square one of this industry" and "in the commercial context you're kind of starting again" because there's much learn. "It's a level playing field for everybody." ■

AUVSI Pathfinder Chapter President Peter Blocker addresses the audience at the 2016 Pathfinder Symposium in Huntsville, Alabama.

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AUVSI PATHFINDER

Pathfinder Chapter

AUVSI's Pathfinder Chapter is based in Huntsville, Alabama, home to Redstone Arsenal, which hosts the Army's Program Executive Office Aviation and Project Management Office UAS, responsible for development and fielding of the Gray Eagle, Shadow and Raven UAS, along with investigation of future technologies and systems.

The chapter is an active supporter of STEM education. Over the last eight years, the Pathfinder Chapter has provided just under $500,000 in support of robotics education, including grants, competition expenses and awards, scholarships and funding to education organizations to support robotics competitions. This funding comes primarily from the Pathfinder Symposium, held annually in Huntsville.

The 27th Annual AUVSI Pathfinder Chapter symposium was held Aug. 30–Sept. 1 this year. Pathfinder, in conjunction with the Armed Forces Communications and Electronics Association's Huntsville Chapter, hosted a classified forum for day one with topics including counter UAS, UAS threats, electronic weapons, UAS protection, ground systems, and UAS weaponization. The second day was comprised of sessions from the U.S. Army's Unmanned Aircraft Systems Project Management Office to explain the future direction and potential business opportunities. Other Redstone Arsenal leadership discussed their initiatives with Unmanned Systems, and technical presentations from companies and Government agencies across the country discussing current and future unmanned technologies. For day three, the state of Alabama teamed with Pathfinder to present the state initiatives in unmanned systems, including plans for educating the populace, policy initiatives, unmanned operations such as precision agriculture and powerline surveys.

This year's Pathfinder Chapter Symposium is an example of the changes being made to keep up with the unmanned community in the northern Alabama area. By engaging the state while continuing to work with our long-term customer, the U.S. Army UAS Project Management Office, the Pathfinder Chapter will continue to be a viable chapter within AUVSI.

Photo: Peter Blocker.

Chapter of the Month:
Pathfinder Chapter

Chapter President:
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DOMINATING THE COMPETITION

Carnegie Mellon Students Train AI Agent to Play, and Dominate, Doom Video Game

By Brian Sprowl

We've all been beaten by friends or relatives while playing video games, but thanks to two Carnegie Mellon University computer science students, there might be stiffer competition on the horizon while playing at least one classic game. Devendra Chaplot and Guillaume Lample have successfully trained an artificial intelligence agent, whom they named Arnold, to not just be competitive, but to dominate while playing the popular Doom video game. Arnold, which is known for being a deadly shot and a hard to hit target, has managed to beat human players, as well as the game's built-in artificial intelligence agent, leaving one Carnegie Mellon professor in amazement.

"The fact that their bot could actually compete with average human beings is impressive," said Ruslan Salakhutdinov, an associate professor of machine learning. Salakhutdinov expounded upon this by pointing out the difficulty for this type of AI agent to not just navigate a virtual reality world, but to also compete successfully in these types of environments.

Using deep learning techniques, based on neural networks in their own specially built architecture, Chaplot and Lample have created an almost impossible-to-beat juggernaut while playing Doom. They taught Arnold to navigate the 3-D world by using a reinforcement learning architecture called Deep Q-Network, which was originally used by Google to train its DeepMind to master two-dimensional Atari 2600 videogames. Once Arnold recognizes an opponent, it switches to a Deep Recurrent Q-Network, which includes a long short-term memory (LSTM) module, and this helps it precisely locate its opponent and predict where to shoot.

The two students also used an application program interface (API) to access the game engine during training, and this helped Arnold learn how to quickly identify opponents and game pieces.

This unique combination of technology was put on display during the Visual Doom AI Competition, which pits AI agents against each other in death matches. Arnold placed second in this competition, finishing behind a team from Facebook in one track, and a team from Intel in another track.

While the object of the game is to obviously kill while avoid being killed, the two students wanted it to be known that they did not train the computer how to kill.

"We didn't train anything to kill humans," said Chaplot. "We just trained it to play a game."

What makes the accomplishment of the two master's students so impressive, on top of the obvious set of circumstances, is the fact that Arnold was trained as if it was a human, meaning it could only see the information that was on the screen. The game's built in artificial intelligence agent has an inherent advantage while playing, because it can access information through the game that humans can't. Clearly though, this advantage is no match for the almighty Arnold.

Photo: Carnegie Mellon.

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