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# Unmanned Systems Sentinel / 4 April 2016

Naval Postgraduate School (U.S.)

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## **Unmanned Systems Sentinel**

Thanks to Robin Alexander and Mark Rindler for providing several of the below articles. xx APR 2016

Please keep in mind that in most instances the below summaries are excerpts from the original article. The full articles can be viewed at the accompanying hyper-links. The inclusion of these links does not represent an endorsement of the organization, service, or product. All opinions expressed are those of the respective author or authors and do not represent the official policy or positions of the Naval Postgraduate School, the United States Navy, or any other government entity. Immediately below are this edition's highlights with links to the respective articles:

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## **NAVY/USMC:**

### **Navy Set to Buy Advanced Weapons Enhanced by Submarine UAS against Mobile Targets (AWESUM) - Miniature Sub-Launched UAVs**

THE PENTAGON — U.S. attack and guided missile submarine are set to field miniature unmanned aerial vehicles that will act as the eyes and ears not only for the boats below water but also help special operations forces and strike aircraft target weapons, the Navy's Director of Undersea Warfare told USNI News last week.

As part of the Fiscal Year 2017 budget submission to Congress, the Navy is asking for small Blackwing UAVs to be launched from attack and guided missile submarines, the Navy's director for undersea warfare Rear Adm. Charles Richard told USNI News.

"So there's 150 small unmanned aerial systems coming in on submarines, so we're now buying them," Richard said.

"It's not something that you would [just] see on a PowerPoint presentation. These are fully integrated they'll go in talk back to the ship, talk to the combat control system and additionally we'll have 12 of a 21-inch torpedo tube launched vehicles with much longer launched duration."

According to a follow-on statement provided by the Navy, "the three-inch canister launched UAVs are part of Advanced Weapons Enhanced by Submarine UAS against Mobile targets (AWESUM) demonstrates submarine launch, data sharing and control across the Joint Force."

The current year budget move is set to further operationalize a years-long program to use small UAVs from attack and guided missile boats.

The briefing slides from late 2013 indicated the Blackwings would communicate with a submarines antennas and could provide third party targeting information to aircraft through Link 16 data links. In addition to the targeting function, the UAVs could also possibly be weaponized as a defensive measure for submarines operating in the littorals.

The miniature UAVs are launched through the boats' existing systems it uses for acoustic countermeasures and have a flight endurance of less than an hour, according to the 2013 presentation.

<https://news.usni.org/2016/03/31/navy-set-to-buy-awesum-miniature-sub-launched-uavs>

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### **First Look at the Pentagon's New Unmanned Sub Chaser (ACTUV)**

The U.S. Department of Defense has released the first footage of its prototype unmanned anti-submarine ship being developed to track quiet diesel-electric submarines over long distances.

The new vessel was launched in January at Vigor's shipyard in Portland, Oregon, where it has quietly been under construction for the Pentagon's Defense Advanced Research Projects Agency (DARPA).

During a speed tests in February, the vessel reached a top speed of 27 knots.

<https://www.youtube.com/watch?v=DJ0oW3wcFuo#action=share>

The vessel is part of a DARPA program is to design, develop and construct an entirely new class of ocean-going vessel intended to chase submarines across thousands of miles of ocean for months at a time without a single crew member aboard.

Until now DARPA has only released some basic illustrations of the vessel, depicting a sleek wave-piercing trimaran reminiscent of Sea Shepherd's late-powerboat Ady Gil, a vessel that was originally created circumnavigate the globe.

DARPA says the vessel is scheduled to be christened on April 7, 2016, with open-water testing planned to begin in summer 2016 off the California coast.

<https://gcaptain.com/first-look-at-the-pentagons-new-unmanned-sub-chaser/>

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### **ARMY:**

#### **Mini UAS: Big Capabilities Can Come in Small Packages**

WASHINGTON (Army News Service, March 29, 2016) – The basic small-unit fighting capability of the Army is the squad.

One of its weaknesses is broad-area situational awareness, particularly in unfamiliar environments, according to Col. Phil Cheatham, deputy branch chief of the Electronics and Special Developments Branch at the Maneuver Center of Excellence, or MCOE, Fort Benning, Georgia.

A likely solution? A nano unmanned aerial system, or UAS, with reconnaissance capability, he said. For now, it's called the Soldier Borne Sensor, or SBS.

While large formations have access to intelligence gleaned from helicopters, satellites and large UASs like the Raven, more often than not, the fighters at the squad level don't know what's around the corner, over the hill or beyond the trees, particularly in areas where the enemy knows the terrain, he said.

A camera in the sky, perhaps 50 to 70 feet above the ground, would give them that invaluable capability, he said.

There are a lot of factors that would determine whether or not the Army would purchase something like this. For example:

#### COST

The British have been using a similarly effective mini UAS called Black Hornet, for several years now, said Cheatham.

However, the United Kingdom army is a lot smaller in comparison to the U.S. Army, which buys things like this in bulk. And, while their Black Hornets are a thing of beauty and function, each is individually hand-crafted and quantities of these could get pretty expensive.

#### WEIGHT

For at least a century, much has been written about the Soldier's load, meaning that they go into combat carrying heavy stuff that inhibits their effectiveness, Cheatham pointed out.

While a mini UAS, the size of a sparrow or even a bumblebee may not sound like much, it could be enough of a tipping point to limit combat effectiveness. Thus, a lot of emphasis has been placed on weight limitations.

General requirements would be a UAS not weighing over 150 grams and perhaps fitting in a Soldier's cargo pocket where it could be trickle charged in two hours or less.

#### EYES IN SKY

Ideally, the UAS would fly about 1,000 meters, 50 to 70 feet in the air for 10 to 15 minutes. That would be a "game changer" for squad situational awareness, Cheatham said. They could most likely control and dominate their area out to the limits of their small-arms fire capabilities.

Currently, the requirements call for day and night camera capability, able to detect a man-sized target with 90 percent probability from 75 feet high, he said. The requirements for all of its capabilities are being staffed right now and could change slightly.

#### OTHER DESIREABLES

The Army would also like these mini UASs to be as quiet as a bumble bee, Cheatham mentioned, so as not to alert the enemy.

They should be able to also operate on certain military-only radio frequencies, he said. Allowable frequencies for these are different in the U.S. from those overseas.

Also, the system should be able to rebound from human or machine error, he said. For example, if a Soldier dropped or damaged the controller, it would be nice for the UAS to stop in midair rather than continue on in an unintended direction. That might be an important safety feature as well.

Maj. Alexander Gonzales, assistant product manager, MCOE, said the proposed SBS must also be capable of tactical employment out of the range of contact and under constrained rules of engagement, and be inherently safe to operate without damage to equipment or injury to personnel.

#### USER TESTING

The best thing the Army can do, Cheatham said, is get these prototypes in the hands of Soldiers for some real-world field testing. "Experimentation informs requirements," he said.

Equal or greater to industry feedback is feedback from Soldiers, he added. Soldiers inform what needs to be changed or what works. Their input is the ultimate test. "Either they say it hinders or helps the mission, or provides no added benefit."

#### EVENTUAL FIELDING

Soldiers are already experimenting with prototypes, Cheatham said. The next goal is eventually getting them fielded. But first, industry will need to help make that happen.

That process is taking place this year.

Lt. Col. Timothy A. Fuller, assistant product manager, SBS, Project Manager, Soldier Sensors and Lasers, or PM SSL, PEO-Soldier, Fort Belvoir, said that the Soldier Enhancement Program, or SEP, is a program in which COTS items are procured and tested "to see if they can make a difference to Soldiers. This is an extremely cost-effective way to try out and test new technologies."

Fuller also pointed out that the Army is inviting small and large businesses to participate in "industry days" to discuss opportunities to build SBS, using requests for information, followed by a request for proposal.

The next industry day is April 12, he said.

Gonzales added. "We encourage large companies, small companies, and even startups with great ideas to join us for the industry day."

Fuller said the Army will likely make limited purchases of SBS candidates over the next year or two and then move forward on larger-scale buys in fiscal year 2018.

<http://www.militaryspot.com/news/mini-uas-big-capabilities-can-come-small-packages>

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## **USAF:**

### **Worcester Polytechnic Institute Professor Receives Grant to Assist USAF with UAV Research**

A Worcester Polytechnic Institute (WPI) professor has received an 18-month, \$185,000 grant from the U.S. Air Force for research exploring how unmanned aerial vehicles (UAVs) can be operated safely, reliably, and intelligently even when they experience mechanical problems or encounter other unexpected situations.

Raghvendra V. Cowlagi, assistant professor of mechanical engineering and aerospace engineering, received the grant in collaboration with Aurora Flight Sciences Corp., a leader in the manufacturing and design of optionally piloted and unmanned aircraft.

The research can be applied in UAVs used in military and civilian applications, including those designed for search-and-rescue missions.

UAVs are designed to fly under the control of a human pilot on the ground. However, a loss of communications and/or onboard contingencies, such as engine problems or undetected structural damage to the airframe, can impair the ability of a UAV to complete its mission. UAVs operated by the Air Force include the General Atomics MQ-1 Predator, which has a wingspan about one-quarter the size of a Boeing 747 and can carry about 450 pounds of payload.

Even when communications are not interrupted, the large volumes of data transmitted by UAVs operated by the Air Force— including aircraft health, positioning, weather, and other factors—can overwhelm pilots during emergencies, making it difficult to assess the true nature of the situation.

To address the challenge, Cowlagi and his research team are developing algorithms to run on a UAV's onboard computer that will allow the aircraft to perform high-level missions with minimal human supervision or remote piloting, while also enabling the vehicle to tolerate severe degradation to the airframe and engines. The algorithms will also help remote pilots parse the vast amount of information transmitted by UAVs to gain a better understanding of the vehicle's condition.

"We're trying to determine what types of intelligent algorithms we can put on board the aircraft that can deal with these sensor inputs," said Cowlagi. "We'd like the UAV to be able to do a lot of the computations on board and take care of these contingencies before communicating back to the pilot."



Cowlagi stressed that the remote pilot will still be the supervisor, but the algorithms will take much of the burden of real-time decision making off of pilots. “A lot of the decision making that might have gone on in a pilot’s head will now go on board the UAV, and we think this will lead to safer operation of UAVs in the future,” he said.

In building the algorithms, Cowlagi said his team is using a novel method based on linear temporal logic (LTL) specifications. LTL is a logic system that allows the human supervisor to command the UAV, and impose safety behaviors on the UAV, all in a unified human-friendly format. The challenge, which is being addressed by Cowlagi’s research, is to design algorithms that can ensure that the UAV diligently follows these commands from the human supervisors, while accounting for health degradation’s in the airframe structure and/or engines.

“This research has never been used before in the context of unmanned aerial vehicles,” said Cowlagi. “We are the first group to try this and to try to apply this method in the hopes of making UAVs safe and reliable.”

Aurora leaders are pleased with the partnership with WPI.

“The collaboration between Aurora and WPI is producing exciting results, proving that self-aware and self-reacting UAVs are obtainable in the not-too-distant future,” said Jeffrey Chambers, composite structures research engineer and project lead at Aurora. “Aurora provides expertise in UAVs and helps formulate the research statement, while WPI provides novel concepts to address the operational obstacles at hand.”

This grant builds on previous U.S. Air Force–funded research Cowlagi has conducted in collaboration with Aurora. In particular, the feasibility of the current research was demonstrated in early 2015 through preliminary results obtained by Cowlagi and his team.

<http://www.pressreleaserocket.net/worcester-polytechnic-institute-professor-receives-grant-to-assist-u-s-air-force-in-unmanned-aerial-vehicle-research/429988/>

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## **NATIONAL AIR SPACE:**

### **Senator Sheldon Whitehouse Hosts Round-table on Drone, Laser Interference with Aircraft**

Warwick, RI – Senator Sheldon Whitehouse today hosted a round-table discussion on the growing threat that laser pointers and drones pose to aviation.

“Flying has never been safer,” said Senator Whitehouse. “But new threats to aviation safety are emerging. Pilots are reporting a big increase in the number of incidents of laser pointers being aimed at cockpits and drones flying dangerously close to aircraft. I led the charge in Congress to pass a law protecting our pilots from laser pointers. Now it is time for Congress to pass my Drone Operator Safety Act, which would create new penalties for drone operators who recklessly endanger aircraft.”

“While affordable recreational drone operation is an exciting technological development, we must figure out a way to resolve the serious risks to airplanes that occupy the same airspace,” said Congressman Langevin. “We want drone operators to be able to enjoy their hobby, while still respecting the safety issues and privacy concerns that come with being a responsible drone pilot. Our world is ever changing, and the old rules for civil aviation need adjustment for the improvements in technology we have today. I look forward to continuing to work on this issue in Congress, and I applaud Senator Whitehouse for his leadership.”

The dramatic increase in the number of drones in the skies presents new challenges for aviation safety. Pilots reported more than 1,200 drone sightings to the Federal Aviation Administration (FAA) in 2015, an increase of over 500 percent from the previous year. More than 400,000 drones have been registered with the FAA since the agency launched its Unmanned Aircraft System registry in December 2015.

“This is a continuing conversation on clarifying the rules, regulations and laws promulgating the proper use of drone technology,” said Rhode Island State Police Superintendent Col. Steven G. O’Donnell. “I commend Senator Whitehouse for his leadership on the issue of safety in our airspace and his effort to hold those who deviate from the rules accountable.”

To help keep aircraft crews and passengers safe in the face of new threats, Senator Whitehouse recently introduced the Drone Operator Safety Act, which would make it a federal offense to use a drone to disrupt the operation of a manned aircraft. While the FAA has the authority to levy civil penalties on individuals operating drones in a manner that puts people and property at risk, there currently is no criminal provision that directly addresses the unsafe operation of drones.

The Drone Operator Safety Act follows legislation Senator Whitehouse introduced in 2011 that made endangering aircraft passengers by aiming a laser pointer at an airplane cockpit a criminal offense. That bill was signed into law and is now used by the Department of Justice to prosecute laser pointer incidents around the country.

<http://www.whitehouse.senate.gov/news/release/whitehouse-hosts-roundtable-on-drone-laser-interference-with-aircraft>

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## **UAS Hot Topics**

A number of important activities related to the integration of unmanned aircraft systems (UAS) into the national airspace are underway. These activities are being pursued by federal agencies including the Federal Aviation Administration (FAA), Federal Communications Commission (FCC), National Telecommunications and Information Administration (NTIA), and the National Aeronautics and Space Administration (NASA). Below are brief updates of the various items:

FAA Symposium. The FAA will host its first UAS Symposium in conjunction with Embry-Riddle Aeronautical University on April 19-20, 2016 in Daytona Beach, Florida. This event is a forum for the UAS

industry and stakeholder community to provide feedback directly to FAA decision-makers on topics related to UAS integration. Mike Lewis of Wiley Rein will be speaking at the Technological Enablers and Restrictors discussions. We encourage interested parties to register early here.

**Section 333 Exemptions.** The FAA continues to grant exemptions to authorize commercial UAS operations pursuant to Section 333 of the FAA Modernization and Reform Act of 2012. As of March 25, 2016, the FAA had granted 4,223 Section 333 petitions. In addition, the FAA has made several recent policy changes that impact Section 333 exemption holders:

On March 29, 2016 the FAA announced that it raised the UAS “blanket” altitude authorization for Section 333 exemption holders to 400 feet. Previously, the agency had had put in place a nationwide Certificate of Waiver or Authorization (COA) for such flights only up to 200 feet.

Although the FAA continues to grant “summary” exemptions that impose a standard set of conditions on operators, the agency recently relaxed two of its conditions. First, instead of listing all of the aircraft for which entities are seeking exemption, entities may now apply to operate any aircraft included on the FAA’s list of approved UAS, which currently includes 1,120 UAS models. Second, the FAA has revised its previously standard grant language regarding operations near people to allow flights “near but not over” persons participating in the “intended purpose of the UAS operations,” such as actors being filmed by UAS and personnel collecting and analyzing aerial data. Previously, the conditions permitted operations over only “essential persons,” such as the UAS pilot and visual observers.

**FAA Re-authorization Legislation.** The FAA Re-authorization Act of 2016 is working its way through Congress. Both the U.S. Senate and the U.S. House of Representatives bills have passed out of their respective committees and the U.S. Senate bill is expected to be sent to the Senate floor for consideration next week. We expect both bills to clear their floors this spring. The two bills do have some significant differences, which will need to be resolved by a conference committee. The FAA authorization extension runs through July 15, 2016.

**FCC Technical Advisory Council (TAC) Aeronautical and Space Transmitter Working Group.** The FCC formed a new TAC Working Group composed of technology and telecommunications companies. The group plans to examine the implications of new types of aeronautical and space transmitters, such as UAS, balloons, and high altitude/long endurance platforms (HALE) relative to FCC rules and policies, including identifying any spectrum issues and recommending how the FCC might address them. Wiley Rein will be briefing the TAC in April on UAS spectrum considerations.

**Small UAS Notice of Proposed Rulemaking (NPRM).** The FAA is still working to produce final rules in its small UAS rulemaking proceeding. The agency issued an NPRM on February 23, 2015, and received approximately 4,500 public comments in response. The proposed rules would replace the Section 333 exemption process and authorize commercial small UAS operations on a widespread basis pursuant to certain conditions and limitations. Once the FAA finalizes the rules, they will need to be reviewed by the Office of Management and Budget (OMB) within the Executive Office of the President. The FAA has stated it expects to have final rules in place by summer 2016.

Federal/State Issues. States and localities across the country are showing increasing interest in regulating UAS, in ways that could impinge on federal authority or create compliance challenges for UAS operators. For example, California's state legislature has a range of bills before it, one of which would establish geographic limitations on the operation of UAS and require UAS operators to procure liability insurance. Wiley Rein has been working as counsel to AUVSI and with its other clients to help track these types of legislative activities and navigate the complex issue of where federal regulation of UAS ends and state authority begins.

Micro-UAS Advisory Rulemaking Committee. In February of this year, the FAA established an aviation rulemaking committee (ARC) to develop a performance-based standard that would allow certain UAS to be operated over people not directly involved in the operation of the aircraft or protected by a covered structure. The FAA first raised the possibility of more flexible rules for micro UAS, which it defined as weighing less than 4.4 pounds, in the small UAS NPRM. The micro UAS ARC, which consists of government officials and twenty-six invited industry stakeholders and interest groups, is modeled after the FAA's UAS registration task force that was established and concluded last fall. The ARC began its work this month and is tasked with providing a final report to the FAA on April 1. The FAA will use the ARC's recommendations to create proposed rules on micro UAS.

NASA UAS Traffic Management (UTM). NASA is developing a UTM system that would safely enable UAS operations in low-altitude airspace. NASA is leading the research, development, and testing that is taking place in a series of activities called "Technology Capability Levels (TCL)," each increasing in complexity. The second stage of testing, scheduled for October 2016, will leverage results from TCL1 and focus on beyond-visual line-of-sight operations in sparsely populated areas. Researchers will test technologies that allow dynamic adjustments to availability of airspace and contingency management. NASA has also posted a Special Notice seeking parties interested in collaborating to conduct UAS and UTM research and development, with the goal of safely enabling these operations at lower altitudes by the UTM system. Wiley Rein's Mike Senkowski, Mike Lewis, and Anna Gomez have joined the stakeholders involved in this research and development project.

NTIA Multi-stakeholder Process. In February 2015, the President tasked NTIA with convening a multi-stakeholder process to develop best practices for privacy, transparency, and accountability regarding UAS operations in the national airspace. NTIA has held several meetings during which stakeholders have developed two drafts of best practices. Wiley Rein also chaired a group that established Guiding Principles for the development of the best practices. NTIA will hold its next multi-stakeholder meeting on April 8.

[http://www.wileyrein.com/newsroom-articles-UAS Activities Update March 2016.html](http://www.wileyrein.com/newsroom-articles-UAS_Activities_Update_March_2016.html)

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### **FAA Expands Online Small Unmanned Aircraft Registration**

Thursday, March 31 – Starting today, owners of small unmanned aircraft systems (UAS) used for commercial, public and other non-model aircraft operations will be able to use the FAA's new,

streamlined, web-based registration process to register their aircraft. The web-based process will significantly speed up registration for a variety of commercial, public use and other users. Registration for those users is \$5, the same low fee that model aircraft owners pay.

“Registration is an important tool to help us educate aircraft owners and safely integrate this exciting new technology into the same airspace as other aircraft operations,” said FAA Administrator Michael Huerta.

All owners of small UAS used for purposes other than as model aircraft must currently obtain a 333 exemption, a public certificate of authorization or other FAA authorization to legally operate, in addition to registering their aircraft. Before today, the FAA required all non-hobby unmanned aircraft owners to register their aircraft with the FAA’s legacy aircraft registry in Oklahoma City, OK.

Those owners who already have registered in the legacy system do not have to re-register in the new system. However, the FAA is encouraging new owners who are registering for the first time to use the new, web-based registration system. Owners who register under the new system can easily access the records for all of the aircraft they have registered by logging into their on-line account. Small UAS owners who have registered under the web-based system who intend to use their aircraft for purposes other than as model aircraft will also need to re-register to provide aircraft specific information.

The FAA first opened up the web-based registration for model unmanned aircraft owners on Dec. 21, 2015. The agency is expanding that existing website to accommodate owners of aircraft used for purposes other than model aircraft. This registration process includes additional information on the manufacturer, model and serial number, in addition to the owner’s physical and email addresses. Like the model aircraft registration process, a certificate is good for three years, but each certificate covers only one aircraft.

### **Register here**

[http://www.faa.gov/news/updates/?newsId=85305&omniRss=news\\_updatesAoc&cid=101](http://www.faa.gov/news/updates/?newsId=85305&omniRss=news_updatesAoc&cid=101)  
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### **Legal drone shot down**

A drone was shot out of the sky in the 23000 block of Lauren Ln. in Edmond. The Oklahoma County Sheriff's Office says it was flying legally and now they are addressing new concerns when it comes to the growing number of drones in the air.

"Drones are very hot now. You can buy all different types and kinds of drones nowadays and people fly them for all kinds of reasons," says Mark Ogrande, spokesperson for the Oklahoma County Sheriff's Office.

Wednesday a drone was flying on Lauren Lane in Edmond, sheriffs tell FOX 25 it was being used legally by a construction company to inspect gutters on a home, but a woman in a nearby home, got spooked.

"We were told that the person operating the drone was doing it for work. I believe he was surveying the house, possibly the gutters, they were doing some work on the home. Somebody thought that they didn't know why the drone was there, thought they were spying, so the neighbor came out and shot it down," says Opgande.

That drone was registered with the FAA but the operator, allegedly, did not tell anyone why they were flying.

The OKCSO says even if you're using a drone legally, you should communicate with those in the area so that a situation like this does not happen.

"If you're going to be flying a drone and it happens to be in a neighborhood and you're there because you're working, let people know. As much as you can, let the people around there know, hey I'm going to be flying my drone around," says Opgande.

Right now the Oklahoma County Sheriff's Office is investigating, but they tell us they do not think any charges will be filed.

<http://okcfox.com/news/local/legal-drone-shot-down-in-edmond-neighborhood>

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### **First two Texas companies credentialed for drone operations**

AUSTIN — Companies in Austin and Addison on Wednesday became the first two firms to become officially credentialed to operate unmanned aircraft systems under a new training and safety program that officials said promises to boost Texas' key place in the emerging drone market.

At a statewide conference hosted by the Texas A&M University System, which operates the new certification program through its Corpus Christi campus and its engineering extension service, officials presented HUVRdata, of Austin, and Aviation Unmanned, of Addison, with their certificates — among the first granted in the nation since the Federal Aviation Administration announced new rules governing the use of drones.

"Through this credentialing program that will ensure the safety of operations for unmanned aircraft systems, Texas is in a position to be a leader in this emerging industry," said Joe Henry, director of outreach and commercialization at the Lone Star UAS Center for Excellence and Innovation, which is part of the A&M program.

With the new credentials, which the A&M center and similar programs in five other states have been approved to grant, conference officials said operations safety can be assured — a step that will allow the drone industry to grow as more and more companies find ways to utilize the technology.

In Texas, drones already are used by the wind-power, oil and gas and transportation industries to provide aerial inspections and mapping, and for port and border security and coastline monitoring.

As a business hub for many of those concerns, as well as home to the NASA's Johnson Space Center that is developing drones to explore Mars, officials said Houston stands to be a center for the growing industry.

<http://www.chron.com/news/houston-texas/texas/article/First-two-Texas-companies-credentialed-for-drone-7217781.php>

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### **FAA tweaks rule making process for private drones**

Registration of privately owned drones has jumped to almost 400,000 from 180,000 registrations in January, according to Michael Huerta Federal Aviation Administration administrator. The quick implementation of the B4UFLY registration portal has prompted the agency to take a more flexible look at how it's drawing up subsequent operational rules for privately owned tiny drones, he said.

In a March 14 presentation at the South by Southwest festival, Huerta said the agency's high-speed efforts to tap input from commercial drone manufacturers and unmanned aerial system users in the run-up to the 2014 Christmas season was so successful the FAA is using that process as a model for how it drafts rules for "microUAS" vehicles, which weigh 4.4 pounds and under.

The idea for a microUAS task force gelled, said Huerta, after conversations with industry partners involved in the registration task force took place during the January Consumer Electronics Show in Las Vegas.

"The idea was that we shouldn't treat all UAS the same," he said. "Some might be carved out and considered differently because they would pose less of a hazard due to their size, shape, weight or materials."

According to Huerta, the agency decided in late February to stand up an Aviation Rulemaking Committee to develop recommendations for how to safely allow certain UAS to be operated with people below. The goal, he said, is to create a performance-based regulatory framework that addresses potential hazards, rather than a classification that is based only on weight and speed.

The approach departs significantly from the agency's traditional approach to safety rules, he said, but noted the FAA is trying to be more flexible and open-minded in integrating new technologies into the national airspace.

The MicroUAS aviation rulemaking committee, Huerta said, began meeting the week of March 7. A final report is due on April 1, and the FAA will use those findings to draft a proposed rule.

<https://fcw.com/articles/2016/03/17/faa-drone-tweak.aspx>

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## **Plane Crazy? New Study Claims Drones Not as Dangerous as the FAA Says**

Despite dire predictions from the Federal Aviation Administration that the nation's air traffic is at peril from unmanned aerial vehicles, a new study claims that the chances of a drone damaging a passenger plane are fairly slim.

"Contrary to sensational media headlines, the skies are crowded not by drones, but by fowl," wrote researchers from George Mason University, citing America's 10 billion birds.

The most famous "bird vs. plane" incident happened in 2009, when US Airways Flight 1549 suffered a catastrophic "wildlife strike" to its jet engines by a flock of Canada geese, resulting in the "Miracle on the Hudson" when the pilot made an emergency landing in New York City's Hudson River.

In that instance, the geese in a flock weighed an average of 18 pounds each — but recreational drones average around 4.5 pounds.

"Aircraft collide with birds many thousands of times per year, [but] only a tiny fraction of those collisions result in damage to the aircraft, much less human injuries or deaths," wrote the study's authors, Eli Dourado and Samuel Hammond.

To determine the risk of collision by a drone, the researchers used revised methodology that weighed the risk of plane collision versus the risk of that collision being fatal.

"We further estimate that  $6.12 \times 10^{-8}$  collisions that cause an injury or fatality to passengers on board an aircraft will occur every 100,000 hours of 2kg UAS flight time, or once every 187 million years of operation," concluded the researchers.

"We believe the risk of drones to public safety to be overstated," agreed Frank Schroth, editor-in-chief of DroneLife.com.

"Technology will, over time, help to mitigate risk and control aberrant flights," he told NBC News, citing the example of a new drone with "autonomous sense-and-avoid capabilities." Other advancements include geo-fencing, which Schroth described as "the setting of a virtual boundary around a location [such as an airport] and preventing entry, regardless of whether an operator wants it to."

Michael Huerta, administrator of the FAA, addressed a drone panel at South by Southwest in Austin on Monday, saying "We are not your father's FAA." He assured tech companies and innovators that "the path in front of us will continue to be paved with the same kind of partnerships that have taken us to where we are today. The safe integration of unmanned aircraft is a goal that we're committed to pursuing together."

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## **FAA to consider report on micro drones**



SAN FRANCISCO – The next step in regulating, and potentially expanding, drone use in the U.S. hit a deadline Friday, when the Federal Aviation Administration was slated to receive recommendations on very small drones.

As consumers and the industry surge forward with ideas for what they want to do with drones, the FAA is still working on the details on how these new devices, dubbed UAV (unmanned aerial vehicles) or UAS (unmanned aerial systems), will be treated.

The report due to the FAA comes from the Micro UAS Aviation Rulemaking Committee, or the ARC. Its charter was to come up with recommendations for the FAA covering “micro UAS,” or drones weighing less than 4.4 pounds.

That size of drone includes everything from small, inexpensive toy drones to \$3,000, film set quality flying cameras. Delivery drones would be larger.

The Senate is seeking to create regulations for larger drones that could do commercial deliveries.

The FAA has typically forbidden anyone from flying drones over people who aren't associated with the flight, such as visitors to the cherry-blossom festival this month in Washington or at a sporting event like the Super Bowl. The concern is that a drone could lose contact with its remote operator and crash.

The ARC's task was to consider recommendations for standards that would these very small drones to fly over people who weren't directly participating in their operation. While the FAA was expected to receive the report Friday, it isn't expected to make it immediately public.

The report is only a single step in a long and painstaking rule-making process, said Mark Dombroff, a partner and aviation industry expert at Dentons law firm in McLean, Va.

#### DRONE SPLIT

It comes just one day after a split in the Small UAV Coalition, which had contained almost all the major drone manufactures and large tech companies involved in drones.

The more consumer-facing wing of the coalition, China-based DJI, French-based Parrot, San Mateo, Calif.-based GoPro and Berkeley, Calif.-based 3DR, pulled out of the coalition on Thursday.

While still tightly aligned with the coalition on big issues, the break-away companies plan to create a still-unnamed group to very specifically focus on consumer issues, said GoPro spokesman Jeff Brown.

To a certain extent it represents a split between companies keen on doing beyond line of sight work and everyone else, said Colin Snow, a drone analyst with Skylogic Research.

Google, Amazon, Intel and other major companies remain in the coalition. Their focus has been on delivery and long-range flight for things like inspecting railways or energy pipelines. That's a much longer road, as there's no federal regulation covering such drone uses today, Snow said.

'AT KITTY HAWK WITH WRIGHT BROTHERS'

The drone world will see a constant stream of development and events in the next few years, said Dombroff.

“It’s very exciting. We’re there at Kitty Hawk with the Wright brothers. I’m not sure people really appreciate this. We’re watching and participating in the development and growth of a whole new segment of the aviation industry,” he said.

The commercial drone industry only really started in the last three or so years, making it very new and still finding its way.

“I’m not sure that many of the companies, even the most sophisticated ones, knew what their place was in the business,” he said.

Waiting for regulations to be created by the federal government, with its slow and careful focus on safety, has been frustrating to some of the players, especially because airspace is a very different realm from the tech arenas.

“You had an influx of companies who had never been in the regulated world of aviation — and it’s a very highly regulated world,” he said.

<http://www.usatoday.com/story/tech/news/2016/04/01/faa-consider-report-micro-drones/82525050/>

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## **PUBLIC SAFETY:**

### **Not just for the Navy: unmanned surface vessels (USVs) in wide use for surveillance at NOAA**

COMMENTARY, 29 March 2016. When we think about unmanned marine vessels, naval applications usually come to mind first. The U.S. Navy, for example, is using unmanned underwater vehicles (UUVs) for surveillance and counter-mine operations. Navy experts also are developing unmanned surface vessels (USVs) for mine warfare and harbor security.

Future Navy unmanned marine vessels as motherships to launch and recover UUVs, USVs, and even unmanned aerial vehicles (UAVs). Navy applications capture the imagination so deeply that sometimes we forget about other users of these unmanned waterborne technologies.

Take the U.S. National Oceanic and Atmospheric Administration (NOAA), for example. NOAA's mission ranges from tracking changes in the weather, charting shifting sandbars along treacherous coastlines, to monitoring the health and well-being of marine wildlife sanctuaries.

The agency -- a bureau of the U.S. Commerce Department -- faces the daunting task of observing atmospheric and oceanic phenomena at far-flung locations all over the world, with far more miles to cover than the agency has personnel.

Related: NOAA's small unmanned surface vessels (USVs) help map the ocean's shallow floors

In other words, NOAA is a perfect place for unmanned vehicles, which excel at the dull, boring, dangerous, and dirty jobs that human beings wouldn't want to do, even if they had the time and money to do them.

Just this week came a story from Popular Science about how NOAA is using small robot boats -- or "roboats" as the magazine terms them -- to take measurements of quickly changing coastal features to help keep nautical charts up to date.

Mariners of every stripe, from commercial tanker captains to weekend pleasure boat sailors, rely on NOAA nautical charts to help keep them out of trouble. Without accurate charts, boats can run aground, or worse. It's essential to have frequently updated measurements to keep mariners out of harm's way.

Then there's the Emergency Integrated Lifesaving Lanyard (EMILY) Hurricane Tracker unmanned surface vessel, developed with NOAA funding by Hydronalix in Green Valley, Ariz. The EMILY Hurricane Tracker is five and a half feet long USV balanced to operate in heavy weather for as long as five to ten days at speeds to 7 knots.

Related: Navy chooses AAI Textron to provide mine-hunting unmanned boat for Littoral Combat Ship

This unmanned vessel, a new tool for hurricane research, has a satellite link, camera, reciprocating internal combustion engine, and a variety of sensors. EMILY is collecting sea-level data for NOAA.

NOAA also is working with Liquid Robotics Inc. in Sunnyvale, Calif., on a project to use the company's Wave Glider long-endurance unmanned surface vessel to keep tabs on shipping in marine protection areas such as the Channel Islands National Marine Sanctuary off the California coast.

NOAA officials are working with Liquid Robotics to evaluate the Wave Glider's ability to approach and discreetly image vessels and onboard activity.

NOAA also is working with Ocean Aero Inc. in San Diego to use the company's Unmanned Underwater Surface Vessel (UUSV) for a variety of long-endurance surveillance applications. The UUSV is a rugged surface and sub-surface vessel powered by wind and solar. It can spend several months at sea and can be deployed from land, sea or air.

Related: Navy to develop unmanned surface vessels as its newest generation of minesweepers

NOAA experts can configure the UUSV with a wide variety of sensor and observational systems to provide ocean-area surveillance and reconnaissance.

Unmanned submersibles also are helping NOAA researchers document and survey old shipwrecks from World War II off the coast of North Carolina. UUVs have helped researchers search for unknown shipwrecks in an area known as the Graveyard of the Atlantic.

In other projects NOAA experts are using sea gliders -- efficient UUVs that dive deeply to gather information from many layers of the ocean and the resurface to upload gathered data over radio links.

It just goes to show you that unmanned marine vehicles aren't just for the Navy. In fact, these types of unmanned vehicles are opening up new research vistas to learn more about the world's oceans for science, commercial, and military applications.

[http://www.militaryaerospace.com/articles/2016/03/unmanned-surface-vessels.html?cmpid=enl\\_MAE\\_Weekly\\_2016-03-30&eid=288641596&bid=1354012](http://www.militaryaerospace.com/articles/2016/03/unmanned-surface-vessels.html?cmpid=enl_MAE_Weekly_2016-03-30&eid=288641596&bid=1354012)

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### **Amazon has filed a patent to develop drone propellers that could tell people to 'watch out'**

Amazon has filed a patent to build drone propellers that can emit warning noises and certain phrases.

The eCommerce giant is interested in using drones to deliver parcels to people's homes and offices, cutting out delivery companies like FedEx and DHL.

One involves using drone propellers to alert people on the ground of the drone's presence, possibly by shouting phrases like "watch out" at them.

The patent reads:

Suppose, for instance, that the AAV were delivering an inventory item to a location. Upon approaching the location, the AAV determines (e.g., based on a video signal fed as an input parameter to the controller via a camera) that a person is situated at or near an intended or a suitable landing area corresponding to the delivery location. Such an input parameter may satisfy a flight condition corresponding to an audible communication, such as a "Watch out!" warning message. Accordingly, the controller may determine and cause to implement modulations of the rotational speed of a propeller, thereby causing the propeller to produce a series of sounds that are audibly perceptible as "Watch out!"

A diagram in the patent shows that Amazon also thinks it would be possible to use LED's in/on the propellers to convey messages like "Hi."

Amazon droneAmazon This diagram illustrates how the propellers could use LED s to convey messages.

The other element involves developing drones with noise-cancelling propellers rotating in different directions. In the patent, Amazon gives an example of a drone with two propellers, stating that one would generate lift, while another could cancel out noise.

The patent reads:

In some cases, an audio sensor (e.g., a microphone) located near the first propeller may detect the noise generated by the first propeller. A controller may be in direct or indirect communication with the audio sensor. The controller may be configured to receive a signal representing the noise detected by the

audio sensor. The controller may also be in direct or indirect communication with the second propeller, and may cause the second propeller to produce anti-noise sound that cancels the noise generated by the first propeller.

<http://www.businessinsider.com/amazon-has-idea-to-develop-talking-drone-propellers-2016-3?r=UK&IR=T>

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## **Small UAV Coalition Splinters into Commercial, Consumer-Focused Groups**

### **Drone coalition splits as DJI, GoPro faction quits**

SAN FRANCISCO — The national group that represents companies that make and sell drones has split, with those focused on consumers leaving to form their own organization.

Four drone companies left the Small UAV Coalition on Thursday. They are China-based DJI, French-based Parrot, San Mateo, Calif.-based GoPro and Berkeley, Calif.-based 3DR.

UAV stands for Unmanned Aerial Vehicle.

While still tightly aligned with the coalition on big issues, the break-away companies plan to create a still-unnamed group to very specifically focus on consumer issues, said GoPro spokesman Jeff Brown.

As the drone market matures, a shifting of needs was inevitable. Larger companies such as Amazon's Prime Air, Alphabet's Google X and others are looking more at drones for delivery, cargo and more commercial uses. Consumers have gravitated to using drones for photography, racing and just to play with.

DJI and the other three companies all joined the Coalition about a year ago, "so it was a natural time to review where we were going," said Adam Lisberg, spokesman for DJI Technology, the world's largest drone manufacturer.

Phantom 4 can track humans and animals, fly home to base

"We consider the Small UAV Coalition to be allies and friends. But the business is growing so big that we thought we would most benefit from a group focused on the issues that are important to small drone manufacturers and our customers," said Lisberg.

Many of the regulatory issues that surround drones are beginning to diverge, as the FAA makes a distinction between pleasure and commercial use. However the final outlines of what the rules will look like is still far from clear.

Drone rules remain up in the air for now

The split was not unexpected and was very amicable, said Michael Drobac with the law firm of Akin Gump in Washington D.C. He is the spokesperson for the Small UAV Coalition.

“We wish them incredibly well in their work and we remain committed as a coalition to what we believe is going to be an incredibly vibrant commercial marketplace,” he said.

<http://www.usatoday.com/story/tech/news/2016/03/31/drone-coalition-splits-into-commercial-and-consumer-groups/82492584/>

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## **States using drones to cut costs, improve traffic**

Any driver with a few miles under their belt can attest that lane closures cause traffic jams. So if states could avoid doing lane closures more often, wouldn't that be worth trying?

Many states think so, and that's why they're increasingly turning to drones as a way to minimize the impact on traffic when conducting bridge inspections or clearing vehicle crashes.

The Georgia Department of Transportation (GDOT) could be using drones to monitor traffic in the next several years. The department commissioned a Georgia Tech study in 2014 that found 40 different ways the agency could use unmanned aerial vehicles. The \$75,000 research project was conducted by Javier Irizarry and Eric N. Johnson.

READ MORE: Five surprising uses for drones

A police helicopter flies past a UAV drone which was flying over a post-march street celebration in west Baltimore, Maryland

A March 2016 survey by the American Association of State Highway and Transportation Officials (AASHTO) found that 33 state departments of transportation have either studied, tested, developed policies for, or are currently using drones for these and other purposes.

For example, the state of Ohio has used drones to collect data about freeway conditions, intersection movement and monitoring parking lots.

Another popular use for drones helping transportation engineers to maintain roads and bridges in a state of good repair. Typical bridge inspection involves shutting down several lanes of traffic so that workers can be hoisted in bucket trucks.

Drones could change that by letting state transportation engineers examine bridges remotely. That makes the process faster, safer, and less expensive. Drones can produce 3D images by combining thermal, infrared and photography cameras. The images can then be examined to determine whether repairs are needed.

Compared to a typical bridge inspection, which takes about eight hours and costs about \$4,600, a drone inspection takes only about two hours and costs about \$250, the AASHTO survey found.

<http://commuting.blog.ajc.com/2016/03/30/states-using-drones-to-cut-costs-improve-traffic/>

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## **Insurers adopt drones for airborne inspections**

The days of the harried insurance adjuster climbing a ladder to poke at your storm-damaged roof may soon be history as insurance companies look to drones as the new wave for property inspections.

State Farm, the first insurer to win approval from the Federal Aviation Administration to use drones commercially, has launched hundreds of experimental drone flights for routine roof inspections. If the technology works out, the company could eventually use drones to give them a bird's eye view of catastrophes.

State Farm has not said yet when it will deploy drones company-wide to routinely do such inspections.

More insurance companies, utilities and telecommunications firms will likely embrace drones for the more dangerous or difficult to reach inspections, says Jonathan Downey, CEO of Airware, a drone startup based in San Francisco that is working with State Farm. Airware says it works with companies find the right aircraft and navigation software, train workers to use the equipment and to steer through complex government regulations.

“If you had asked me a year ago, if insurance was going to be a major adopter of drones, I probably would have been a little skeptical,” Downey said. “It really makes a lot of sense.”

Flying a remote-controlled aircraft over a disaster areas saves time and money while also minimizing the risks to employees who now must rummage around broken buildings and navigate around fallen trees, Downey said.

Drones are less expensive than hiring a standard helicopter to do survey work. Drones are more agile, can provide a variety of views, and depending on the model, can be equipped with cameras, sensors and other devices to accomplish specific tasks.

A roto-copter drone can hover in place while a fixed-wing plane covers more ground and could be used to survey a natural disaster. Rooftop inspections require high-resolution cameras to examine hail or wind damage, but also a way to flag the important five minutes during an hour-and-a-half video, Downey said.

Utilities want an infrared camera to monitor hot or cold spots on pipes or wires, Downey said. The Environmental Protection Agency might want a sensor that sniffs for methane emissions, he said.

Airware navigates future of drones

The drone industry is already booming, with the FAA granting more than 4,200 special permits for companies to fly drones for commercial purposes such as aerial photography and crop monitoring.

Among the first 1,000 exemptions were companies representing more than 600,000 jobs and \$500 billion in economic impact, according to the Association for Unmanned Vehicle Systems International, an industry advocacy group.

<http://www.usatoday.com/story/news/2016/03/31/insurers-adopt-drones-airborne-inspections/82434322/>

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### **Colorado Charter Airline Adds UAS Services**

A Colorado-based private airline management and charter company has expanded into the unmanned aircraft systems industry. Mountain Aviation has announced it received a U.S. Federal Aviation Administration section 333 exemption to commercially operate UAVs through services tied to aerial mapping, agriculture support, industrial inspections, aerial video, search and rescue, energy system inspections and forestry monitoring. Gregg Fahrenbruch, CEO of Mountain Aviation, said the company is excited to bring its safety protocols and aerospace knowledge to its UAS clients. "We're certain the impeccable safety record we've earned in our private jet business will set the bar for reliable and safe drone operations in the commercial and industrial sectors," adding that, "as an air carrier with full global operating authority we have the ability to serve clients both domestically and overseas."

[http://www.uasvision.com/2016/03/21/colorado-charter-airline-adds-uas-services/?utm\\_source=Newsletter&utm\\_campaign=18029d79f8-RSS\\_EMAIL\\_CAMPAIGN&utm\\_medium=email&utm\\_term=0\\_799756aeb7-18029d79f8-297560805](http://www.uasvision.com/2016/03/21/colorado-charter-airline-adds-uas-services/?utm_source=Newsletter&utm_campaign=18029d79f8-RSS_EMAIL_CAMPAIGN&utm_medium=email&utm_term=0_799756aeb7-18029d79f8-297560805)

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### **UAS that can help start prescribed burns will be tested at Homestead National Monument**

How effective an unmanned drone can be in helping firefighters on wildland blazes will be tested at Homestead National Monument of America during a prescribed burn there.

The park, located in Beatrice, Nebraska, is planning to burn about 26 acres of restored tall-grass prairie between now and mid-May. The one-day fire will include a test of a University of Nebraska-Lincoln small Unmanned Aircraft System (sUAS). The UNL system is a greatly scaled-down version of a manned helicopter aerial ignition device. A multidisciplinary team of UNL experts in micro-UAS technology, fire ecology, conservation and public policy is developing this unmanned aerial system for supporting prescribed and wildland fire operations.

"UAS's in firefighting have the potential to reduce direct risk to firefighters doing ignition work while reducing costs and making an aerial resource more widely accessible to wildland firefighting efforts," said Jim Traub, the Park Service's Unmanned Aircraft System Specialist. "The National Park Service is



pleased to facilitate this unique and innovative opportunity with UNL, for this test of a sUAS in a fire situation.”

Homestead National Monument of America, the NPS Midwest Region Fire and Aviation Program, and the NPS National Aviation Offices are collaborating with UNL’s Nebraska Intelligent Mobile Unmanned Systems (NIMBUS) Laboratory and the Department of Interior Office of Aviation Services (OAS) for this operational test and evaluation of the integration of sUAS into wildland fire operations.

“Historically, fire has been a tool in the management of the prairie at Homestead National Monument of America.” said Mark Engler, Homestead’s superintendent. “Today, the National Park Service conducts carefully planned prescribed fires to control woody plants, invasive species, as well as reduce thatch. Though fire is often considered to be inherently dangerous, it is a natural occurrence that holds many benefits for the native prairie grasses. We are grateful for the assistance from local firefighters, fire departments and other federal agencies on our prescribed fire. We look forward to the live test of the University of Nebraska-Lincoln’s sUAS.”

The 2.5 miles of trails within the monument will be temporarily closed during the prescribed fire and will reopen as soon as it is deemed safe. Travelers on State Highway 4 should use extra caution if traveling through the monument while the burn is occurring.

<http://www.nationalparkstraveler.com/2016/04/unmanned-drone-be-tested-homestead-national-monument-america-during-prescribed-fire>

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## **SENSORS/APPLICATIONS:**

### **New Gravimeter Technology Will Enable High-Res Drone-Based Gravity Mapping**

Gravity along Earth's surface is anything but constant. The variation from location to location may not be enough to handicap basketball games, but it is large enough to matter. A gravity map of Earth then winds up looking more like the malformed wad below rather than a smooth uniform sphere.

The biggest factors in these gravitational distortions are pretty obvious: elevation and latitude. Elevation changes the distance from a point to Earth's gravitational center (thus changing its local gravity), while latitude can have the same effect for the simple reason that Earth is really more of a smooshed ball than a perfect sphere. The maximum gravitational variation on Earth's surface winds up being around 0.7 percent.

In addition to elevation and latitude, there are other reasons for gravitational variance, and these are more difficult to detect. For instance, a subterranean tunnel or oil reservoir can yield relatively tiny changes in local gravity. It's these slight disturbances that a low-cost gravimeter recently developed at the University of Glasgow, and described in the current issue of Nature, is able to register. While an existing gravimeter of comparable sensitivity might cost over \$100,000, the Glasgow instrument is built

onto a 15-millimeter-square piece of silicon using the same fabrication methods used to build smartphone accelerometers.

<https://www.youtube.com/watch?v=yM7EV8T3-Xw#action=share>

The utilities of such an instrument are clear. Hydrocarbon hunting is one thing, but tiny gravitational fluctuations could reveal magma movements prior to a volcanic eruption in addition to other geological information useful to engineers. Local gravitational variations can also yield information about tidal forces that result from varying configurations of the Sun, Moon, and Earth. Note that in the case of tidal forces, the relative strength of gravity changes with time instead of location.

"Gravimeters are now used on ships and aircraft, on land, on the seabed and even in boreholes to produce maps of the relative value or of the vertical gradient of gravity," explains Hazel Rhymer, a geologist at the Open University, in a separate Nature commentary. "These maps can be interpreted in terms of subsurface mass anomalies in applications such as oil prospecting. When changes in gravity through time are measured, applications extend to cavity detection beneath structures such as railway tracks and even to the monitoring of magma and fluid movement beneath active volcanoes."

The gravimeter-on-a-chip system developed at the University of Glasgow isn't exactly a smartphone app, but it's a major step in that direction. It's built on basically the same idea as the micro-electro-mechanical system (MEMS) accelerometer in your phone except super-charged to the point of being about 1,000 times more sensitive while also maintaining the stability required to make such fine measurements. An accelerometer, after all, is already a conceptual mimic of the aforementioned spring-mass gravimeter only at micro- or nano-scales. Here, the spring is replaced with just a tiny bit of sealed gas surrounding a similarly tiny mass affixed to a cantilever beam.

Put somewhat differently, the Glasgow group's gravimeter is really an accelerometer capable of registering displacements at very low frequencies. To verify this low frequency capability, the researchers used their gravimeter to successfully monitor tidal forces for several days at a time.

"This MEMS gravimeter could be flown in drones by oil and gas exploration companies, reducing the need for dangerous low-altitude aeroplane flights, it could be used to locate subterranean tunnels, and it could be used by building contractors to find underground utilities," the Glasgow team writes.

"Networks of sensors could be operated in areas unsafe for humans, to monitor natural and man-made hazards, for example, on volcanoes or unstable slopes to measure the spatial and temporal resolution of subsurface density changes and improve hazard forecasting."

[http://motherboard.vice.com/en\\_uk/read/gravimeter-technology-drone-based-gravity-mapping-geologists-volcano-detection](http://motherboard.vice.com/en_uk/read/gravimeter-technology-drone-based-gravity-mapping-geologists-volcano-detection)

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## **Cyber-security for Unmanned Aerial Vehicle Missions**

An ongoing effort is discovering new factors for protecting remote-controlled or autonomous craft.

This threat can come from signals beamed into a control stream or even embedded software containing a Trojan horse. Researchers are addressing this challenge from traditional and innovative directions as the use of unmanned aerial vehicles continues to expand into new realms. But the issues that must be accommodated are growing as quickly as threat diversity.

In December 2014, at Early County Airport in Blakely, Georgia, a team from the University of Virginia (UVA) and the Georgia Tech Research Institute (GTRI), operating under a Federal Aviation Administration (FAA) Certificate of Authorization, conducted flight tests that evaluated a new class of cyber-security solutions on an unmanned aerial vehicle (UAV) performing a video surveillance mission. The goal was to protect computer-controlled remote systems from cyber attacks. The specific solutions that were assessed are part of a UVA-developed concept for a new layer of cyber-security referred to as System-Aware. The System-Aware nomenclature is based on the fact that this class of solutions depends on detailed knowledge of the design of the system being protected. This layer of security serves to both complement network and perimeter security solutions as well as protect against supply chain and insider attacks that may be embedded within a system.

The team launched experimental cyber attacks to prevent the UAV from observing specific ground-based locations. Attacks included changing navigation way-points, embedding errors in the Global Positioning System (GPS) and taking control of camera direction. In addition, cyber attacks were conducted on-board the aircraft, including corrupting aircraft-provided camera direction data being sent to the ground to support video exploitation, thereby disabling ground-based interpretation of streaming video.

Some of the attacks were initiated through the UAV pilot's support system, some via embedded Trojan horses within the aircraft and some from third-party locations using the aircraft's air-ground communication system to access on-board electronic systems. To ensure safe operation during the experiments, a dual command system allowed a safety-focused operational team to take immediate control of the aircraft if needed. Technical results from the flight tests were positive, demonstrating that the System-Aware concept can significantly improve the cyber-security of physical systems.

In correlation with the Georgia flight tests, a team from UVA and the MITRE Corporation at Creech Air Force Base in Nevada designed and conducted a set of tabletop simulation-based experiments with active military UAV pilots. The experiments involved the pilots being supported by System-Aware solutions that could automatically detect cyber attacks that were similar to those launched in the Georgia flight tests. The pilots were presented with suggested aircraft re-configurations to restore operations, such as resetting a way-point or switching from GPS-based navigation to less accurate—but more trusted—inertial navigation.

While the pilots found attack detection to be useful, some of their reactions differed from what was anticipated when designing the experiments. For example, one pilot indicated that the system's response to an attack was not enough to deter him from terminating the operation because of concerns about residual elements of the attack that had not yet occurred. Another pilot suggested that real-time access to a cyber-security expert would greatly reduce worries about making decisions with insufficient

knowledge. A third pilot raised concerns about the possibility of the monitoring system being the target of attack, potentially causing the pilot to make counterproductive decisions. These results highlighted the importance of operator training for addressing rare, unpredictable cyber attack situations that require confident decision making. Researchers have begun to understand and address this important issue better.

The System-Aware cyber-security concept developed at UVA is pertinent to a wide range of computer-controlled systems, such as UAVs, cars, radars, turbines and weapon systems. System-Aware implementations involve connecting the dedicated cyber-security monitoring system, known as Sentinel, to the system being protected. The Sentinel monitor is designed to collect information to detect illogical behaviors that can be categorized as likely cyber attacks. The low-power, small-footprint prototype electronics package implemented for the UAV flight evaluations consisted of sensors, microprocessors and communication devices. This technology collected and analyzed data to detect potential cyber attacks, and it disseminated the results.

For example, if the Sentinel observed a change in way-point occurring within the navigation subsystem but no message from the pilot directing this change, the monitor could conclude that a cyber attack was underway. Similarly, if a camera-pointing command was received on-board the aircraft and the Sentinel observed that the command differed from the camera's response, it could deduce that a cyber attack was the likely cause.

Although system restoration can be automated, operators themselves still may want to respond to an attack to sustain operations. For this capability, planners can create specially protected locations for storing critical flight information, and the Sentinel can draw on that information to restore a way-point or camera direction. With critical aircraft subsystems, in particular, the operational community gains confidence when pilots are involved in initiating these commands.

Recognizing that different systems require their own unique solutions, the System-Aware concept includes reusable design patterns for monitoring and restoration. For example, monitoring for unfounded parameter changes that significantly affect system performance is a reusable response to a broad set of potential cyber attacks designed to make such changes.

Parameters in a radar surveillance system determine the system's performance regarding false and missed detection's. Criteria for automated collision-avoidance systems initiating their warnings are determined through parameter settings in the automated collision-detection algorithms. An entirely different design pattern under development involves monitoring to ensure that the chain of command's doctrinal requirements for implementing critical system configuration changes—such as switching modes in a multimode system—are met. This type of design pattern would force an attacker who wants to change a system's operating configuration to concurrently attack the computers that are engaged in the process that supports the chain of command's structure. The Sentinel research effort has developed a significant set of reusable design patterns that were implemented for the experiments.

One risk associated with applying a Sentinel-based solution is the potential for a cyber attack to affect the Sentinel's performance, causing false or missed attack detection's or corrupting automated

reconfiguration decisions. Accordingly, a critical element of the System-Aware concept is to provide careful attention to Sentinel cyber-security. Implied in this concept is that securing the Sentinel is more readily accomplished and less expensive than security additions to the system the Sentinel protects.

Still, Sentinel designs must satisfy a number of technical requirements. First, they must be significantly less complex than the protected systems. Second, the amount of software required for Sentinels must be a fraction of the software embedded in the controller for the protected system. Third, the deterrence of supply chain and insider attack risks must be addressed.

The research prototype used on-board the UAV employed triple diverse redundancy, providing a high level of security while satisfying economic and physical constraints related to airborne systems. The prototype Sentinel used three different manufacturers' computer boards, three separate operating systems and three versions of the Sentinel software. Comparing the outputs from the diverse implementations provided a real-time capability to detect and eliminate a corrupt Sentinel element. Furthermore, the Sentinel prototype design included a moving target cyber-security solution; on a randomized basis, every few seconds, a switch would occur between the three diverse implementations to select the portion of the Sentinel that would be in control versus operating in a hot shadow mode.

Sentinel's diverse components were sufficiently low in cost to make the hardware portion of the solution economically viable. And the quantity and complexity of the monitoring software supported achieving the desired Sentinel attributes. For example, the software-based monitoring functions for detecting a cyber attack required 300 to 500 lines of code and were not intertwined. This made them far more manageable in quantity and complexity than the software being protected in the UAV.

An important aspect of the UAV research project involved developing an approach for selecting which system functions to monitor and protect. The Sentinel needs to secure the functions considered to be most critical by the system owners and operators as well as the activities deemed to be most desirable and easiest for cyber attackers to disrupt. Satisfying this requirement calls for an integrated design team with expertise on the system to be protected, the motivations of cyber attackers and the technical approaches for conducting cyber attacks. In addition, cost analysis is necessary to determine the most cost-effective subset of System-Aware solutions.

The recognition of the complexity of deriving Sentinel design requirements led to a decision-support tool research effort to aid system-specific determinations of the most desirable Sentinel defense capabilities. This activity currently is advancing toward a prototype-based set of experiments involving system planners. The U.S. Defense Department, through the Systems Engineering Research Center, is supporting the work. The SERC is a federally funded University Affiliated Research Center managed by Stevens Institute of Technology in Hoboken, New Jersey.

With the high visibility of automation innovations such as autonomous vehicles, robots and the Internet of Things, people are becoming more aware of the need to address cyber-security for physical systems. However, because of the rapid emergence of these innovations, the nation's work force and education system are not ready to fully support this new need. Engineering schools, for example, do not integrate the curriculum for electro-mechanical systems-related departments, such as mechanical engineering,

with the curriculum for the departments that teach cyber-security, such as computer science. The same separations occur in industrial organizations.

Furthermore, cyber-security experience related to information systems does not address the need for immediate response to disruptions that physical system solutions require—nor does it include training to respond to rare events that can be life-threatening. Important cyber-security investments will be required to enable safe deployment of the innovations for automated physical systems that are being developed.

<http://www.afcea.org/content/?q=Article-cybersecurity-unmanned-aerial-vehicle-missions>

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### **Researchers assisting NASA with testing unmanned aircraft software**

North Dakota researchers will conduct an experiment next month as part of a program helping NASA study space—airspace, that is.

The federal agency is exploring the potential for regulating unmanned aircraft systems traffic as the technology advances and is integrated in commercial operations for tasks such as package delivery, inspections and news gathering.

Managing additional drone traffic on top of manned aircraft is key to both types of aircraft coexisting in the national airspace, and NASA is developing a system to do just that.

"NASA has this design of this system they want to use to deconflict and keep unmanned aircraft systems at low altitudes separate and safe from each other," said UND professor Doug Olsen, who is leading the local research effort. "They've been developing it for a year and a half, two years now, and they're working with industry across the country."

The software wouldn't require human operators to monitor every moment of each vehicle's flight, NASA wrote on its website.

"NASA has been trying to come up with concepts on how you would do this, but NASA is not the (Federal Aviation Administration)," Olsen said. "They look at the world through different directions.— and rightly so because they have different organizational responsibilities— so this is a good step to get the two agencies to work together."

Testing is part of NASA's process for developing the software, and the agency has turned to various organizations around the country to complete this step, including groups in North Dakota.

UND, in collaboration with the Northern Plains UAS Test Site, will be stress testing a version of the software in mid-April.

Olsen said the flights of 24 aircraft will be simulated for the test, with four of those aircraft being real drones flown by operators in western Grand Forks County.

One of the aircraft will be UND's ScanEagle, an unmanned aircraft simulator used by students. The remaining aircraft will be flown with the cooperation of regional UAS companies Botlink, Altavian and Sensurion.

During the flights, researchers hoped to turn on the aircraft cameras and collect data. Doing so required permission from the university's UAS Research Ethics and Privacy Committee, which vets UND research proposals involving unmanned aircraft.

At its Wednesday meeting, the committee gave Olsen permission to collect data but required property owners whose land would be flown over be contacted through the means of a certified letter.

The research group had received verbal permission from several landowners, but committee members said they'd feel more comfortable if as many means to contact owners were made as possible.

<http://www.grandforksherald.com/news/education/3999324-und-researchers-assisting-nasa-testing-unmanned-aircraft-software>

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### **Gremlins Takes Flight to Provide Air-Recoverable Unmanned Air Systems – DARPA**

Four teams initiate research into affordable, distributed technologies that could provide breakthrough tactical and strategic capabilities

DARPA's Gremlins program seeks to develop innovative technologies and systems that would enable existing aircraft to launch volleys of low-cost, reusable unmanned air systems (UASs) and safely and reliably retrieve them in mid-air. In an important step toward that goal, DARPA has awarded Phase 1 contracts for Gremlins to four competing teams led by Composite Engineering, Inc., Dynetics, Inc., General Atomics Aeronautical Systems, Inc., and Lockheed Martin Corporation. Click below for high-resolution image.

DARPA has awarded Phase 1 contracts for its Gremlins program, which seeks to develop innovative technologies and systems enabling aircraft to launch volleys of low-cost, reusable unmanned air systems (UASs) and safely and reliably retrieve them in mid-air. Such systems, or "gremlins," would be deployed with a mixture of mission payloads capable of generating a variety of effects in a distributed and coordinated manner, providing U.S. forces with improved operational flexibility at a lower cost than is possible with conventional, monolithic platforms. The Phase 1 contracts have been awarded to four teams whose proposals cover a spectrum of technical approaches to this challenging mission. The teams are led by:

Composite Engineering, Inc. (Roseville, Calif.)

Dynetics, Inc. (Huntsville, Ala.)

General Atomics Aeronautical Systems, Inc. (San Diego, Calif.)

Lockheed Martin Corporation (Dallas, Tex.)

“We’ve assembled a motivated group of researchers and developers that we believe could make significant progress toward Gremlins’ vision of delivering distributed airborne capabilities in a robust, responsive and affordable manner,” said Dan Patt, DARPA program manager. “These teams are exploring different, innovative approaches toward achieving this goal and are rolling up their sleeves for the hard work ahead.”

Phase 1 of the Gremlins program is designed to pave the way for a proof-of-concept flight demonstration that would validate an air recovery concept of multiple gremlins. The program plans to explore numerous technical areas, including:

Launch and recovery techniques, equipment and aircraft integration concepts

Low-cost, limited-life airframe designs that leverage existing technology and require only modest modifications to current aircraft

High-fidelity analysis, precision digital flight control, relative navigation and station keeping

Named for the imaginary, mischievous imps that became the good luck charms of many British pilots during World War II, the program envisions launching groups of UASs from existing large aircraft such as bombers or transport aircraft—as well as from fighters and other small, fixed-wing platforms—while those planes are out of range of adversary defenses. When the gremlins complete their mission, a C-130 transport aircraft would retrieve them in the air and carry them home, where ground crews would prepare them for their next use within 24 hours.

The gremlins’ expected lifetime of about 20 uses could provide significant cost advantages over expendable systems by reducing payload and airframe costs and by having lower mission and maintenance costs than conventional platforms, which are designed to operate for decades.

<http://www.darpa.mil/news-events/2016-03-31>

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## **The race is on to be the Microsoft Office for drones**

Drones are now gadgets that the average consumer can easily own and operate. In fact, the FAA predicts that 2.5 million of them will be sold in the US this year. But aerial robots, at least for now, are unlikely to ever become as ubiquitous as personal computers or smartphones. The big growth in unmanned aerial vehicles is going to come from companies that will use drones to collect data or deliver packages. And those companies are going to want someone to hold their hand through the process.

Airware, a San Francisco startup with some big name backers, is trying to become, the Microsoft Office of the drone world, the default software suite for big corporations that want to put sensors in the sky with minimal risk. It's competing with companies like Drone Deploy and SkyCatch. Today Airware announced a major new client, State Farm insurance.



Airware will be providing the software to plan flights, capture aerial images, and process and organize whatever data is collected. In addition, Airware is now expanding its offering beyond just the software. It will be selecting and customizing the drones State Farm flies, and even providing the pilots who will accompany claims adjusters and operate the aircraft.

Founder and CEO Jonathan Downey says State Farm is planning to begin operations in the US over the next few months. If you call in a claim on a roof damaged by high winds or hail this summer, an Airware drone may stop by to buzz your house. As for exactly what kind of drone State Farm is flying, Airware won't say. Most of their clients from the Fortune 500 have so far worked with the kind of cheap, easy-to-use consumer drones we review here on The Verge. But for inspecting rooftops, Airware went with an industrial grade unit that can deliver longer flight times, more detailed images, and greater stability in high winds.

A heavy hitter joins the board

Along with its first big client, Airware announced the addition of John Chambers, the veteran CEO of Cisco, to its board. Chambers will help the company to optimize its enterprise sales funnel, which is a fancy way of saying he knows how to close big deals with stuffy Fortune 500 customers. Airware has also banked another \$30 million in funding as part of a Series C round of venture capital. The round was led by Next World Capital with John Chambers, Andreessen Horowitz, and Kleiner Perkins Caufield & Byers all investing as well.

Downey, a veteran of Boeing, is an astute observer of the rapidly shifting legal landscape for drones. He expects the FAA to issue its small drone rules by this summer, eliminating the need for complex exemptions and licensed pilots. That will open the floodgates for commercial operators to start using them at scale, an inflection point Airware is positioning itself to capitalize on. And while it won't reveal any names yet, Airware says it has also signed on Fortune 500 clients in the utility, telecom, and oil industries.

<http://www.theverge.com/2016/3/31/11335144/airware-drone-software-suite-state-farm>

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### **'Worker Bee' Quadcopter Can Apply Paint**

Florida-based startup Apellix developed a prototype unmanned aerial system that can potentially paint homes or ships, apply chemicals, or pressure wash windows. It's called the "Worker Bee."

Company founder Robert Dahlstrom presented the pitch for his drone on Friday at an event for Starburst Accelerator in El Segundo, California, hoping to find partners who could potentially use the technology.

"Drones can do more than gather data, take pictures, and deliver packages," Dahlstrom said. "They can do real work."

For its prototype, Apellix flies a quad-copter connected to a base station and paint materials via an umbilical cord and tether. The small drone can then paint evenly on a surface, opening a large opportunity for industrial painting of skyscrapers or ships in dry dock — which normally requires about four days and 30 people setting up scaffolding before they get started.

Apellix wants the drone to take over, which removes the need for scaffolding. And it's also focused on worker safety, since at least 95 climbers working on cell or other towers have died since 2004. "We develop technologies to keep workers safe," said Dahlstrom.

It's a unique new use case for drones, which most associate with military intelligence and targeting operations. The unmanned aircraft are increasingly being used in farming, emergency search and rescue, and overseeing construction. A 2013 report says the civilian drone industry could generate upwards of \$82 billion over the next decade.

Currently, the Worker Bee is a pre-production model that can only paint small buildings up to three stories, Dahlstrom told Tech Insider. But now that the drone has a patent pending, he said, the company has emerged out of stealth mode and plans to offer it as a "platform as a service," where clients can rent the drone for about \$25 an hour.

Besides painting buildings, there are other potential uses: The drones can be used to de-ice airplanes, or to fumigate ships, both of which are tasks that would keep humans from breathing in toxic chemicals. Dahlstrom also said it'd be ideal for coating above ground storage tanks, power transmission and telecommunication towers, and bridges.

[http://www.uasvision.com/2016/04/04/worker-bee-quadcopter-can-apply-paint/?utm\\_source=Newsletter&utm\\_campaign=3b2d01aaef-RSS\\_EMAIL\\_CAMPAIGN&utm\\_medium=email&utm\\_term=0\\_799756aeb7-3b2d01aaef-297560805](http://www.uasvision.com/2016/04/04/worker-bee-quadcopter-can-apply-paint/?utm_source=Newsletter&utm_campaign=3b2d01aaef-RSS_EMAIL_CAMPAIGN&utm_medium=email&utm_term=0_799756aeb7-3b2d01aaef-297560805)

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### **Potential for Unmanned Air Systems - Hawaii State Dept. of Health**

Meet Jon Shear of ReadyZoneHQ and Terry Visperus of State Dept. of Health as we look at the potential for Unmanned Air Systems, or Drones, to serve in situations such as we are facing with mosquito-borne threats.

<https://www.youtube.com/watch?v=9h2BTJlMrQ#action=share>

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<http://thinktechhawaii.com/the-potential-for-unmanned-air-systems-jon-shear-and-terry-visperas/>

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## **COUNTER UAS:**

### **INTERNATIONAL:**

#### **ISIL plotting to use drones for nuclear attack on West**

Isil terrorists are planning to use drones to spray nuclear material over Western cities in a horrific “dirty bomb” attack, David Cameron has warned.

World leaders are concerned that jihadists want to buy basic drones that are widely available online to transport radioactive material into the heart of major cities in a strike that could kill thousands.

The Prime Minister warned that the dangers of Islamic State of Iraq and the Levant (Isil) getting hold of nuclear material was “only too real”.

Footage has reportedly emerged showing Isil using drones and the threat was deemed so serious that – in a highly unusual move – world leaders were asked to take part in war games to plan how they would respond.

One scenario, mapped out by US officials and presented at the special Nuclear Security Summit session in Washington DC, spelt out the danger in remarkable detail.

It imagined radioactive material had been taken from a medical facility by “insiders” and sold to extremists through the internet’s secretive “dark web”.

Mr Cameron outlined how ministers would urgently hold a Cobra meeting and deploy counter-terrorism police and the UK Border Force. A British official said: “We have already seen Daesh [another name for Isil] trying to look at whether they can they get their hands on low-level crop-using-type drones.”

Isil is believed to have seized around 90 pounds of low grade uranium from Mosul University in Iraq after taking over the city in 2014, though its limited toxicity means its use would likely cause panic than serious harm.

"The issue of nuclear security and the security of nuclear materials, particularly when it comes to the problems of international terrorism, the concept of terrorists and nuclear materials coming together – which is obviously a very chilling prospect. And something in the light of the Belgian attacks, we know is a threat that is only too real.

Michael Fallon, the Defence Secretary, also announced yesterday that over £40 million will be spent on a new Cyber Security Operations Centre.

The facility will be dedicated to using “state-of-the-art defensive cyber capabilities” to protect Britain from “malicious actors”, according to government officials.

Mr Fallon said: “Britain is a world leader in cyber security but with growing threats this new Operations Centre will ensure that our Armed Forces continue to operate securely.”

<http://www.telegraph.co.uk/news/2016/04/01/isil-plotting-to-use-drones-for-nuclear-attack-on-west/>

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## **COMMENTARY:**

### **DepSecDef on Boosted Humans & Robot Weapons**

WASHINGTON: The senior leadership of the US military knows that genetically modified humans — stronger, faster, or better at altitude — and intelligent machines that could kill without remorse and with enormous efficiency, are two of the thorniest policy nettles they must grasp.

Deputy Defense Secretary Bob Work firmly grasped that nettle today, saying the United States would not grant artificially intelligent weapons or other automated systems the right to kill. He hedged a bit on whether the US military would genetically modify humans, saying “that is really, really troubling.”

Asked by the Washington Post’s well-known columnist, David Ignatius, how the US would counter an enemy willing to give robots lethal authority, Work danced around a bit describing the difference between “assisted” and “enhanced human operations”: the first is computers and sensors improving human performance, the second is genetically modifying humans. “Right now, we think in terms of assisted human operations,” Work said.

If you comb through DARPA’s work, such as that coming from the Biological Technologies Office, the ragged edges of work that could lead to improved human beings can be seen.

For example, its Biological Robustness in Complex Settings (BRICS) program is focused on this:

“The development of techniques and tools to rapidly sequence, synthesize, and manipulate genetic material has led to the rapidly maturing discipline of synthetic biology. Potential applications of synthetic biology range from the efficient, on-demand bio-production of novel drugs, fuels, and coatings to the ability to engineer microbes capable of optimizing human health by preventing or treating disease.

“If applications such as those highlighted above are to come to fruition, methods to increase the biological robustness and stability of engineered organisms must be achieved while maintaining or enhancing assurances of safety. While this program will support the development of technologies that

would be prerequisite to the safe application of engineered biological systems in the full range of environments in which the Department of Defense (DoD) has interests, all work performed in this program will occur in controlled laboratory settings.”

Some of this genetics work has arisen because biological weapons remain perhaps the top potential threat to the United States (whether attacks are aimed at our crops, our people, or our water). Protecting humans against such attacks may require rapid development of counteragents or built-in genetic changes. As the above quote makes clear, the program will do its work “in controlled laboratory settings.”

Of course, work on prosthetics also can bring with it the ability to give humans much greater strength or speed or endurance without genetic modifications.

I asked Selva about this issue in January and here’s what he said:

“Where do we want to cross that line, and who crosses that first?” Selva said regarding the potential to embed microelectronics in human beings. “When do we want to cross that line as humans? And who wants to cross it first? Those are really hard ethical questions.” He called for an international debate on this, clearly thinking of amendments or additions to the existing Geneva Conventions or of a new set of internationally agreed to standards.

It sounds as if Bob Work might welcome such a debate.

Best line of Work’s discussion with Ignatius sprang from the JICSPOC, the unpronounceable acronym for an experimental space command post: “You have to have spock (sic) in something about space.”

<http://breakingdefense.com/2016/03/depsecdef-on-boosted-humans-robot-weapons/>

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### **They're 400, 000 strong and the Pentagon sees them as an emerging threat**

The Pentagon, the world's largest user of drones, has posted a new policy on signs outside the mammoth five-sided building: No Drone Zone.

The signs, complete with a red slash through an image of a quadcopter drone, reflect America's growing concern about the proliferation of the small, inexpensive remote-controlled devices and the risk they pose to safety, security and privacy.

Federal law prohibits flying a drone anywhere in and around Washington, an area known as the National Capital Region. Other communities and institutions across the country are wrestling with the potential threat from more than 400,000 private and commercial drones now registered to operate in the skies.

Under the law, hobbyists and commercial users must keep unmanned aircraft below 400 feet and avoid flying within five miles of an airport to avoid endangering manned aircraft. With a maximum weight of 55 pounds, even a recreational drone could disable a jet flying hundreds of miles per hour.

Lufthansa jet and drone nearly collide near LAX

“Introduction of unmanned aircraft into America’s airspace must take place incrementally and with the interest of safety first,” said Laura J. Brown, spokeswoman for the Federal Aviation Administration.

But some drone operators regularly ignore or flout the law.

Pilots reported 238 sightings of drones in 2014, the first year such sightings were tracked, according to the FAA. Drone sightings jumped to 583 – or nearly 100 per month – in the six months between August 2015 and January 2016, the FAA’s most recent records show.

On Jan. 15, for example, Compass Airlines reported a near collision with a black-and-silver drone at 5,700 feet as the passenger jet came in for a landing at Los Angeles International Airport.

A day earlier, a pilot in a single-engine Cessna spotted a blue drone hovering at 9,500 feet above Riverside. That same week, a pilot landing at El Cajon reported three drones off his right side at about 500 feet in altitude -- one with yellow lights, one with green lights, and one with red lights.

The U.S. Forest Service says drones interfered with firefighting aircraft about 25 times last year, often forcing the planes to be diverted from fast-moving wildfires.

Law enforcement and national security officials worry that small drones could carry explosives, chemical agents or other potentially hazardous material over sensitive facilities.

The risk hit the headlines in January 2015 when a 2-foot-by-2-foot quadcopter crashed on the South Lawn of the White House at about 3 a.m., triggering a Secret Service lockdown of the compound. President Obama and the first lady were overseas, but their two daughters were home.

The recreational drone, called a DJI Phantom, posed no danger. But it had evaded radar that is calibrated to detect much bigger threats, like an airplane or a missile.

The Justice Department ultimately decided not to charge the drone's operator, a federal employee. He had lost control of the device several blocks away earlier in the evening and did not intend to fly it near the White House, officials said.

Late one night in October, a much smaller quadcopter crashed near the Washington Monument, behind the White House. In that case, U.S. Park Police issued the owner an \$85 citation for operating an unmanned aircraft in a restricted zone.

To help identify drones, the FAA requires owners to register their aircraft in a federal database before they fly it outdoors. Since the registry went live in late December, more than 406,000 people have registered. That compares to about 590,000 pilots licensed by the FAA to fly manned aircraft.

People who do not register their drones could face a civil penalty of up to \$27,500 or criminal penalties of up to \$250,000 and three years in prison for noncompliance.

Off-the-shelf drones are difficult to detect and monitor because they fly low and slow, and don't carry a radio transponder to signal their position. Most drones are made primarily of plastic and are too small for radar detection.

Drones are banned from flying above most stadiums hosting concerts or sporting events. The FAA advises against flying drones over what it calls critical infrastructure, including power plants, prisons and office buildings, but it is not illegal.

On March 16, the Senate Committee on Commerce, Science and Transportation approved a bill that would make the FAA the nation's sole regulator of drones. If signed into law, the bill would supplant the patchwork of local and state drone laws that have popped up

Last year, 45 states considered 168 bills meant to regulate use of drones, according to the National Conference of State Legislatures, which documents state laws. So far, 26 states have moved to limit police use of drones, bar drone surveillance over private property, or impose other restrictions.

In California, for example, it's illegal to use a drone to photograph or record footage of a person or property without his or her consent. The legislation was mostly meant to limit intrusions by celebrity-seeking photographers.

Some municipalities have imposed their own rules.

Poway, for instance, passed an ordinance in September that prohibits drones within two miles of a wildfire or other public emergency – the first such ban in San Diego County – after drones hindered firefighting efforts. Violators can be fined \$1,000 and face possible jail time.

General Atomics Aeronautical Systems Inc., which makes the Pentagon's MQ-1 Predator and MQ-9 Reaper missile-firing drones, is based in Poway.

"There's a great irony that one of the world's largest drone manufacturers is based here and is our largest employer," Poway's mayor, Steve Vaus, said in a telephone interview. "But we wanted an enforceable ordinance on the books to protect our first responders in the case of an emergency."

Inevitably, the boom in drone sales has created a market for counter-measures, including devices intended to disable drones by jamming their signals in midflight.

DroneShield, based in Herndon, Va., builds sensors that it says can detect the unique audio signature of a drone in flight, and send an alert if drones fly near a stadium, prison or other restricted property. The company says it has installed about 200 acoustic detection systems so far.

"The chance of drones being used in a way that endangers security and privacy is increasing," James Walker, chief executive of DroneShield, said in a telephone interview. He said the company's devices will be used during the Boston Marathon on April 18 to notify police if unauthorized drones fly near the runners or spectators.

Some individuals have taken more drastic measures.

William “Willie” Merideth, a truck company owner in Hillview, Ky., was grilling dinner for his family on a warm Sunday evening in July when he saw a small drone with a camera mounted on it pass near his property three times in half an hour, he said.

He went inside and grabbed his Binelli shotgun and a few shells of birdshot. After the third blast, the drone fell into the woods behind Merideth’s house.

“We had no idea who owned it, what they were up to. Were they looking for stuff to steal? Were they stalking kids? You just don’t know,” Merideth said in a telephone interview. “There was no other recourse for me to stop them from coming over my property.”

The drone’s owner called police, and Merideth was charged with felony wanton endangerment and criminal mischief. In October, Bullitt County District Judge Rebecca S. Ward dismissed the charges, saying Merideth “had a right to shoot” the drone.

The incident has made Merideth a folk hero in corners of the Internet where gun enthusiasts and privacy advocates meet.

The Kentucky press dubbed him “the drone slayer.” A banner on Merideth’s Facebook page reads: “Not only did I do it, but I meant to do it. And I’d do it again.”

Merideth isn’t against private citizens flying drones.

“I think they’re neat. In fact, I’d like to have one,” he said. “But they need to be used in the proper way.”

The Pentagon takes a similar position. It was a terrorist target on Sept. 11, 2001, is on the flight path to nearby Ronald Reagan Washington National Airport, and is the obvious focus of foreign surveillance.

“We’re going to leverage every capability we can to protect this building,” said Daniel P. Walsh, assistant director for security integration and technology at the Pentagon Force Protection Agency. “This is an emerging threat.”

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### **As commercial drone use explodes, will FAA change policy?**

Photographers and cinematographers from all corners of the industry are increasingly interested in drone use. Drone usage is now a trend in high end real estate markets such as California and New York.

In California alone, particularly in areas such as Silicon Valley, real estate photography makes up 35 percent of all commercial drone use in the state, according to Dan Gettinger of Bard College’s Center for the Study of the Drone. Nationwide, 18.4 percent of commercial drone licenses are granted for real estate purposes.

And interest in aerial real estate photography only seems to be growing.



“In the past year,” said Mr. Gettinger in a phone interview with The Christian Science Monitor, “real estate has emerged as a bigger category of drone use.”

“Seventy-five percent of our business is real estate related,” said Bill McGonagle of Cape Cod Aerials, an aerial photography business in one of the wealthiest parts of Massachusetts. “People seek out aerial photography for high-end real estate. That’s become the norm.”

Yet, the rise of commercial drone use has muddied the regulatory waters for drone users. Although the Center for the Study of the Drone says that the Federal Aviation Administration (FAA) reports just over 6,000 drones registered for business purposes under Section 333 exemptions, there are 400,000 FAA-registered hobbyists, some of whom could be engaging in under-the-table commercial dealings.

According to Parker Gyokeres of Propellerheads Aerial Photography, a Section 333-compliant photography company located in New York, his focus has shifted from real estate photography to commercial filming over the years, as demand for real estate photography has decreased in his area.

“The shift in our demand has been due to our pricing structure,” Mr. Gyokeres told the Monitor. “It is easier for a realtor to go out and buy a drone and do their own filming now.”

The proliferation of drones amongst younger people has also cut demand for professional services. Gyokeres says, “We are being overrun by kids who own one drone.”

The biggest danger in the proliferation of small time, semi-commercial drone use is that often, small time users are not insured and don’t necessarily have the experience to avoid catastrophic accidents, says Gyokeres.

If a hobby drone user flies his unmanned aerial vehicle (UAV) too close to an airport or airline flight path, for example, it could cause a terrible accident. Inexperienced drone pilots could also lose control of their drones and accidentally harm a customer – an event that could have tremendous legal and financial repercussions for the uninsured.

Currently, FAA commercial regulations are so strict that many opt not to go the commercial route, despite interest, says Abby Speicher of DART Drones, a FAA 333 exempt company offering drone training, in an email to the Monitor. It takes four to five months for the FAA to grant a Section 333 exemption for commercial drone use, and to gain such an exemption, one must have a full sport pilot’s license. The cost and time investment of pilot training necessarily deters many.

It is difficult, however, for the FAA to regulate how drone pilots use their drones. According to Mr. Gettinger, the FAA is usually quick to follow up on commercial Internet postings (on YouTube and similar sites) by drone users with hobby use registrations, but it has little ability to regulate beyond that.

“Unfortunately, there are many people offering drone services today without the approval of the FAA,” says Ms. Speicher. “We are hoping that our classes help promote safer skies so that the FAA can come out with regulations that will be easier for commercial pilots to fly legally.”

Regulatory change could happen as soon as June, 2016.

Expectations for the new rules differ.

Mr. McGonagle of Cape Cod Aerials believes that regulations will become stricter when they change. "It's only a matter of time before there is an accident," he says. "It's not if, it's when."

Speicher disagrees, saying that the FAA is expected to create an Airmen Knowledge Test, a two and a half hour exam designed specifically for commercial drone pilots.

Meanwhile, the convenience and elegance of aerial drone photography and videography mean that drones will likely become a permanent fixture of the industry.

"We believe that drones are here to stay for the real estate industry," said Speicher. "The real question is will realtors be the ones to capture the aerial photos, or will they hire contractors instead."

<http://www.csmonitor.com/Business/2016/0317/As-commercial-drone-use-explodes-will-FAA-change-policy-video>

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## **UPCOMING EVENTS:**

### **Xponential 2016 – An AUVERSI Experience – 2-6 May 2016 New Orleans, LA**

Thousands of curious minds will gather in New Orleans in about a month. Folks from all of the unmanned systems domains will come together from May 2-5 to discuss the latest advances in the unmanned systems industry, which today spans from driverless cars to personal drones to automated robots. Don't miss this exciting event...check out the below link for additional details and check out the outstanding list of guest speakers!

<http://www.xponential.org/auvsi2016/public/enter.aspx>

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