

FAA Safety BRIEFING

May/June 2018

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Pushing the Envelope – A Plan of
“Attack” for Loss of Control **p 10**

Weather ... Or Not? Weather
Tech in the Cockpit **p 14**

LED There Be Light
p 18



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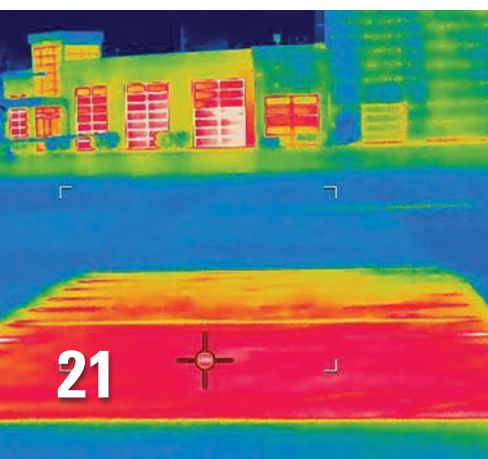
The May/June 2018 issue of *FAA Safety Briefing* focuses on the FAA's Center of Excellence for general aviation research, the Partnership for Enhancing General Aviation Safety, Accessibility, and Sustainability (PEGASAS). This partnership facilitates collaboration and coordination between government, academia, and industry to advance aviation technologies and expand FAA research capabilities. Feature articles in this issue focus on several of these forward thinking and safety enhancing projects.

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COE-operation *Center of Excellence for General Aviation*

The United States has the largest and most diverse general aviation community in the world, with more than 1.2 million aircraft registered to fly through American skies. With the astonishing size and diversity of the N-registered fleet, which now includes an ever-expanding number of drones, the FAA has long recognized the critical need to develop this nation's technology base while educating the next generation of aviation professionals.

This magazine has previously explored the work that FAA researchers perform at the William J. Hughes Technical Center in Atlantic City, New Jersey (*FAA Safety Briefing*, May/June 2016). In this issue, we focus on activities underway through the FAA Center of Excellence Partnership to Enhance General Aviation Safety, Accessibility, and Sustainability — more easily known as PEGASAS.

COE Concept

We will talk specifically about PEGASAS elsewhere in this issue, so let me kick off the tour by explaining the Center of Excellence (COE) concept.

In the Federal Aviation Administration Research, Engineering and Development Authorization Act of 1990 (PL 101-508), Congress authorized this agency to create Air Transportation Centers of Excellence. The COE program facilitates collaboration and coordination to advance aviation technologies and expand FAA research capabilities. Specifically, it enables the FAA to conduct research in areas such as airspace and airport planning and design, environment, and aviation safety via cost-sharing partnerships with university partners and industry affiliates.

The Center of Excellence approach represents an excellent use of resources, including your tax dollars. The 1990 legislation requires COE members to match FAA grant awards to establish, operate, and conduct research on a dollar-for-dollar basis. So far, the COE universities and their non-federal affiliates have provided more than \$300 million in matching contributions to augment FAA research efforts. Through these long-term, cost-sharing activities, the FAA and academia/industry teams can make the most of resources to advance the technological future of the American aviation industry, while also educating and training a new generation of aviation scientists and professionals.

Current COE Count

To date, the FAA has entered into cooperative agreements with ten competitively selected COEs established with academic institutions and their industry affiliates throughout the United States. In general, here's how it works. Through a rigorous competitive process, the FAA Administrator selects a university team to serve as a Center of Excellence (COE) in individual mission-critical topics. The COE forms through cooperative agreements with this country's premier universities, and their members and affiliates, who conduct focused research and development and related activities over a period of 10 years.

FAA Center of Excellence members have assisted in mission-critical research and technology areas focused on topics that include: technical training and human performance; unmanned aircraft systems; alternative jet fuels and environment; general aviation safety, accessibility and sustainability; commercial space transportation; advanced materials; airliner cabin environment and intermodal transportation research; aircraft noise and aviation emissions mitigation; general aviation; airworthiness assurance; operations research; airport technology; and computational modeling of aircraft structures.

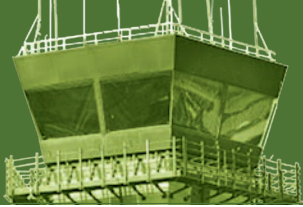
The FAA established the first Center of Excellence for General Aviation Research in 2001 through a ten-year agreement to conduct general aviation research in airport and aircraft safety areas. The first COE contributed to research in pilot training, human factors, weather, Automatic Dependent Surveillance-Broadcast (ADS-B), remote airport lighting systems, and other matters.

We kicked off the PEGASAS Center of Excellence in September 2012, and, as you will learn, there is a lot of horsepower in this collaborative partnership. Read on!

Learn More

For more information about the FAA Centers of Excellence program, visit the COE webpage:

www.faa.gov/go/coe



ADS-B Videos on FAA YouTube Channel

January 2018 was an important month for the Automatic Dependent Surveillance-Broadcast (ADS-B) program — it marked 24 months until the January 1, 2020, ADS-B Out equipage deadline. To accompany a monthly countdown on the FAA’s Equip ADS-B website and corresponding social posts, five new videos were released on social media to emphasize the urgent need for pilots to equip with ADS-B Out.

The videos feature a pilot, Jamal Wilson from the FAA Office of NextGen, asking David Gray, Surveillance and Broadcast Services program manager, some common questions pilots have when making ADS-B equipage decisions. Watch the playlist at bit.ly/2GMpsmi.

the post-9/11 security demands placed on the airport and FBO, the lack of traffic volume to support FBOs, and airport sponsors’ need to operate self-sustaining enterprises, along with other variables, have been factors that have put the FBO business under stress. Airport sponsors have no control over industry consolidation or local market forces, and the federal government does not regulate the pricing of FBOs.

The FAA has prepared a questions and answers sheet as a basis for discussion between the airport sponsor, the FBO, and aeronautical users on the issue of reasonable access, without unjust discrimination, at federally obligated, public-use airports. These Q&As are based on existing statutes, guidance, precedent, and industry practices and are not an attempt to impose new regulations or policies on airports. It is acknowledged that not every concern raised by an aeronautical user is a violation of a federal grant obligation and that variables may exist that impact how airport sponsors exercise their discretion in managing their facilities and operations. Aeronautical users should consult with their respective airport managers and local FAA field offices for further clarification. Download the six-page Q&A at bit.ly/2HObRw7.



FBO Industry Consolidation and Pricing Practices

The FAA has received a number of complaints about fixed base operator (FBO) services at federally obligated airports. Some users have voiced concerns over the rising costs of FBO services, including fueling costs, ramp fees, parking fees, and handling fees. Concerns have also been raised over significant, if not exclusive, FBO control over airport ramp parking and associated fees. Pricing practices could, in some cases, preclude reasonable access to public-use airports. Changes in the FBO industry in recent years have presented challenges for airport sponsors, FBOs, and their customers. The continuing consolidation of the FBO industry,

Airman Certification Standards Update

Working with the aviation training community, the FAA is finalizing June 2018 updates to the Airman Certification Standards (ACS) for the private and commercial pilot certificates and the instrument rating, all in the airplane category. To stay up to date on these and other ACS developments, please subscribe to the FAA website’s Airman Testing page: www.faa.gov.training_testing/testing.

The GA and Part 135 Activity Survey is Cleared for Takeoff

Did you receive an email or postcard invitation asking you to complete the survey for your aircraft? The survey takes only 10-15 minutes and helps the FAA improve general aviation infrastructure and safety. Please complete the survey today, online at aviationsurvey.org, or contact Tetra Tech, an independent research firm, toll free at 800-826-1797, or email at infoaviationsurvey@tetratech.com.

For survey results from previous years, visit

bit.ly/GASurveys.

FAA Expands Drone Airspace Authorization Program

Last March, at the third Annual UAS Symposium in Baltimore, Maryland, FAA Acting Administrator Dan Elwell announced plans to expand tests of an automated system that will ultimately provide near, real-time processing of airspace authorization requests for small Unmanned Aircraft Systems (sUAS) operators nationwide.

Under the FAA's part 107 sUAS (drone) rule, operators must secure authorization from the agency to operate in any airspace controlled by an air traffic facility. To facilitate those approvals, the agency deployed the prototype Low Altitude Authorization and Notification Capability (LAANC) at several air traffic facilities last November to evaluate the feasibility of a fully automated solution enabled by data sharing.

LAANC uses airspace data provided through UAS facility maps. LAANC gives drone operators the ability to interact with the maps and provide automatic notification and authorization requests to the FAA. It is an important step in developing the Unmanned Aircraft Systems Traffic Management System (UTM).

Drone operators using LAANC can receive near, real-time airspace authorizations. This dramatically decreases the wait experienced using the manual authorization process and allows operators to quickly



plan their flights. Also, air traffic controllers can see where planned drone operations will take place.

Based on the prototype's success, the agency plans to conduct a nationwide beta test this spring that will deploy LAANC incrementally at nearly 300 air traffic facilities covering approximately 500 airports. The final deployment will begin on September 13.

The FAA will also consider agreements with additional entities to provide LAANC services. Currently, there are four providers — AirMap, Project Wing, Rockwell Collins, and Skyward. Those wanting to apply must do so by May 16.

For more information, go to go.usa.gov/xQ48r.

FAA Recommends Use of Reflective Vests During Drone Operations

According to a recently issued Information for Operators (InFO) bulletin, the FAA now recommends

Safety Enhancement Topics

May: Best Glide Speed

Understanding the safety benefits of flying at best glide speed while maneuvering to a forced landing runway or off airport landing area.



June: Transition Training

Understanding the need for transition training when moving on to a new or different type of aircraft.



Please visit www.faa.gov/news/safety_briefing for more information on these and other topics.



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Elaine L. Chao *Secretary of Transportation*
Daniel K. Elwell *Acting Administrator*
Ali Bahrami *Associate Administrator for Aviation Safety*
John Duncan *Executive Director, Flight Standards Service*
Susan Parson *Editor*
Tom Hoffmann *Managing Editor*
James Williams *Associate Editor / Photo Editor*
Jennifer Caron *Assistant Editor*
Paul Cianciolo *Assistant Editor*
John Mitriane *Art Director*

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CONTACT INFORMATION

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Comments or questions should be directed to the staff by:

- Emailing: SafetyBriefing@faa.gov
- Writing: Editor, *FAA Safety Briefing*, Federal Aviation Administration, AFS-920, 800 Independence Avenue, SW, Washington, DC 20591
- Calling: (202) 267-1100
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remote pilots in command, anyone manipulating the flight controls of the small Unmanned Aircraft System (sUAS), visual observers, and any other person directly participating in the sUAS operation wear brightly colored and reflective vests during flight operations. The FAA believes this will help bolster public awareness of sUAS operations and reduce the number of distractions for remote pilots and others participating in sUAS operations. The vest should have wording on the back identifying the individual as the remote pilot, visual observer, or other person participating in the sUAS operation and include a caution against distracting the person wearing such vest. For more information, you can view InFO 18001 at go.usa.gov/xnJ6h.

New Smartphone App Takes You on a Virtual Flight with ADS-B

Do you want to see what it's like to fly with ADS-B In or ADS-B Out equipment? The FAA's new, Fly ADS-B Virtual Reality (VR) app let's you do just that. With the app, you can fly an aircraft equipped with ADS-B Out and In technology and see what it looks like from the cockpit, as aircraft appear on your instrument panel and out of the horizon. The plane's traffic display on the bottom right-hand side lets you track your surroundings and identify approaching planes long before you see them through the cockpit window. You will experience a level of situational awareness and safety that you don't have when flying without ADS-B. The app is currently available for download on Android devices at bit.ly/2p1menJ.

Flight Service Transitions to Leidos Pilot Web Portal

The FAA will discontinue the Direct User Access Terminal Service (DUATS II) program, effective May 16, 2018. Internet services, including access to weather and aeronautical information, flight plan filing, and automated services will remain available at no charge to pilots at www.1800wxbrief.com.

The DUATS II contract provided web-based flight services for general aviation pilots at no charge through two service providers — Leidos and CSRA. The DUATS contract began in 1989 and was a success in transitioning many pilots to automated flight services.

To continue to receive free services, users are encouraged to register with www.1800wxbrief.com. The FAA is working with DUATS II providers on transition activities to conduct pilot outreach, establish commercial interfaces, and provide user migration assistance.

Please contact the FAA's Flight Service at our customer feedback website, go.usa.gov/xQ444, if you have any questions.

Checking Our Work

If you've followed these pages in the last several years, you no doubt are aware of just how much concern we in Aerospace Medicine have about pilot impairment. It's an important issue for us because so many of the accidents it leads to are avoidable.

To deal with a problem you must first be able to measure it. That work started with Civil Aerospace Medical Institute (CAMI) research and led to a National Transportation Safety Board (NTSB) Safety study, published in 2014.

The NTSB analyzed the CAMI toxicology data from fatally injured pilots between 1990 and 2012. They were concerned that the use of over-the-counter (OTC) prescription and illicit drugs were increasing in the general population, but there was little data regarding the transportation industry population.

Aviation was the mode with the best data in terms of post-accident toxicology testing. The majority of the pilots in the study were flying GA operations when their fatal accident occurred. From this data, the NTSB concluded that there is an increasing trend in the use of all drugs, potentially impairing drugs, drugs used to control potentially impairing conditions, drugs designated as controlled substances, and illicit drugs.

The most common potentially impairing drug was diphenhydramine (one trade name is Benadryl®) (see Condition Inspection in this issue). The study also showed that while the number of pilots testing positive for illicit drugs was small, the percentage of positive marijuana results increased over the study period.

Quality Assurance

When scientists look at data, they don't like to see the kind of data sets the NTSB study used. There is no debate about the quality of the data. CAMI is renowned for the quality of its testing and data recording. Likewise, the NTSB's handling of the data was also above reproach. So what's the problem?

The problem is that all the data was collected from fatally injured pilots. This is because only after a fatal accident is a full toxicology test run. Routine drug screening, for those required to be a part of it, does not test for anywhere near as many substances. The NTSB recognized this deficiency in the data.

While the NTSB and the FAA both believe the data is likely valid for the larger pilot community, that is only a hypothesis. It is a critical distinction. It's pos-

sible that the pilots who are fatally injured have a different pattern of drug use (legal and illicit) than both the general pilot population and the study sample.

Verifying the Hypothesis

This verification was so critical that the NTSB issued a Safety Recommendation to the FAA directing it to conduct a study to determine if the data was reflective of the whole pilot population. To meet that recommendation, the FAA is working to set up a study that would conduct an anonymous toxicology test on urine from randomly selected airmen.

To conduct this study, CAMI will receive de-identified urine samples obtained at the time of a pilot's routine physical examination by an Aviation Medical Examiner (AME). CAMI will insure the anonymity of the airmen. As part of this effort, CAMI will collect samples from a wide geographical range of AMEs, and only collect from AMEs with large practices, thus preventing any identification of individual airmen. CAMI personnel will be blind to the aviators' identity as they perform their research on the samples. These samples will not be connected to medical certification in any way.

The goal is to collect 7,500 random samples from the 400,000 yearly exams over a three-year period to give CAMI enough data to represent the pilot population accurately. This study will help the FAA understand how representative our post fatal accident toxicology testing data is.

If the results verify those of the NTSB study, then we can use that information, and the toxicology results, to guide our education efforts on pilot impairment.

Whether we show that the non-accident pilots have the same drug use trend as the accident pilots, or that they are very different, we will have a better map to make us both more efficient, and more effective, in combating pilot impairment.

Learn More

Drug Use Trends in Aviation: Assessing the Risk of Pilot Impairment:

go.usa.gov/xQ48C

From this data, the NTSB concluded that there is an increasing trend in the use of all drugs.



Allergies and Allergy Medication

*[Editor's Note: To provide a wider range of medical information to aviation enthusiasts, we have retired "Ask Medical" and introduced **Condition Inspection**, which will focus on a specific medical condition in each issue.]*

The spring months bring welcome warmth, but also an unwanted stowaway — seasonal allergies. In terms of fitness for flight, allergies usually fall into the category of a condition that the airman can manage without assistance from an Aviation Medical Examiner (AME) or other physician.

Remember the swollen, boggy, nasal, and sinus tissues associated with allergies are a prime setup for ear and sinus blocks. And just because you can safely ascend, does not mean you can safely descend. If the symptoms are bad enough to interfere with your ability to act as pilot in command, then you should ground yourself until the symptoms have subsided.

It's similar — but not identical — to dealing with fatigue. If you feel fatigued, you should ground yourself until you can get sufficient rest. Once rested, no medical clearance is required to return to flight status.

So what's different with allergies? Some of the most common over the counter (OTC) medications used to treat them can be more problematic than the allergies themselves. The chief offender is diphenhydramine (common trade name: Benadryl®). It is one of the most commonly used medications, both alone and in combination products, and its prevalence can create a problem. Since diphenhydramine is an OTC medication and so widely available, it doesn't occur to most airmen that it might be disqualifying. But it is.

Frequently Asked Questions

Q: What is the concern with diphenhydramine?

Diphenhydramine is a sedating antihistamine. In fact, diphenhydramine is such an effective sedative that it is used in most OTC PM pain relief medications and as the sole active ingredient in most OTC sleep aids. In this case, the sedation is not only an unwanted side effect, but also a directed use of the medication. Even if diphenhydramine doesn't put you to sleep, it can dramatically impair your cognitive abilities, which are critical to your safety.

Q: Are there allergy medications that I can take and still fly?

Yes, there are a number of non-sedating antihistamines available. These include Loratadine

(Claritin®), Desloratadine (Clarinex®), and Fexofenadine (Allegra®). Each person's reaction to certain medications differs, but if one of these medications controls your symptoms and doesn't have any adverse side effects for you personally, you may use them and continue flying. There is no wait time for subsequent doses once you have made sure it does not make you sleepy.

Q: What if I have to take diphenhydramine?

For some airmen, diphenhydramine may be the most or only effective solution. In that case, you should be aware that laboratory testing has demonstrated an extremely long period of impairment associated with this medication. Normally we recommend a waiting period of five times the maximum pharmacologic half-life of the medication before returning to flight. A good rule of thumb for this is to take the longest dosing interval and multiply by five. For example, a medication taken every four to six hours would calculate as follows: Six times five equals a 30-hour wait time. However, the required wait time after taking diphenhydramine is 60 hours.

Resources

One of your best resources is the Do Not Issue-Do Not Fly (DNI-DNF) list from the Guide for AMEs, www.faa.gov/go/dni. The DNI-DNF list covers many commonly used medications. If a medication appears in either section, you should not fly while using it.

If the medication appears under the DNI section, you should consider speaking to your AME. These are generally more serious conditions and medications.

If the medication appears under the DNF section, you should determine an appropriate wait time before returning to flight.

If you have any questions, don't hesitate to contact an AME or your Regional Flight Surgeon's (RFS) office.

Penny Giovanetti, D.O., received a bachelor's degree from Stanford, a master's in Environmental Health and Preventive Medicine from the University of Iowa and doctorate from Des Moines University. She completed a 27-year career as an Air Force flight surgeon. She is board certified in aerospace medicine, occupational medicine and physical medicine/rehabilitation. She is also a Fellow of the Aerospace Medical Association and a private pilot.

Look! Listen FOCUS

LIVES
ARE AT
STAKE!



- **IT CAN HAPPEN TO YOU:** When you're approaching an airport that has a set of parallel offset runways, you may accidentally land on the wrong runway than originally cleared for.
- **THE FIX:** During pre-flight, remind yourself of possible landmarks that will help you clearly identify the runways. Use your passengers help to pinpoint the correct runway!



Federal Aviation
Administration

For additional runway safety education, take the AOPA Air Safety Institute's Runway Safety online course at www.airsafetyinstitute.org/runwaysafety.

Let It Flow!



PEGASAS

PEGASAS Inspires a River of Research

SUSAN PARSON

The myth of Pegasus holds that by stamping his hooves on the summit of Mount Helicon, the winged white horse released a flow of sacred waters “whence the Muses quaffed their richest draughts of inspiration.” So it seems very appropriate that the acronym for the FAA’s Center of Excellence (COE) Partnership to Enhance General Aviation Safety, Accessibility, and Sustainability — PEGASAS — should invoke the story of everyone’s favorite flying equine.

To be sure, the PEGASAS effort is all about creativity. Everyone in GA can list the challenges facing our community, with the majority of these falling within one of the three categories that form this COE’s name: safety, accessibility, and sustainability. As officially stated, therefore, the mission of PEGASAS is to “enhance general aviation safety, accessibility, and sustainability by partnering the FAA with a national network of world-class researchers, educators, and industry leaders.”

The mission of PEGASAS is to enhance general aviation safety, accessibility, and sustainability by partnering the FAA with a national network of world-class researchers, educators, and industry leaders.

The Wellspring of Creativity

The inspiring flow of research work from the PEGASAS program began in September 2012, when then-Transportation Secretary Ray LaHood announced the selection of a COE team led by Purdue University, Ohio State University, and the

Georgia Institute of Technology, with the Florida Institute of Technology, Iowa State University, and Texas A&M University rounding out the core team. Affiliate members of the partnership include Arizona State University, Florida A&M, Hampton University, Kent State University, North Carolina A&T State University, Oklahoma State University, Oregon State University, Southern Illinois University (Carbondale), Tufts University, Western Michigan University, and University of Minnesota, Duluth. (For a complete list of PEGASAS participating organizations, follow the links under the “Learn More” heading).

To underscore the very practical and (so to speak) well-grounded nature of PEGASAS research projects, the PEGASAS COE announcement included the observation that three of the six core members (Purdue, Ohio State, and Texas A&M) own and operate their own airports, with the remaining partners maintaining facilities, aircraft, and close working relationships with their own community airports.

Top: A photo of the PEGASAS Site Directors Front Row (left to right): Brian Strzempkowski (OSU), Dr. Katie Schwartz (Georgia Tech), Prof. William Crossley (Purdue), Prof. John Valasek (Texas A&M), Prof. Debbie Carstens (FIT) Back Row (left to right): Shawn Pruchnicki (OSU), Prof. Seth Young (OSU), Prof. Dimitri Mavris (Georgia Tech), Prof. Mary Johnson (Purdue), Prof. Halil Ceylan (Iowa State), Prof. Stephen Cusick (FIT), Ryan King (FAA) Not Pictured: Dr. Simon Briceno (Georgia Tech), Prof. Karen Marais (Purdue), Dr. Julienne Krennich (Iowa State)

Navigating the Creative Stream

Since then, PEGASAS has launched 30 research projects that support the FAA in ways that, as its name implies, enhance general aviation safety, accessibility, and sustainability. Specific topic areas include Airport Technology, Airport Safety, Airport Research and Development, Airport Pavements, Software and Systems, Human Factors, Weather Technology in the Cockpit, and Structures and Propulsion. Eighteen of the 30 projects are still active, and two new projects with the FAA's Flight Deck Human Factors Research Lab at the Civil Aerospace Medical Institute (CAMI) launched at the beginning of 2016. PEGASAS also works with the General Aviation Joint Steering Committee (GAJSC) as a participant in several of its teams for safety and issue analysis.

To conduct this work, PEGASAS uses a partnership of principal investigators from the participating universities. As part of the COE mission to develop the next generation of experts, both graduate-level and undergraduate students participate as well. In this connection, during the summer of 2016, PEGASAS launched its first "Center of Excellence Summer Experience" program. This effort involved having nine students from various PEGASAS universities working with researchers in the Aviation Research



Professor William A. Crossley, PEGASAS Director, Purdue University

Division at the William J. Hughes Technical Center, and in the Flight Deck Human Factors Laboratory at CAMI.

Loosely using the "Aviate-Navigate-Communicate-Mitigate" approach we have used to frame the presentation of stories in the past few issues of *FAA Safety Briefing*, we will explore some of the ongoing PEGASAS work, with special focus on projects whose benefits are likely to flow into GA operations. So join us, and go with the flow! ➔

Learn More

FAA Centers of Excellence
go.usa.gov/xnJBy

FAA Press Release on PEGASAS COE
go.usa.gov/xnJBd

PEGASAS Website
www.pegasas.aero

Susan Parson (susan.parson@faa.gov, or @avi8rix for Twitter fans) is editor of FAA Safety Briefing. She is an active general aviation pilot and flight instructor.

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Pushing *the* Envelope

TOM HOFFMANN

A Plan of “Attack” for Loss of Control

“... The pilot’s failure to maintain adequate speed while maneuvering to land, resulting in an aerodynamic stall.”

It is an all-too-common probable cause statement found in literally hundreds of National Transportation Safety Board (NTSB) accident reports. In many of these cases, the pilot simply asked more of the aircraft than it could aerodynamically provide. These scenarios are also indicative of the types of inflight loss of control (LOC) accidents that have plagued the GA community for decades and have remained the elusive white whale of the aviation safety industry. But LOC accidents — your days are numbered!

Thanks to advances in technology and a renewed focus by government, industry, and academia on ways to help eradicate LOC, the industry is on a flight path to success. Solving the LOC equation is by no means an easy task, nor is it prudent to believe in any type of silver-bullet solution. There are many variables and underlying factors leading up to

a LOC situation (distraction, weather, fatigue, lack of proficiency, etc.), but in most cases it boils down to one simple element — proper energy management. The key is figuring out the most

effective way to help pilots better recognize their aircraft’s energy state and alert them when life-saving intervention is needed. Short of having something reach out and grab a pilot by the collar, angle of attack (AOA) indicators fit the bill nicely in terms of augmenting airspeed information and providing energy state awareness in critical situations.

Many pilots may already be familiar with the benefits of an AOA system, yet very few GA pilots have equipped with this technology. High prices and installation red tape have historically contributed to that. But, as you may recall from previous AOA-

related articles in this magazine, the FAA has recently made this technology more wallet-friendly and easier to install. Even more exciting is how future applications of AOA-based systems will not only help pilots manage a critical phase of flight, but they may also hold the key for automation safety with aircraft of the future. Join me for a brief look at the past, present, and future of this impactful technology.

Looking Back

There has been a renewed interest in the benefits of AOA indicators in recent years, but this technology is hardly new. In fact, AOA technology first debuted on the *Wright Flyer*, albeit in a more crudely fashioned setup than by today’s standards (picture a stick with a flailing piece of colored yarn attached). The Wrights were well aware of this aerodynamic “secret” that could abruptly cause an airfoil to cease its lift-giving powers. In later years, military aviators were also keen on leveraging AOA technology, which even today proves especially useful in helping U.S. Navy pilots meet the challenging demands of aircraft carrier landings.

But before I go further, allow me to break down what angle of attack is and why it’s important. Simply put, the angle of attack is the angle between an aircraft’s wing and the oncoming air (the FAA defines AOA as the acute angle between the chord line of the airfoil and the direction of the relative wind). If this angle becomes too great in flight (critical AOA), lift is drastically reduced and the airfoil will stall. Depending on how the aircraft responds, a spin may also develop. Not good. Most GA pilots rely on airspeed and the piercing bleat of the stall warning horn to avoid getting into a stall situation. However, this bipartite solution has its limitations.

A published stall speed, while generally accurate, assumes that a specific set of circumstances are in play during flight (i.e., unaccelerated and coordinated flight and, typically, maximum gross

The FAA believes that the GA community can reduce LOC accidents through widespread acceptance, training, and appropriate use of AOA-based systems. — FAA InFO 14010

weight). Furthermore, speed by itself is not a reliable parameter to avoid a stall. As you have probably heard a million times by now, an aircraft can stall at any airspeed and any pitch attitude. As far as the stall warning horn system goes, this is more or less a binary system — it is either on or off, with little warning to provide a corrective input.

A Plan of Attack

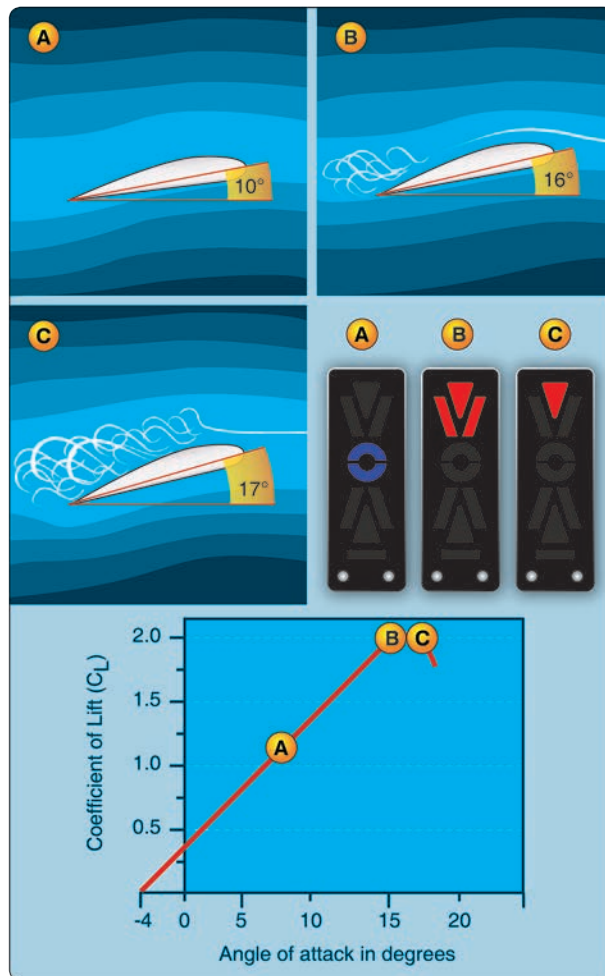
Having a reliable method of “seeing” this all-important angle of attack is definitely where it’s at in terms of mitigating LOC-related accidents — the leading category for GA accidents. To get a better grasp on the situation, the General Aviation Joint Steering Committee (GAJSC) — a joint government/industry partnership — took a deep dive into GA accident causal factors in 2011 in order to seek effective mitigation strategies and safety initiatives. The GAJSC convened two LOC Working Groups that reviewed 180 accidents that occurred over a 10-year span. AOA awareness, not surprisingly, was at the top of the GAJSC’s list in terms of focus areas.

What the GAJSC’s LOC Working Group discovered was that a pilot’s awareness of overall energy state in flight was just not where it needed to be. AOA indicators seemed a logical place to start with how to mitigate this risk. At the time, there was a path to having AOA indicators installed, but these were qualified as primary flight instruments requiring a more costly and labor intensive process, hardly within the means of an average GA pilot. What was lacking was a means of having this equipment installed as a supplementary system that would require a lighter touch regulation-wise, but still be permissible in type-certificated aircraft.

It turns out that several avionics manufacturers interested in developing AOA equipment for the light type-certificated fleet had approached the FAA’s Small Airplane Directorate. Both the FAA and industry embraced this idea and the framework for change was quickly underway. By February 2014, the FAA issued a ground-breaking policy statement that laid out not only the required standards, but also provided the limitations of non-required safety equipment for type certificated aircraft, how it can be used, and what manufacturers had to do to produce the equipment. In addition to AOA technology making a new foray into pilot safety, it also became the nexus for how to get other non-required safety equipment into the light end of the GA fleet. (By the way, if you are not familiar with the FAA’s Non-Required Safety Enhancing Equip-

ment (NORSEE) policy, take a minute to have a look (go.usa.gov/xnJ9d).

Among those working behind the scenes to drive support of this policy, and further the agency’s understanding of AOA technology, were the top-notch student and faculty researchers at the FAA’s Centers of Excellence (COE) for GA safety research. The Center for General Aviation Research (CGAR) did initial work in this area, led by Embry Riddle Aeronautical University. Then in 2012, the FAA formed a new COE called PEGASAS — the Partnership to Enhance General Aviation Safety, Accessibility and Sustainability. The FAA chartered PEGASAS to study some of the operational aspects of mechanical AOA indicators, as well as look at the potential applications of derived AOA (AOA interpolated from an internal system as opposed to a mechanical sensor). These studies, along with several other



A conceptual representation of an AOA indicator. It is important to become familiar with the equipment installed in a specific airplane.



An array of angle of attack indicators

industry and academia-sponsored projects, proved fruitful in gaining some important operational insight with AOA.

With the first AOA-related project, PEGASAS looked at providing background information on AOA for educational and outreach purposes. As a result, the PEGASAS team created a video that provides an excellent overview of what AOA is and why using an AOA display can be beneficial. The video also provides side-by-side demonstrations of three popular AOA displays in operation, pointing out the various visual and aural differences among them. The video is about 20 minutes long, but if you're in the market for an AOA indicator, or are just curious about how they work, it's worth having a look: youtu.be/8JcjWnAJGKQ.

As part of that same project, the PEGASAS team also completed an operational study to see if using an AOA display influenced pilot behavior during an approach. Three different universities conducted the study and measured the variability of the flight path angle at each second of the last 30 seconds of an

approach. The project team also looked at whether AOA training was a factor in conducting an approach, with some participants receiving training and others going in cold turkey, relying

solely on intuition. While the final technical report from this study is still pending, initial determinations indicate some promising safety benefits.

"The PEGASAS study showed that AOA was most beneficial during high workload events," said Corey Stephens, Operations Research Analyst with the FAA's Office of Accident Investigation and Prevention. Stephens, who was also the technical sponsor of the PEGASAS project, added that the study seemed to support the idea that pilots having a visual representation of where they are in the flight envelope was very beneficial. "If it was a complex

approach, or there was a lot of activity going on in the cockpit, an AOA display helped pilots maintain situational awareness of their energy state."

Complementing these findings was another AOA study (outside of PEGASAS) conducted by the University of North Dakota. This analysis revealed that when aircraft involved in the study turned final, the nose would typically drop about 0.7 degrees more on airplanes equipped with AOA indicators than on those without. This discovery reinforces the idea that AOA systems help pilots maintain awareness of proper attitude control on final approach. Incidentally, UND is also in the midst of a broader and longer-term study on AOA; stay tuned for more information on this in a future issue.

Measuring Up

After the FAA's NORSEE policy was issued, the market reacted positively. AOA product availability jumped and more than 600 units were installed in just the first year.

"It's a good piece of avionics," says Jens Hennig, Vice President of Operations at the General Aviation Manufacturer's Association. "And what's nice about this equipment is that it's possible to retrofit on so many aircraft at a really low price point." However, Hennig is also quick to caution that AOA "is not the end-state to LOC mitigation." While acknowledging AOA as an effective and relatively simple way to mitigate risk, Hennig is also keeping his eye on the evolution of future NORSEE products and the potential for more involved technology that can address the core risk of LOC. "We must look beyond supplemental non-required AOA if we wish to truly move the needle on GA safety," he added.

Looking Forward

That brings us to PEGASAS' second AOA-related project, which aims to characterize AOA data inferred by aerodynamic modeling and software algorithms, and develop minimum performance

Focusing on derived AOA will allow us to expand more into the future of how this technology can keep us safe.

standards for that equipment.

“This research is looking at ways to leverage existing aircraft equipment to provide AOA awareness information,” says FAA flight test pilot and derived AOA project sponsor David Sizoo. “We asked the PEGASAS team to look at how accurate a derived AOA solution could be. Would it be good enough to provide stall margin awareness in a display? Could it be used as a signal in a more expansive envelope protection system or even a fly-by-wire aircraft to prevent departure from controlled flight?”

Texas A&M University and Ohio State University were the PEGASAS members chosen to help answer those questions and determine whether derived AOA is feasible in an operational environment. The six-phase project spanned a year and a half and involved numerous lab studies and flight tests to try to back out useful AOA data from existing avionics equipment.

The plan was to have this data help support three use cases. First is having a gauge in the cockpit that would show pilots their margin from critical angle of attack. The second is using derived AOA to drive an envelope protection system that will work in concert with an AOA sensor and prevent pilots from making improper control inputs during critical situations. The third use case is to take derived AOA as a supplement to sensed AOA in developing fly-by-wire flight control systems.

“There are no fly-by-wire GA aircraft currently certified under part 23, but this research is trying to bring in this technology to allow derived AOA to be exploited in flight control systems for vehicles and flying cars of the future,” says Sizoo. With Boeing already predicting the sale of autonomous flying taxis in the next decade, this research may not only have critical implications for enabling future safety standards, but could also be the springboard that keeps this technology on a forward trajectory.

So in the end, how useful was the derived AOA gathered during the study? Did it stand up to the AOA fidelity provided with mechanical sensors? Although the team’s technical paper is still under final review, Sizoo remarked that the findings showed great promise of being able to render quality AOA data by hacking into existing avionics. Sizoo further backed up this theory by conducting his own flight test using a Cessna 172 and a Cirrus Vision Jet. “The idea was to look at how well this concept works within the low speed envelope up to high-end jets.” The flight test showed similarly promising results.


“Focusing on derived AOA will allow us to

expand more into the future of how this technology can keep us safe,” says Sizoo. As a former military aviator and seasoned test pilot, Sizoo has made it a goal to try to trickle down military technology into GA aircraft. “AOA is just the tip of the iceberg,” he says. “It is a toehold into a much larger venue of bringing technology that has evolved back into GA so that we can significantly reduce the accident rate.”

Who knows? Maybe having R2-D2 or Siri along with you as a digital co-pilot could be a viable offspring of this technology and be another huge step in accident mitigation. But as Sizoo points out, “The key is to aid pilots and reduce their workload, not distract them.” “If we mechanize that interface incorrectly, it can be a nuisance.” You could make a similar argument for existing mechanical AOA displays. Pilots need to pick the make and model that suits them best and works *for* them, not against them.

The Education Angle

Findings from the PEGASAS projects and other research studies on AOA technology indeed make a good case for improved safety — whether it’s a retrofitted AOA display on a J-3 Cub, or an envelope protection system on a Cirrus SR22. However, the importance of AOA goes beyond technology. Merely having a conversation about AOA and raising a pilot’s awareness of this critical concept is an integral part of improving safety. “You don’t have to have the technology to reap the benefits of AOA awareness,” says Sizoo. “Community awareness and discussion is just as valuable.”

I think that’s an angle we can all agree on. 

Tom Hoffmann is the managing editor of FAA Safety Briefing. He is a commercial pilot and holds an A&P certificate.

Learn More

FAA Information for Operators Bulletin 14010 - Installation, Training, and Use of Non-required/ Supplemental AOA Based Systems for GA Airplanes
go.usa.gov/xQ4kc

Presentations from NTSB Humans and Hardware Seminar on Preventing LOC
go.usa.gov/xQ4kC

FAA Fact Sheet on the Benefits of AOA Indicators
<http://1.usa.gov/16VwICR>

AOPA video on AOA Indicators
youtu.be/qF9E3eOibNI

SABRINA WOODS

Weather . . . Or Not?

Weather Technology in the Cockpit

Photo courtesy of Garmin

Got weather? I have no doubt that you do. Today's savvy general aviation population utilizes a wonderful mix of old and new tech. Classic steam gauges and luminescent digital glass screens; gas turbines and single piston engines; wooden frames, fabric wings, aluminum bodies and sleek carbon fiber. Regardless of whatever infinite combinations you might be rocking for aircraft preference, the thing that remains fairly constant is that most pilots want the latest and greatest when it comes to getting the weather. With the vast number of handheld electronic devices that are able to provide weather information in the palm of your hand, most pilots are getting just that.

Therein lies the rub.

ForeFlight or FltPlan Go? WingX or WINDY?

All GA weather information products over the past 10 years have the ability to provide incredibly accurate, detailed, and timely meteorological information to pilots. The biggest and brightest in flight planning apps are hard to beat for ensuring you are getting a good weather briefing. With the swipe of a finger you can overlay your flight plan route on different maps that depict METARs, icing and icing potential, winds, precipitation, and turbulence to name a few. I have personally watched

many a lively "This App is King" debate with each pilot arguing everything from its ease of use to the vibrancy of the colors and high definition of the depictions. The conversations are always informative and even mildly entertaining; however, the human factors scientist in me can't help but wince when I hear about just how different each application can be. I am not the only one who has concerns.

While these products have been designed and implemented with the ultimate goal of allowing pilots to make better weather decisions regarding their intended flight operations, unfortunately, they haven't led to a decrease in the level of weather-related accidents and incidents. Part of the problem, we are realizing, could be found in those same human factors considerations that give me pause. Although there is lots of weather out there and there are lots of vendors providing that information on their device or via their application, there are inconsistencies in how some of the information is actually packaged, displayed, and disseminated. These "inconsistencies" in information could introduce unintended safety risks to the user, depending on the device or the application. One of the primary goals of the FAA's Weather Technology in the Cockpit (WTIC) Program is to incorporate weather and human

performance research into the standards and guidance documents that support pilot weather-decision-making. The intent is to address those inconsistencies and start budging that weather-related accident and incident safety needle again.

WTIC is an FAA NextGen weather research program that consists of various research projects relating to how weather information and technology is delivered to the cockpit. Once any gaps in weather information or technology are identified, WTIC research will develop, verify, and validate a set of Minimum Weather Service (MinWxSvc) recommendations for 14 CFR part 121, 135, and 91 to address those gaps and enhance pilot weather decision making before he or she encounters potentially hazardous weather conditions.

One Person's Emoji ...

My mother, who has only recently become comfortable with communicating via text, has been learning the basics of the process. A few months ago I received a message from her followed by a long series of what can only be described (for this PG publication anyway) as a bunch of poo emojis. Amused, I gently queried her on what I had done to deserve the poop emoji post. She didn't know what I meant. It was near Valentine's Day, and she thought she was sending tiny chocolate kisses.

This rather humorous little learning experience actually serves to highlight one of the primary problems with weather dissemination and all those apps. Currently, the guidance and regulations on how the information is supposed to look is incomplete. Therefore, each company is doing its own thing. This can be problematic as it shifts the responsibility of interpretation to the user. That, dear reader, means YOU. Sure, many vendors take their cues from the symbols the National Oceanic and Atmospheric Administration (NOAA) use, but when it comes right down to it, one person's poop emoji can be another's chocolate kiss.

Ian Johnson, the engineering psychologist and human factors lead with the WTIC program says that vendors electing to use different shapes and colors for their symbols could unintentionally affect a pilot's behavior. "Results from WTIC studies have shown that depending on the symbology, pilots varied considerably in their overall detection of METAR symbol change during flight," says Johnson. That gap in understanding and in the inherent latency of when those symbols even pop up is where the issues are creeping up.

The researchers and scientists in the WTIC program get it, so they have been working to better understand how the current information is being displayed in the cockpit and used, and whether or not what is presented is at least the minimum set of weather information necessary for the pilot to safely conduct their flight. To date, the WTIC research team has completed more than 30 studies and experiments. The research aims to recommend the minimum necessary weather information and its presentation on cockpit or portable displays to enable pilots to make consistently effective and safe weather decisions. Based on these findings, researchers publish recommendations and guidance that will help educate cockpit instrument designers on which display symbols and techniques best convey critical weather information. The WTIC team isn't just getting it done in a lab, however. The hard-working WTIC team has taken its research on the road, meeting the crossroads of what we already know and what the average pilot actually experiences.

Getting WILD

At the 2017 Sun 'n Fun Fly-In and Expo, the WTIC team let a series of volunteer pilots fly the Weather Information Latency Demonstrator (WILD). WILD was created as part of a WTIC research effort by Purdue University and Western Michigan University under an award to the Partnership to Enhance General Aviation Safety, Accessibility and Sustainability (PEGASAS) program.

The PEGASAS team used data gathered from NTSB and NASA Aviation Safety Reporting System (ASRS) databases to develop scenarios that were as realistic as possible. Pilots who flew the WILD were surprised when they unintentionally flew their virtual aircraft into a dangerous thunderstorm or low visibility. Most pilots flying the simulation didn't know about inaccuracies, latencies, and limitations of weather displays in the cockpit. Those who got themselves into the undesirable situations were surprised to find that their favorite and familiar weather displays often didn't match what they were seeing "out the window."

Even with the best weather applications, a display may show pilots information about a thunderstorm that can be five to 20 minutes old. Believing they are still flying in the clear, pilots can stumble

Although there are lots of vendors, providing that information on their device or via their application, there are inconsistencies in how some of the information is actually packaged, displayed, and disseminated.



into a storm they thought was several minutes away. Worse, some pilots might try to “shoot the gap” in storms that simply aren’t there anymore by the time he or she arrives.

Gary Pokodner, the WTIC program manager, says “another thunderstorm cell can pop up behind the one a pilot is watching, and this can happen in a matter of minutes.” It was challenging for the pilots to judge how soon the weather or visibility would start to deteriorate and how quickly they needed to respond. The result is the dreaded VFR into IMC scenario which still today remains stubbornly affixed as one the most prevalent (and fatal) causal reasons for aircraft accidents and incidents.

Now You See It?

Another issue the WTIC program is actively researching has to do with a rather insidious phenomenon known as change blindness. This is when a change in or on the visual stimulus (such as a tablet or flight deck array) is introduced and the person using it doesn’t even notice. It happens far more often than you would think.

Once again, the WTIC researchers put a volunteer force of 100 pilots to the test. The results? The researchers found that the pilots were more likely to miss a cue that the weather had changed (e.g., from VFR to IMC) if the alert display used one color versus another. The pilots simply didn’t detect the changes shown to them in those certain colors. Which means that not only do the symbols and colors across different weather application platforms vary from one another leaving room for interpretation (i.e., risk); once something does change, the user might not even notice it.

So we’ve learned that alerting — meaning attracting the user’s attention to the place where it is needed most — is key in effective weather dissemination. The research results, MinWxSvc recommen-

dations, and guidance documents originating from WTIC research on which display symbols, colors, and rendering techniques effectively and intuitively convey weather information to pilots are frequently briefed to industry experts so that they can aid in the development of even better software.

6 or 9? It Makes a Difference.

There is a meme floating around out there about two people coming from different directions and approaching a number that has been drawn on the ground. One person proudly declares that the number is a 6 while the other counters and says it is a 9. The original intention of the meme was to show that sometimes there is no true “right answer.” With respect, I have to disagree. Someone, at some point provided information — a 6 or a 9 — and it is highly likely they did so with specific intent in mind. However, because of the nature of information acquisition (i.e., the info was left to stand on its own) things were left up to interpretation, ambiguity was introduced, and the true nature of the information got befuddled.

This is where you come in. As a pilot, the information you access and use might not always be exactly as it seems. Taking things for face value might have you winding up in one of those “undesirable situations” those poor guys at Sun ‘n Fun found themselves in. Recognize that while these tools are state-of-the-art, they are not flawless. You must, at all times, actively work to reconcile what you are seeing with other bits of information in and outside the cockpit. Use reports from your fellow flyers to complete the picture and try to provide as much information as possible to help the next person out as well. PIREPs go a long way in completing a mental construct of what is going on around you.

Lastly, if there is one take-away the WTIC program representatives would like to impress upon you, it is that weather applications were designed as a decision-making tool so that you can give WIDE berth to bad weather. The applications weren’t designed for tactical maneuvers as “shooting the gap.” VFR into IMC remains today as it has been for the last two decades; by far the most lethal of the causal factors for accidents. It’s best to respect the limitations of the technology and navigate away. ✈️

Sabrina Woods is a guest writer for the FAA Safety Briefing. She is a human factors scientist with the FAA’s Air Traffic Organization. She spent 12 years as an aircraft maintenance officer and an aviation mishap investigator in the Air Force.

Meet the COE Community

In addition to the PEGASAS Center of Excellence, our focus for this issue, five other COEs are active. Since virtually everything in the aviation research field is connected, allow me to introduce the neighbors in this “COE-mmunity.”

COE for Technical Training and Human Performance

Established in 2016 and sponsored by the FAA Office of Safety and Technical Training, the TTHP COE focuses on Curriculum Architecture, Content Management and Delivery, Simulation and Part Task Training, Human Factors, Analytics, Safety, and Program Management.

For more information: www.coetthp.org.

COE for Unmanned Aircraft Systems

Established in 2015 and sponsored by the FAA Office of Environment and Energy, the COE for UAS is researching Air Traffic Integration, Airworthiness, Control and Communication, Detect and Avoid (DAA), Human Factors, and Low Altitude Operations Safety.

For more information: www.assureuas.org.

COE for Excellence for Alternative Jet Fuels and Environment (AJFE)

Also sponsored by the FAA Office of Environment and Energy, the AJFE COE got its start in 2013. The scope of its work includes Alternative Jet Fuels (e.g., Feedstock Development, Processing and Conversion, Regional Supply and Refining Infrastructure, Environmental Benefits Analysis, Aircraft Component Deterioration and Wear, Fuel Performance Testing); and Environment (e.g., Aircraft Noise and Impacts, Aviation Emissions and Impacts, Aircraft Technology Assessment, Environmentally and Energy Efficient Gate-to-Gate Aircraft Operations, Aviation Modeling and Analysis).

For more information: <http://ascent.aero>.

Center of Excellence for Commercial Space Transportation (CST)

Since 2010, the COE for Commercial Space Transportation has focused its research on space traffic management and operations; space transportation operations, technologies

and payload; human space flight; and space transportation industry viability. Its FAA sponsor is the Office of Commercial Space Transportation.

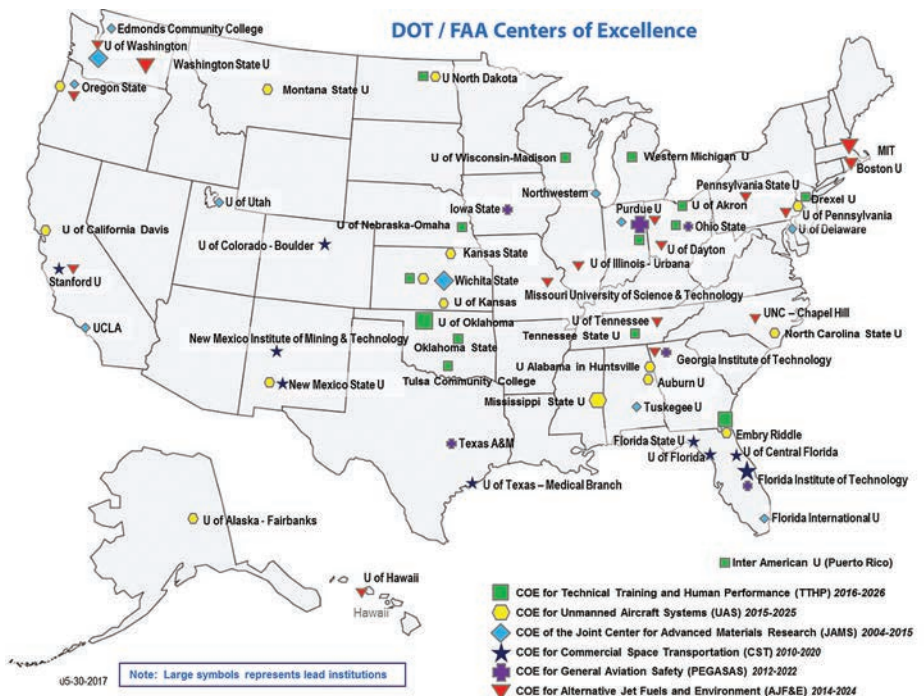
For more information: www.coe-cst.org.

Joint Center of Excellence for Advanced Materials (JAMS)

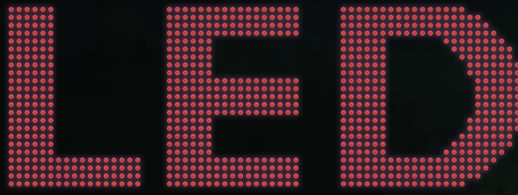
JAMS is the only COE involving a joint effort, which involves the Center of Excellence for Composite and Advanced Materials (CECAM) and the Center of Excellence for Advanced Materials in Transport Aircraft Structures (AMTAS). Established in 2004, its FAA sponsor is the Office of Airport and Aircraft Safety R&D Division. The main focus of JAMS is the research, engineering, and development of information used to assure safety and standardize certification of existing and emerging structural applications of composites and advanced materials. Specifically, projects include the evaluation of past applications, performance of applied research, and the development of standard engineering practices.

For more information: www.jams-coe.org.

Susan Parson (susan.parson@faa.gov, or [@aviatrix](https://twitter.com/aviatrix) for Twitter fans) is editor of FAA Safety Briefing. She is an active general aviation pilot and flight instructor.



PAUL CIANCIOLO



There Be Light

Working to Enhance Airport Lighting

LED lights — or light-emitting diodes — last longer, are more reliable, and use less electricity than the traditional incandescent bulbs. I personally started the switch to LED lights at home and, I admit, I took them with me last time I moved residences. LEDs are worth the investment.

Airport operators are also seeing the light in LED use. The surface of an airport is chock-full of lights, and each serves to enhance safety during times of

The introduction of LEDs on airports was primarily driven by cost, but efficiency and the environmental considerations of using less electricity is making them the light source of choice.

reduced visibility. Lighting systems provide pilots with the visual cues to quickly and positively identify the runway environment. They also provide an extra margin of safety for approaching aircraft.

The introduction of LEDs on airports was primarily driven by cost, but efficiency and the environmental considerations of using less electricity is making them the light source of choice.

LEDs also offer some potential safety enhancements over traditional incandescent lights. For smaller general aviation (GA) airports, including privately owned and operated airfields, LEDs may enable the inclusion of safety enhancing lighting systems that would otherwise be cost prohibitive at smaller airfields.

Testing the Light

This conclusion did not come from some *unicorn* organization; it came from an academic, government, and industry partnership called PEGASAS. PEGASAS is the name given to the FAA's Center of Excellence

(COE) for General Aviation, which stands for the Partnership for the Enhancement of General Aviation Safety, Accessibility, and Sustainability. It is one of six active Air Transportation Centers of Excellence established by the FAA to create cost-sharing partnerships with academia and industry throughout the United States.

What distinguishes a COE from other research grant arrangements is that the core universities go through a vigorous competitive process to exist as a single, cooperating entity for a specific period. Every dollar of federal money awarded to the COE is matched one-to-one, resulting in a win-win relationship for the university researchers, as well as the American taxpayers.

Stretching Out the Light

One PEGASAS research project related to LEDs that has a great potential benefit to GA safety is the *Linear LED Lighting Study*. The project goal was to gain an understanding of the potential benefits of linear LED lighting systems — versus point source lights — for the spatial orientation of airfield users, including pilots and ground vehicle operators. Experimental field-testing arrangements of linear LED lighting systems happened at Ohio State University Airport (KOSU).

Traditionally, a point source lighting system is what we see on taxiways and runways today: the familiar “sea of dots.” Without a good airport diagram, a pilot could potentially make a turn between the lights where there may not be pavement. It is often difficult for pilots to recognize when a turn is

coming up until they are essentially right up on it. With typical 50 foot or more spacing between the dots, and a white-light accidentally turned on in the cockpit by a flying companion, there is potential for unwanted grass cutting.

Accurate visual perception on the airfield is important for safe and efficient operations. Information of this nature needs to be concise, simple, and discernible. With LEDs arranged in closely spaced configurations and, in this case, in a linear arrangement, the pilot will see a line rather than spaced dots. This project evaluated different configurations, e.g., different lengths of lines of LEDs, and measured the distance that pilots could accurately discern what the lights were indicating, such as a gentle left turn or a sharp right turn ahead.

Participants were exposed to a sampling of all conditions — 50 ft. and 150 ft. spacing, left and right turns, and 30 degree and 90 degree turns. The investigator recorded what type of lighting condition the participant reported seeing, as well as the time and distance from the lights at the time of the reaction. The use of linear source LED lighting to depict taxiway leadoff lighting on a runway resulted in improved visual recognition, as compared to point source lighting. The new LED strip-light proved to provide a safer airport surface area than a sea of glowing dots.

Energizing the Light

Another PEGASAS project studied different infrastructure concepts for how LED fixtures perform when installed on existing airport electrical systems. Since LEDs use less energy, have the potential for reduced maintenance on the lighting systems, and have the capability for non-traditional light fixtures — as in shapes like the linear lines of lights mentioned previously — it makes business sense to switch. However, the electrical requirements for traditional lighting systems are different from those using LEDs.

To accomplish this project goal, the PEGASAS team established three different field sites at Purdue University Airport (KLAF), which were outfitted with circuits that included LED fixtures. Each site was located at varying distances from a wireless data collection system. The tests included sending a command signal through the power cables to each of the LED fixtures. The commands tell the lights to change intensity — dim or get brighter. This type of field-testing can be used to validate models to understand the ability of LEDs to respond appropriately to signals sent through airport power circuits.

Since this project has closed, all operations have

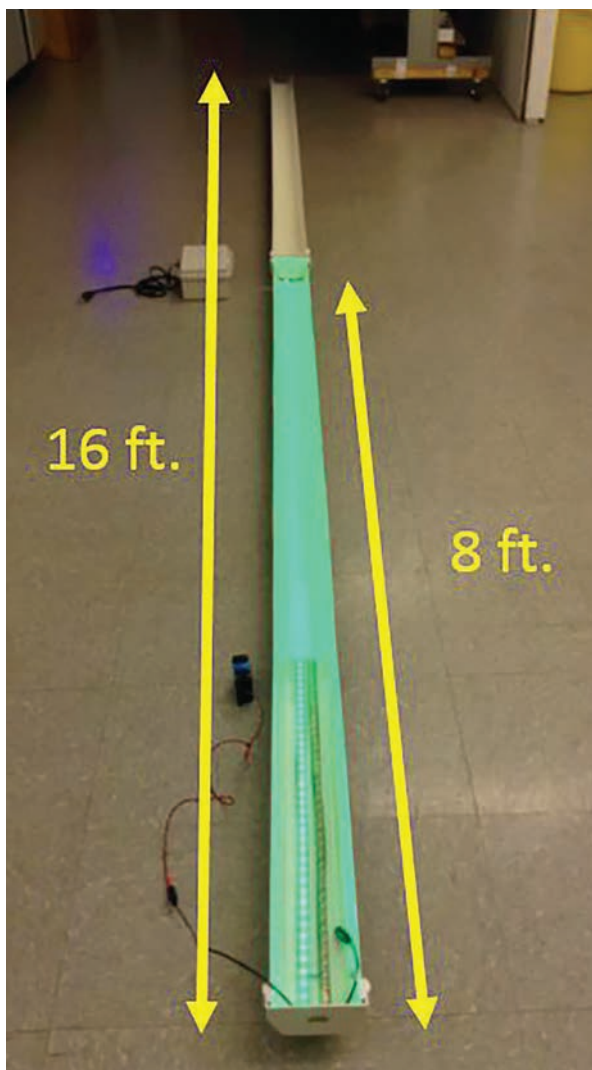
moved to Cape May Airport (KWWD) in New Jersey, where data collection will resume once the necessary equipment is installed.

Modelling the Light

The FAA is considering alternative circuit and control topologies — the arrangement of the various elements of a communication network — to provide power to LED-based runway lighting systems. Each of these new topologies introduce potential technical challenges.

Another PEGASAS project examined two primary topologies. One is vault-centric and the other is fixture-centric. Purdue University was tasked with creating a mathematical model that could run simulations of various electrical infrastructure configurations to address concerns.

In vault-centric topologies, each of the LED lights



LED strip-light

are connected to the system through a transformer. Within the fixture, a current transformer supplies a diode rectifier to power the LED. The electrical current through the system is controlled at the source located in a vault. The challenge is to ensure that each LED will receive the same current so that each creates the same level of brightness. The concern stems from the long distances of cable, which potentially eliminate the accuracy of a series-based model of LEDs. This is particularly a concern for regulating the system at low levels of electrical current.

In fixture-centric configurations, power-

electronics are added at the LED itself to enable regulation of the individual LED current. A primary concern of this architecture is whether each LED will receive the same electrical current so that each LED achieves an equal level of illumination. Over the distances considered in this circuit, the cable-runs act as transmission line elements that create losses, which is a concern at low current levels.

Managing the flow of electricity is still a challenge when integrating LEDs into an airport lighting system. Both models have their pros and cons.

Being the Light

A Pegasus is not a unicorn, and PEGASAS is no ordinary team. If you were to bet on the safest "horse" to ride, the less pointy team player is the way to go. It is the FAA's job to provide the safest, most efficient aerospace system in the world. And *that* is better accomplished through a partnership like PEGASAS. The LED projects are shedding light on ways that may enable small airfield operators to afford safety enhancing lighting systems.

In the not too distant future, you may even start to see that sea of dots stretched out to better guide you down the taxiway. Be assured that you are not taxiing at warp speed; you are witnessing the speed of progress through PEGASAS. ✈️

Paul Cianciolo is an associate editor and the social media lead for FAA Safety Briefing. He is a U.S. Air Force veteran, and a rated aircrew member and volunteer public affairs officer with Civil Air Patrol.



View of LED taxiway leadoff lighting from a height of approximately 50 feet.



QA SAFETY ON THE GO



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faa.gov/news/safety_briefing



Remote Sensors?
Rumble Strips?
Heated Pavements?
Oh My !

Three Fresh Approaches to Improve Runway Surfaces and Safety

In many ways, transportation infrastructure is the backbone of our nation, of which airports are a critical element. But as technology grows and advances, so must our airports.

To further enhance our runway surfaces and safety, the FAA, through its GA-focused Center of Excellence, is conducting cost-sharing research with the Partnership to Enhance General Aviation Safety, Accessibility, and Sustainability, or PEGASAS, to develop more cost-effective methods to improve our runway surfaces and safety.

These methods are not only innovative, but also economical, since they look to re-purpose shelf-stable technology and products from other industries, to serve as safety features in aviation. Let's take a look at three of these fresh approaches to runway surface improvements and runway safety.

Why Didn't I Think of This One?

This first approach to runway surface improvement falls under the "Ah ha" category of incorporating new uses for existing technology to improve safety in GA. It's called Heated Pavements.

Not too dis-similar from the current technology we use in our cars today to de-ice windows and provide welcome warmth to chilly seats on a cold, frosty morning, this technology lends itself to the idea of using heated pavements on runways. PEGASAS studied the idea of using heated pavements to de-ice frozen

apron areas and, potentially, taxiways and runways to improve traction and safety for critical surface operations such as taxiing, takeoffs, and landings.

As we know, frozen precipitation, in the forms of ice, snow, slush, and freezing rain, significantly reduces runway traction. The de-icing methods we currently use involve sand/chemical mixtures that pose not only environmental concerns, but also can potentially result in foreign object damage to aircraft engines. Additionally, the costs of owning and operating snowplows can be substantial for many GA airports.

Over the past decade, a number of national and international research studies have investigated the use of alternative energy for anti-icing, de-icing, and snow removal. Some efforts have studied geothermal hydraulic and battery-based, electrical systems as a source of heat, but with limited success.

Currently, the FAA/PEGASAS research team is investigating the efficacy and cost-effectiveness of new, heated pavement technologies. This collaborative team includes Benjamin Mahaffay in the FAA's Airport Pavement Research and Development division at the William J. Hughes Technical Center, and university leads Dr. Halil Ceylan of Iowa State University, and Dr. John Had-

The FAA is conducting cost-sharing research with PEGASAS to develop more cost-effective methods to improve our runway surfaces and safety.

Innovative concepts such as heated pavement systems show good potential by providing enough heat to keep the surface temperature of the runway above freezing so that any frozen precipitation melts upon contact.

coatings, phase change materials, hybrid heating, and electrically conductive asphalt materials, and explores the use of advanced construction techniques for large-scale implementation of heated pavement systems.

The world's first, full-scale electrically conductive concrete (ECON) slabs at a U.S. airport were constructed and installed in the GA apron area at the Des Moines International Airport (KDSM) in Des

Moines, Iowa in November 2016. Under ambient weather conditions at KDSM during the 2016-2017, and 2017-2018 winter seasons, the team evaluated the performance of the ECON slabs.

Their research involves a multi-pronged approach that examines products such as electrically conductive concrete, superhydrophobic (super-water-repellent)

“As you can see by the performance of the ECON slabs in the photographic findings,” explains Dr. Ceylan, “the results demonstrate that ECON-based heated pavement systems have promising de-icing and anti-icing capabilities to provide uniform heat distribution and prevent snow and ice accumulation under winter weather conditions.”

“The next logical step is to take the technologies developed in-house and implement them full-scale, on-site through a series of field demonstrations,” says Dr. Ceylan.

Innovative concepts such as heated pavement systems show good potential by providing enough heat to keep the surface temperature of the runway above freezing so that any frozen precipitation melts upon contact.

The expected outcome of the research will provide guidance material to airport owners, engineers, operators, and contractors with the possibility of implementing heated pavement systems in the design and construction of our airports.

It Works on Roadways, Why Not Runways?

This next unique approach to improve runway surfaces and safety examines the possibility of re-purposing rumble strips for application on runway pavement.

I'm guessing that most of us, at one time or another, have driven over those bumpy, road safety strips and then experience the jarring and disconcerting — but attention-getting — vibration that follows. Although unsettling, rumble strips serve their purpose as an effective and inexpensive safety tool to warn us of hazards and keep us from drifting over centerlines into oncoming traffic. They are easy to construct, non-intrusive, semi-permanent, and proven to withstand winter operations in the roadway environment.

The FAA and PEGASAS explored leveraging the safety benefits of this cost-effective tool to help prevent runway incursions. The proposed method would involve the installation of rumble strips on runway holding position areas to warn pilots and airport vehicles.

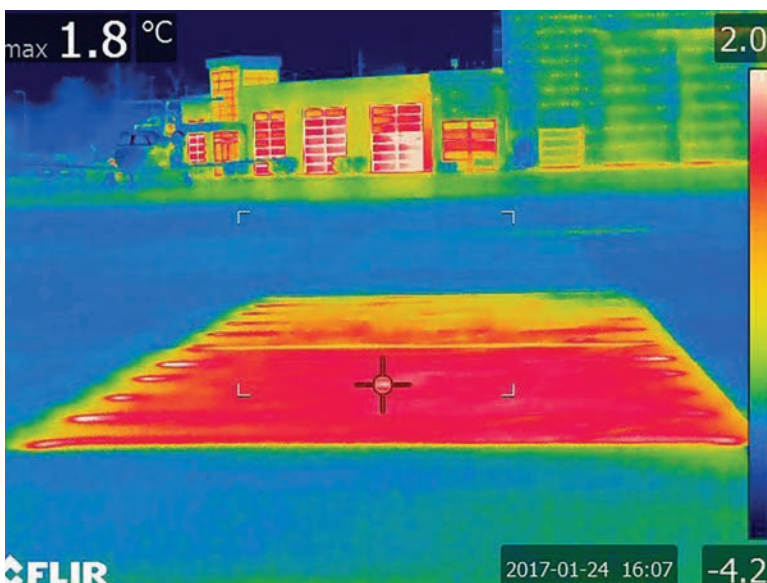
The FAA/PEGASAS team built temporary rumble strips at Purdue University Airport, under the direction of Don Gallagher, mathematician at the FAA Tech Center, and the PEGASAS team of researchers

Photo courtesy of Dr. Halli Ceylan, Iowa State University



Heated test slabs installed at the Des Moines International Airport.

Photo courtesy of Iowa State University



A thermal image of heated airport pavements.

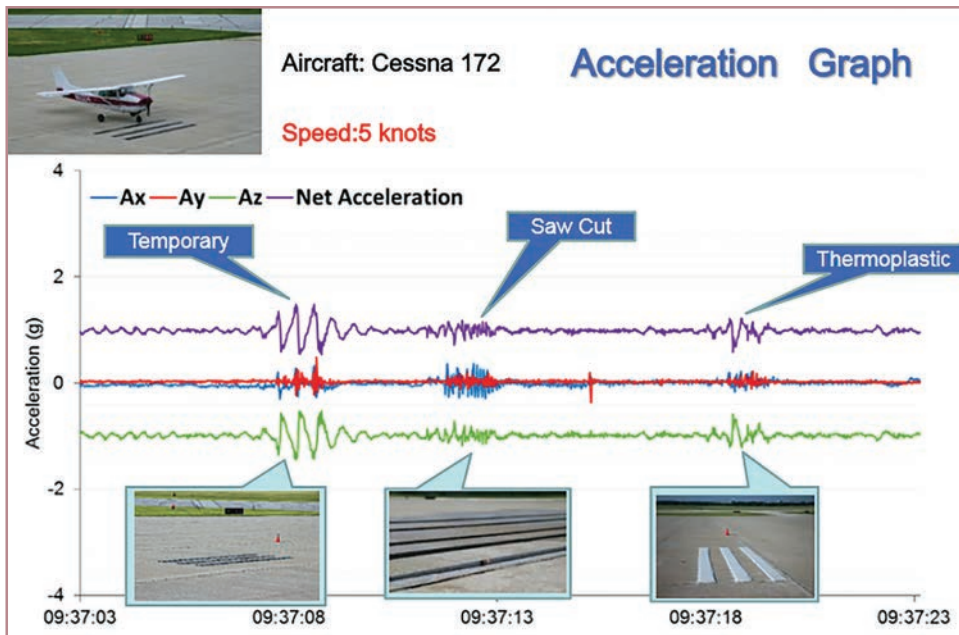


Figure A: The impact of rumble strips on a Cessna 172

from both Purdue and Ohio State Universities. A test bed with raised, saw cut, and temporary rumble strips was tested with a variety of GA aircraft, and a typical airport ground vehicle. The test also recorded the impact on passengers inside the aircraft.

In Figure A, you can see the impact of the rumble strips on a Cessna 172 as it taxied over temporary, saw cut, and thermoplastic rumble strips at 5 knots.

Purdue University researchers Dr. Darcy Bullock and Dr. Sarah Hubbard noted in their concluding report that while the impact of rumble strips varies depending on the aircraft and taxi speed, permanent rumble strips are not recommended out of concern for the airframe; however, temporary rumble strips may be appropriate for installation in areas that aircraft will not regularly traverse.

Teach an Old Dog a New Trick

The third pioneering approach to improve runway surfaces and safety involves the use of a time-tested technology called remote sensing. The FAA looked to re-purpose the object-recognition aspects of remote sensing to track the motion of aircraft in the airport environment.

Traditionally, radar tracks aircraft motion in and around airports; however, radar is not equipped to accurately track an aircraft or vehicle on the ground. Airfield surveillance primarily relies on human observations from control towers, which is not fool-proof, and is vulnerable to impaired visibility during adverse weather conditions.

Active remote sensing, however, is accurate, detailed, operates day and night, and in any type of weather.

Remote sensing works by using laser lights to

measure or sense objects from a great distance. The sensors “see” things by calculating the time elapsed between when its laser pulse is delivered to an object and when that pulse bounces off that object. Remote sensors use this measurement to determine distance and to display that object’s physical characteristics.

You may already be familiar with active remote sensing, also known as LIDAR, which is short for light detection and ranging. Google uses it to create topographic Google Maps, for example, and most auto manufacturers use this technology to control and navigate autonomous, or self-driving, cars to “see” objects on the road.

The FAA/PEGASAS team explored the possibility of using the object-recognition data from this technology to better understand and assess the risk of an aircraft’s patterns, trajectories, and operations in the airport environment. The joint research team included Lauren Collins, Airport Research Specialist at the FAA Tech Center, and the PEGASAS research team at Ohio State University led by Dr. Charles Toth, Shawn Pruchnicki, and Dr. Seth Young.

The team developed a prototype system using two types of sensors. They attached these sensors to the column of standard airport light fixtures along the runways and taxiways at Ohio State University Airport in Columbus, Ohio. Alignment of the sensors with a GPS antenna optimized the largest field of view to capture a maximum number of tracking points with accurate timing.

The sensors captured aircraft movements during taxi, takeoff, and landing. The results showed that

While the impact of rumble strips varies depending on the aircraft and taxi speed, permanent rumble strips are not recommended out of concern for the airframe.

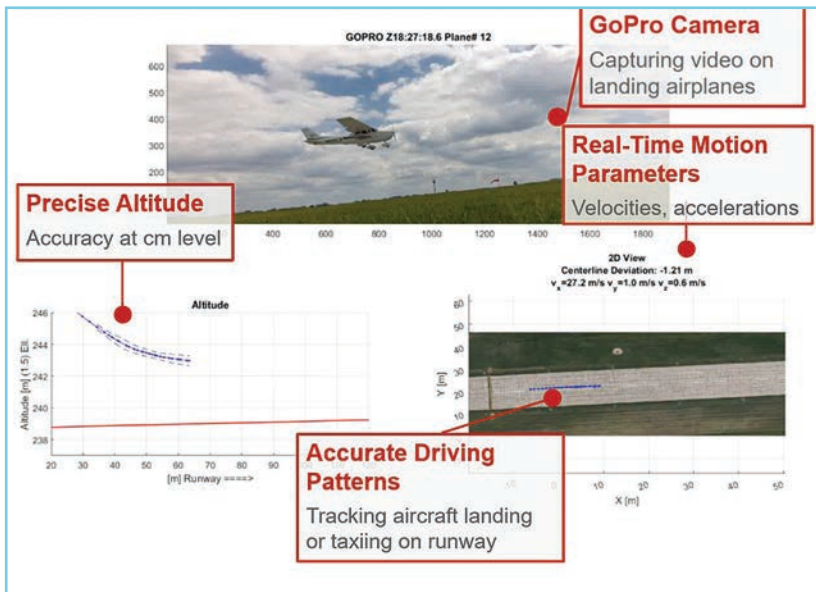


Figure B: Active imaging sensors accurately track and capture the aircraft's speed, altitude, and motion.

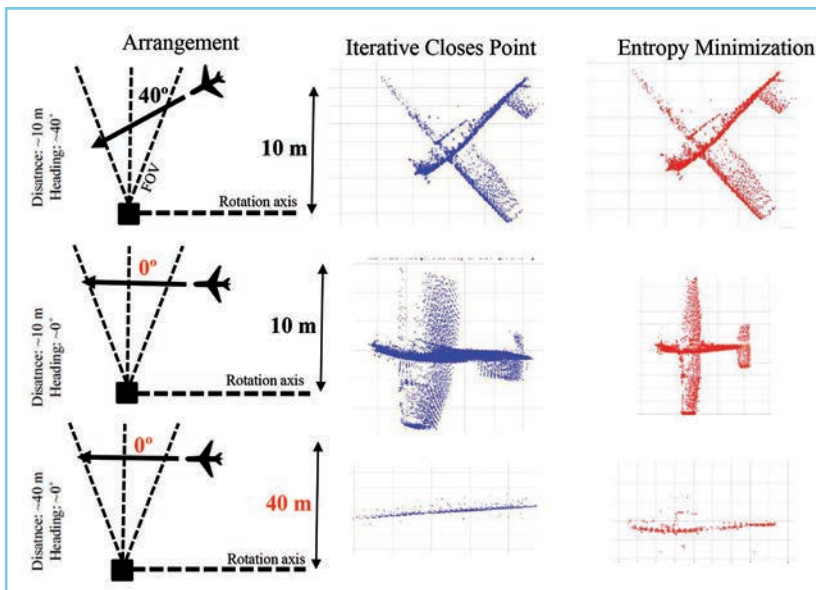


Figure C: Active imaging sensors reconstruct the 3-D model of the body of Cessna aircraft from different distances and headings.

these devices precisely captured the aircraft's speed, pinpointed its location, its orientation, and created a 3-D image of the airplane body in the environment. (See Figures B and C).

"The 3-D data enables the estimation of patterns or trajectories, the detection of aircraft types, and the monitoring of aircraft operations in general," explains Dr. Toth. This data can help pilots understand an airplane's motion relative to the runway centerline, which is beneficial for pilot education and training.

In addition, airport planners can utilize this precise positioning data to determine if they need to widen or increase runways and safety areas, adjust spacing in and between taxiways, adjust spacing from the centerline to maximize aircraft separation, and determine how to accommodate particular types, or sizes, of aircraft.

"Besides centerline deviation analysis, remote sensing can acquire statistical data for wildlife hazard avoidance, veer-off modeling study, and the investigation of security threats," said Dr. Toth. "This data can also provide important information for airport authorities to share and use in planning and design."

Phase I of this study is complete and was well received, with anticipation to move forward and conduct additional research in this groundbreaking field.

Moving Forward

Necessity, as the saying goes, is the mother of invention. It can inspire us to develop creative methods and products to tackle and address our current demands. Amidst the continuing and impactful work of the researchers at the FAA Tech Center and PEGA-SAS, general aviation is poised to move forward with challenges solved, through fresh, innovative, and non-traditional means to keep us safe on the ground, and in the air. ✈️

Jennifer Caron is an assistant editor for FAA Safety Briefing. She is a certified technical writer-editor, and is currently pursuing a Sport Pilot Certificate.

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How I Learned To Stop Worrying And Love The Singularity

JAMES WILLIAMS

Using Collective Data to Drive Safety Improvement

In technological terms, we define the singularity as a hypothetical moment in time when technology, particularly information processing and artificial intelligence, becomes so advanced that humanity undergoes a dramatic and irreversible change. In science fiction, this is usually a moment of terror when our new robot overlords rise to power. In reality, however, this moment is unlikely to be so clearly defined or as ominous. In fact, we've already seen something of a singularity occur in aviation.

In my youth (which wasn't *that* long ago), airline accidents were not common but still occurred on average a few times a year. After each accident, the government would remind us just how much safer air travel was than it had been even a generation before. These statements were unequivocally true. The situation was so much better that looking forward wasn't easy. The metaphorical low-hanging fruit was long gone, and the law of diminishing returns was clearly setting in. The current system of regulation and safety was approaching its theoretical limit.

Synergy is Not Just a Buzzword

Synergy is a buzzword when used in place of an actual strategy. Happily, though, in this case, synergy was key to advancing safety. That synergy took the form of an FAA/industry collaboration called the Commercial Aviation Safety Team (CAST).

CAST uses a data-driven strategy to reduce the fatality risk in commercial air travel. This cooperation has led to historic reductions in the commercial aviation fatality risk.

The CAST model was the driving force behind an 83-percent reduction in the risk of fatalities between 1998 and 2008. But once you drive accident rates so low, how do you proceed?

The FAA's response was to move to the Aviation Safety Information Analysis and Sharing (ASIAS) system. ASIAS takes data from voluntary programs

like the Aviation Safety Action Program (ASAP), Flight Operational Quality Assurance (FOQA), and the Air Traffic Safety Action Program (ATSAP) and combines it into one database. Through ASIAS, the FAA and industry can look for risks in the system and work to mitigate those risks before they become accidents. This means there is even more data to better monitor risks and determine interventions.

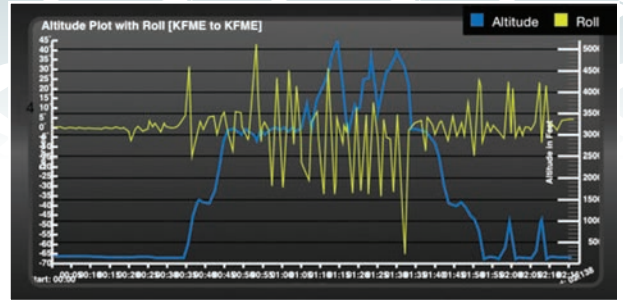
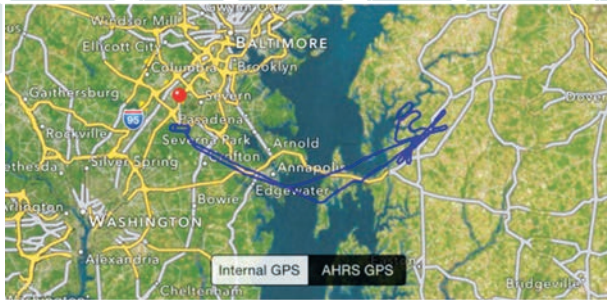
ASIAS has been a great system for all involved and is continuing to evolve. Along those lines, the FAA's Center of Excellence for General Aviation, PEGASAS (Partnership to Enhance General Aviation Safety, Accessibility, and Sustainability), has two active projects focused on new ASIAS communities.

Cracking the Helicopter Conundrum

It's no secret that improving the safety of helicopter operations has been a goal of the FAA for decades. But the challenges that face the FAA and industry are daunting. "There are all kinds of unique operations from air tour and corporate flights to heavy lift, pipeline/powerline inspection, law enforcement, training, and aerial application just to name a few," explained Cliff Johnson, an engineer from the FAA's Technical Center in Atlantic City, New Jersey. "They are all unique and face their own challenges during normal operations. The other aspect has been the relative lack of flight data monitoring being used across the industry," Johnson continued.

Johnson is the FAA Technical Contact for the PEGASAS project on Helicopter Flight Data Monitoring (HFDM). "Since we've started the project, we've seen more operators embrace HFDM technology, but by and large the technology is still in its infancy for this community, except for certain mission segments like oil and gas or offshore," Johnson said. "That is starting to change with the new

It's no secret that improving the safety of helicopter operations has been a goal for the FAA for decades.



Images from the NGAFID that allow users to view the data from their flights.

2018 Helicopter Air Ambulance (HAA) rule and as more operators gain knowledge of the systems and their capabilities. I like to think that our project has contributed to helping spread the word about the benefits of HFDM technologies and how they can be used during daily operations.

“We began this effort back in 2014 and we’re currently continuing to develop some of the metrics, events, and exceedances to analyze helicopter data,” Johnson explained. “These capabilities will form the backbone for incorporating and analyzing helicopter flight data in ASIAs, which is expected to take hold within the next several years, as we transition research capabilities and prototype data analysis tools into operational modules.”

That incorporation into ASIAs is critical to safety improvement. To develop effective safety enhancements, we have to have data to define the problems and measure our success in dealing with them. Much of the work to get helicopter data into ASIAs revolves around the variety of helicopter operations Johnson mentioned earlier. But that problem is only the half of it. The other half is getting more operators to install HFDM devices.

The United States Helicopter Safety Team (USHST) is on board and has issued a Safety Enhancement to support HFDM equipage. “One of the USHST helicopter safety enhancements [H-SE 82] promotes installation and use of HFDM devices for the purposes of detection and monitoring of aircraft and engine limitations that were exceeded,

collecting and preserving more data relevant to accident investigation, and detecting and correcting procedural noncompliance,” Johnson explained. “This

offers operators the opportunity to incorporate HFDM into their own operations, which will increase the safety and efficiency of flight operations and hopefully reduce the helicopter fatal accident rate.”

Pooling data could be a powerful tool for the rotorcraft community because there are many smaller operators that might not have a large enough

fleet to detect systemic issues on their own. But to do that requires a good system to manage it, and a large supply of data to fill that system. The PEGASAS HFDM project hopes to help on both fronts.

Seeing the Forest for the Trees

We’ve discussed previously in this magazine about how modern avionics have made flight data monitoring (FDM) much more accessible to GA. But the question is how do GA pilots access and use that information? Unlike in the commercial world where you have a structured system like FOQA that can be easily used to tap the data from operators, the GA community has more limited options, despite its much greater footprint on NAS operations.

To provide a solution to that problem, the FAA partnered with academia and industry to create a portal that could collect data from the wide variety of GA operations. The end result was the National General Aviation Flight Information Database (NGAFID). The NGAFID enables pilots to upload data from their avionics or from a specially designed smart phone/tablet app. This is an easy, no cost way not only to examine your own data, but also to share it with the database. As with FOQA, the individual data is de-identified and cannot be used by the FAA for enforcement.

The General Aviation Joint Steering Committee (GAJSC) is working to spread the word on the benefits of NGAFID and has signed up 11 universities and 70 corporate flight departments in addition to individual GA pilots. In total, more than 810,000 hours of flight data have been collected in the light GA community alone.

“Flight schools are quickly realizing the benefits,” Operations Research Analyst Corey Stephens said. “The more all of us work together, the better.” Stephens hopes to see similar safety improvements to the ones seen following the establishment of CAST.

The second problem is very similar to the one faced by the rotorcraft community: with such a diversity of operations, how can the data be organized for effective use? We need a meaningful way of analyzing all the data we acquire. The 11 universities

The introduction of smartphones and tablets to the cockpit for EFB purposes, as well as the addition of AHRS devices, can give us insight on how pilots fly.

involved are doing great work incorporating that data into their SMS (Safety Management System) programs, but how do we export those lessons to the wider community? That's where the PEGASAS Safety Analysis for General Aviation project comes in.

"This project develops prototypes that, once fully developed and implemented, could provide all pilots with tools that were previously only available to pilots of GA aircraft with advanced avionics and flight data recorders," explained Professor Karen Marais of Purdue University. Marais is the Site Director at Purdue University and the PEGASAS Technical Contact for the project.

"The introduction of smartphones and tablets to the cockpit for EFB [electronic flight bag] purposes, as well as the addition of AHRS [attitude and reference heading system] devices, can give us insight on how pilots fly in the absence of data of higher resolution," Marais continued.

"The use of machine learning adds to the data by training algorithms on high-resolution data, and then applying the same algorithms to data that tablets and smartphones would record. As a result, not only can we identify areas that are deficient in aggregate and inform decision-making, pilots can also learn from their flights and improve their safety."

Analyzing data can sometimes lead to even more data. Professor Marais explains how this happened with the project. "The ability to retroactively 'recover' data that was not originally present in the dataset was a nice outcome from the GA Safety Analysis project. For example, while most GA flight data recorders do not record flap position, feeding the available flight data into aerodynamic and propulsion models and comparing what we see versus what we were expecting to see, allows us to infer what flap settings the pilot was using during the flight. This work was accomplished by our team members at Georgia Tech."

This kind of post hoc "improvement" of datasets give them more power by letting us see factors not in the original data. For instance, is there an increase in takeoff accidents or incidents in aircraft X at flap setting Y? It's probably not going to be so simple in real life, but the point is that such a trend would be invisible without the "recovered" data.

We can see that PEGASAS is working to not only improve the high-resolution data that we do get, but also to better analyze the low-resolution data. The latter point is important because low-resolution solutions are far easier and cheaper to install in most



Photo Courtesy of Avidyne

Thanks to modern avionics, FDM in rotorcraft and light GA airplanes is now more economical.

aircraft. Removing the barriers to entry is critical to expanding the data pool.

"Due to flight data sharing sensitivity and ASIAs protocol, at this time we have only used a relatively small set of data from Purdue University flights, as well as a subset of flight data provided by the University of North Dakota, for our research purposes," Marais said. "Based on this limited set of de-identified data, we have observed that students in flight programs tend to develop good habits through their flights. Any abnormalities present in the flight data tend to be small and easily corrected."

The takeaway here is that the more data we can feed into projects like this, the more we can improve safety in GA.

The Singularity

We need both data and an intelligent analysis but these concepts are clearly interdependent. In both the GA and rotorcraft realm, we are late to the FDM game.

We need improvements in both the quantity and quality of the data we collect. Likewise, we need to improve the analysis of that data in terms of quality. PEGASAS is hard at work in both communities.

The end goal is a singularity of sorts. By increasing the amount of high-quality data we have, and improving the tools we use to analyze that data, we can create our own singularity. We can create that irreversible change in a positive way.

More data means more safety issues detected. More safety issues detected means more potential interventions. That cascade of events should lead to fewer accidents and fewer lives lost. I think that's a far nicer singularity to look forward to than the one envisioned by science fiction. ✈️

James Williams is FAA Safety Briefing's associate editor and photo editor. He is also a pilot and ground instructor.



To Those Who Taxi, Tow, or Reposition *Runway Safety for Aviation Mechanics*

When most of us think of runway incursions and surface incidents, one word usually comes to mind — pilots. Granted, GA pilots do make up the majority (two-thirds, actually) of these incidents, and they remain the focus of initiatives to improve runway safety. However, there are others operating on the airport surface, including mechanics.

Maintenance Check: Mechanics towing or taxiing aircraft for maintenance or gate re-positioning play an important role in preventing runway incursions.

A runway incursion is the incorrect presence of an aircraft, vehicle, or person on the protected area designated for the landing or takeoff of aircraft. When a runway incursion occurs during a maintenance tow or taxi operation, the FAA currently classifies the event as a vehicle/pedestrian deviation.

The term vehicle includes aircraft taxied under their own power by a non-pilot, or towed with no intention for flight. When an aircraft is not intended for flight, anyone (except pilots) taxiing or towing an aircraft needs vehicle training to access the movement and safety areas of the airport.

Practices: Airports have two distinct areas: Movement and non-movement. The movement area is under air traffic control (ATC) authority. It usually includes runways, taxiways, and other areas used for taxi, takeoff, or landing. The non-movement area includes taxi lanes, aprons, ramps, and other areas not under ATC control.

Most airports separate the two areas with adjacent solid and dashed yellow line ground markings. Moving from dashed to solid is permissible, but to move from solid to the dashed side requires ATC permission. (You might use “dash across” as a way to remember that you can “dash across” if the dashed lines are closest to you.)

Knowledge: Being familiar with the airport environment is critical, especially when conditions include bad weather, low visibility, and runway/taxiway closures. A good rule of thumb for taxiing or driving on an airport, even when activity is light, is to establish a mental picture of airport operations.

Study the airport diagram before taxiing and keep a printed diagram with you when you taxi and drive in the movement and non-movement areas.

Also, understand and properly use aircraft lights, radios, and adhere to airport signs and markings. Be

aware of any Notices to Airmen (NOTAM) that may affect operations.

Crossings: Most mechanic incursions reveal a pattern of unauthorized runway crossings. When necessary, runway crossings should occur at the departure end rather than the midpoint. An aircraft has more time and runway length to react if the vehicle incursion is at the opposite end of the runway from the aircraft.

Next Steps: The FAA has taken steps to address runway safety, including deploying and testing technology designed to prevent runway incursions, through its GA-focused, cost-sharing research with the Partnership to Enhance General Aviation Safety, Accessibility, and Sustainability (PEGASAS). These methods are not only innovative, but also economical, since they look to re-purpose shelf-stable technology and products from other industries, to serve as safety features in aviation.

Research projects include: investigating the use of electrically conductive concrete, or heated pavements, to de-ice and remove snow from aprons, taxiways, and runways; employing rumble strips, similar to those used on vehicle roadways, to warn pilots and vehicles of upcoming runway holding position areas; and using active remote sensors to accurately track the motion of aircraft, and to better understand and assess the risk of an aircraft’s patterns, trajectories, and operations in the airport environment.

Take a look at the articles in this issue to learn more about the impactful work of the researchers at the FAA Tech Center and PEGASAS.

Jennifer Caron is an assistant editor for FAA Safety Briefing. She is a certified technical writer-editor, and is currently pursuing a Sport Pilot Certificate.

Learn More

Take advantage of any runway safety training programs available at your airport. You can also find a number of online courses, presentations, and training aids
FAASafety.gov

Known Best Practices for Airfield Safety
faa.gov/airports/runway_safety/bestpractices.cfm

Runway Safety: A Best Practices Guide to Operations and Communications
go.usa.gov/xQ48x



System Component Failure — Powerplant SE Topics

For the past several years, the FAA Safety Team (FAASTeam), this magazine, the General Aviation Joint Steering Committee (GAJSC), and numerous industry partners have worked diligently to help promote loss of control awareness to the GA community. This promotion was facilitated in part by two Loss of Control Working Groups (LOC WG) formed under the GAJSC, whose analysis and research into accident causal factors from a 2001-2010 study resulted in a list of more than 30 safety enhancements (SE) topics. These safety intervention strategies are specifically aimed at helping pilots avoid loss of control situations.

Following the LOC WG, the GAJSC decided to focus on fatal accidents attributed to aircraft powerplant and component failures, the third ranking causal factor according to an FAA accident study. A new working group — the System Component Failure - Powerplant WG — formed in 2014 to examine many of the airworthiness-related casual factors that appeared in their fatal accident study and provide a prioritized list of intervention strategies. The FAASTeam plans to integrate information on these areas into its 2018/2019 plan for safety seminars and outreach products. Here's a brief description of the approved SCF-PP safety enhancements:

Mitigating the Risk of Improper Torquing:

Educate the maintenance community about the risks caused by improper torquing techniques. The GA community should determine if there are cost-effective technology solutions for new and legacy aircraft that can help eliminate or mitigate the risk of improper torquing.

V_{mc} Scenario Training: Encourage the development of training scenarios based on fatal accidents caused by V_{mc}-related LOC to be used in multi-engine flight training.

Multi-engine Emergency Management Technology: Encourage a research program to develop requirements and performance specifications for proposed V_{mc}-imminent warning device designs under asymmetric thrust conditions, as well as research and develop technological solutions to prevent pilots from feathering the wrong engine.

Smart Cockpit Technology: Research and develop smart cockpit technology that helps identify emergency situations, prompts pilots (aurally/visually) through pertinent checklist items, and provides instructions based on aircraft position and condition of flight.

Survivability: Research survivability issues and potential solutions (air bags, shoulder harnesses, UV-protected attire, helmets, fire prevention, ballistic parachutes, etc.) and implement recommendations.

Mitigating V-Band Clamp Failures: Develop an appliance-specific document addressing the safety of exhaust related V-band clamp assemblies.

Modernized Maintenance Safety Reporting System: Evaluate the feasibility of a modernized maintenance data exchange program to take the place of the current M&D/SDR process and improve the ability to identify issues/trends with components across multiple OEMs and across multiple certification offices.

Maintenance Placard: Develop, distribute, and promote a tool/device to be displayed in the windscreen of aircraft undergoing maintenance. This would be an effective way to alert the pilot and mechanic that the airplane is not currently airworthy.

A&P Education and Training: Examine and improve the quality and availability of guidance to maintenance professionals and improve training and outreach. Compile and provide additional research as required concerning human factors in maintenance.

Ignition Systems: Improve reliability in reciprocating engine ignition systems through research and possible promotion of alternative ignition systems.

Outreach: Develop an education and outreach campaign on eight specific topics that were determined to be effective in helping to reduce fatal accidents related to powerplant system failures. (See the WG report link below for details).

For more details on each of these SE topics, and for an inside look at how the SCF-PP WG made its determinations, you can access their full report at www.gajsc.org/system-component-failure-powerplant.

Tom Hoffmann is the managing editor of FAA Safety Briefing. He is a commercial pilot and holds an A&P certificate.

Helicopter Safety Enhancements

We can all agree that we want everyone who flies in a helicopter to arrive safely at his or her destination. To help support that, the FAA and industry have made great strides toward reducing the helicopter accident rate.

Yet, fatal accidents still occur. That usually happens for the same reasons: unintended flight into bad weather, loss of control, and collisions with objects/terrain while flying at a low altitude.

The United States Helicopter Safety Team (USHST), a joint industry and government safety advocacy organization, developed 22 “Helicopter-Safety Enhancements” (H-SEs) or steps to help reduce fatal accidents by 20-percent by 2020. This plan is part of an effort toward achieving the vision of zero accidents nationwide. The H-SEs, released last year, center around four themes: pilot competency, instrument meteorological conditions and visibility, loss of control, and safety management.

The Fort Worth-based FAA Rotorcraft Standards Branch is helping the USHST promote these H-SEs. We plan to present the H-SEs during the next few Vertically Speaking departments, starting with pilot competency.

The six H-SEs so far developed in the pilot competency area are:

Development of Airman Certification Standards (ACS) for Rotorcraft. The FAA, with help from industry, will develop and publish the Airman Certification Standards Rotorcraft-Helicopter series to replace the current Practical Test Standards for airman certification in this category and class. The rotorcraft-helicopter ACS aims to make tests more meaningful and relevant to actual operations and contribute to standardizing teaching, learning, and testing. Target completion date: Jan. 1, 2022.

Simulations for Safe Decision Making. This H-SE seeks to promote wider use of simulation devices to prevent fatal helicopter accidents resulting from at-risk scenarios. By using simulation scenarios, such as unintended flight into IMC, helicopter community leaders could increase awareness and train pilots about how to handle potentially risky situations that the USHST has identified as most likely to occur. Target completion date: May 1, 2021.

Competency-Based Training and Assessments. The FAA and industry plan to provide guidance about how to best train pilots in helicopter performance and

limitations; in-flight power and energy management training, including prevention, recovery, and settling with insufficient power; basic maneuvers essential to aircraft control, threat and error management (TEM), mission planning, aircraft systems, and familiarity with the helicopter’s pilot operating handbook. Target completion date: Dec. 1, 2020.

Improve Make and Model Transition Training. Pilots and mechanics do not all receive the same high-level training for new equipment. The FAA, along with industry and pilot groups like the Aircraft Owners and Pilots Association, the Experimental Aircraft Association, the General Aviation Joint Steering Committee, and the Helicopter Association International, plan to create a guide with recommendations and a high-quality toolkit to help pilots work with new equipment. Following that, an outreach campaign will target the use of aircraft type clubs — information sharing groups focused on particular helicopters. Target completion date: Dec. 1, 2020.

Safety Culture and Professionalism. This H-SE seeks to create a safety culture that pilots and mechanics can embrace whenever they go to work or fly a helicopter. A safety culture can mean anything from double-checking the proper torque of a tightened nut to a thorough pre-flight check and a foolproof flight plan. A major goal is to have operators who have an effective safety culture mentor those who need advice. Completion date: Sep. 1, 2019.

Utilities, Patrol, and Construction Recommended Practices Guide. This H-SE seeks to promote and encourage wider dissemination of recommended practice guides with the utilities, patrol, and construction helicopter communities. As more organizations and operators are exposed to these practices, the safety team believes it is more likely these safety practices will be built into operations, leading to an increased level of safety. Completion date: To be determined.

The next time you get into your helicopter, know this: There’s a team of people in the FAA and industry working hard to help ensure that you arrive at your destination safely. For more information on the H-SEs, see the USHST’s report at bit.ly/2F7LoJ7.

Gene Trainor is a technical writer for the FAA Rotorcraft Standards Branch.



Flight Forum

Flying By the Basics

Congratulations on the “Back to Basics” articles in the January/February issue of FAA Safety Briefing. Current experience and regular practice with an instructor is the key to safety. I found that our generation of high-tech pilots are not interested in being proficient pilots. They are only interested in transportation — program the GPS, engage the autopilot, select the approach at the destination, automatically intercept the final approach course and arrive. They missed the entire experience of flying the airplane. Where, oh where has the romance, adventure and joy of flight gone? The high-tech way.

I’m not opposed to the advancements and capabilities of technology, just its habit-forming influence on our lives. Flying just for fun is good therapy — high in the bright blue sky, with a bird’s eye view of the world.

— Ray

Thanks Ray! The magazine team works hard to provide content that is both interesting and relevant, and it’s very gratifying to hear that we have been successful in the “Back to Basics” issue. We are especially happy that you liked the Postflight column, and as Susan Parson notes, “I enjoyed writing that piece; it certainly came straight from the heart. I never fly as a pilot or a passenger without being awed by the magic of flying, and grateful for the blessing it is to live in the age of airplanes.”

How to Talk Like a Pilot

Good article [in the Jan/Feb issue]! I have to admit though that on more than one occasion I will slip a ‘thank you’ into a frequency transmission confirmation. I didn’t even know I was doing it until my CFI nudged me. Figured it was just my subconscious letting ATC know how awesome they are!

— Malcolm

Hi Malcom, we appreciate your post on Facebook, and we’re happy to hear that you enjoyed the article. Sarah Patten, Air Traffic Control Specialist at FAA Potomac TRACON responded to your post and says, “please thank this pilot for me!! I had to laugh when he said that the instructor pointed it out; hopefully the instructor tells other students that it’s okay to say ‘thank you.’ We always appreciate when a pilot says thank you. I know ATC seems scary sometimes, especially to new pilots, but we’re just normal people doing our jobs and it’s always nice to feel appreciated!”

ADS-B EQUIP NOW!



UNTIL 2020 EQUIPAGE DEADLINE

DON'T GET LEFT IN THE HANGAR.

By January 1, 2020, you must be equipped with **ADS-B Out** to fly in most controlled airspace.

Q: What equipment is required by the new rule?

A: The rule specifies ADS-B Out equipment that meets the performance requirements of either Technical Standard Order (TSO)-C154c (Universal Access Transceiver) or TSO-C166b (1090 ES). However, to operate in Class A airspace, aircraft are required to equip with avionics certified to TSO-C166b.

Let us hear from you! Send your comments, suggestions, and questions to SafetyBriefing@faa.gov or use a smartphone QR reader to go “VFR-direct” to our mailbox. You can also reach us on Twitter @FAASafetyBrief or on Facebook [facebook.com/FAA](https://www.facebook.com/FAA).

We may edit letters for style and/or length. Due to our publishing schedule, responses may not appear for several issues. While we do not print anonymous letters, we will withhold names or send personal replies upon request. If you have a concern with an immediate FAA operational issue, contact your local Flight Standards Office or air traffic facility.



The Power of Imagination

Like many aviation friends and colleagues, I got hooked on *Star Trek* — the original version — at an early age. So perhaps you can understand why I was recently inspired to read Ethan Siegel's *Treknology: The Science of Star Trek from Tricorders to Warp Drive*. A PhD astrophysicist, science writer, and author, Dr. Siegel takes his readers on a fascinating and well-written tour of the best-known technologies from the various series in the *Star Trek* franchise.

With apologies for Dr. Siegel for possible oversimplification, my first takeaway was that the cool toys, tools, and technologies in the *Star Trek* universe fall into three broad categories. First is *Trek* tech that we have already invented (e.g., smartphones and

tablets). Second is *Trek* tech in development (e.g., artificial intelligence driving interactive computers). Third is *Trek* tech that remains beyond our reach (e.g., warp speed and transporters).

My second big takeaway was the revelation that in sev-

eral cases, *Treknology* has provided the inspiration for the inventors of gadgets we now take for granted. Even in cases where *Treknological* technologies seem unattainable — transporters come to mind

— the *Trek* creators' ability to imagine such things has sometimes prompted valuable research and led to other useful discoveries.

Though not inspired by *Star Trek*, the kinds of research projects under the PEGASAS umbrella make me smile with anticipation and excitement. I sometimes marvel to realize how many technologies have come to fruition — and to market — just in the time I have held a pilot certificate. Today's technologies and techniques are possible because at some point in the past, some person or group of people had an inspiration and, through the alchemy of rigorous research, transformed the nuggets of their imagination into tangible technological reality.

Speaking of people: as other articles in this issue of *FAA Safety Briefing* have explained, one of the goals Congress established for the "Center of Excellence" framework was to provide another means of educating and training a new generation of aviation scientists and professionals. As noted in its annual report, each year the PEGASAS team nominates someone from its recognized group of Outstanding Student Researchers for the prestigious Department of Transportation Student of the Year award. I think the GA community can be proud to know that for several years in a row, the PEGASAS candidate has won this honor and been recognized at the Council of University Transportation Centers award ceremony.

Today's technologies exist because at some point in the past, some person or group had an inspiration and, through the alchemy of rigorous research, transformed the nuggets of their imagination into tangible, technological reality.



Joshua Harris, the 2017 DOT Student of the Year is pictured with Dr. Patricia Watts (National Program Director, FAA Air Transportation Centers of Excellence), Dr. Halil Ceylan (PEGASAS Site Director) and Ryan King (PEGASAS Program Manager).

The Next Frontier

Let me close this issue with a nod to a forward-looking PEGASAS project called "GA 2030 Exploratory Analyses." Led by the Georgia Institute of Technology and Purdue University, this effort — the 25th effort under the aegis of PEGASAS — will look at GA trends and developments for the 15-20 year timeframe. The goal is to identify research topics that will ultimately lead to the advancements tomorrow's pilots will take for granted. In addition to benchmarking and data/text mining, this project expects to use workshops to gather creative ideas about the future of GA airframes, avionics, operators, and "non-traditional GA entrants" (think drones). It will be fun to see the final report — and even more fun to watch what happens next.

Susan Parson (susan.parson@faa.gov, or @avi8rix for Twitter fans) is editor of FAA Safety Briefing. She is an active general aviation pilot and flight instructor.

FAA Faces

Ryan King

Program Manager, FAA Center of Excellence for General Aviation



Following the contrails of his father, a naval aviator and airline navigator, Ryan King soared into FAA service first as a co-op student, during his last two years at Virginia Polytechnic Institute and State University, and later in life as a career move.

As a civil engineering student, Ryan was assigned to the FAA's Airport Technology R&D Branch, where he worked on projects related to airport pavement design.

"Upon graduation from Virginia Tech, I was hired by the FAA and continued working in the Airport Technology Branch as a general engineer," he notes. "I eventually got involved with various research projects including runway friction, engineered arresting systems, and airport planning and design topics."

Ryan took a break in public service to work as a project manager for a large enterprise software company and a small internet development firm. He returned to FAA service in 2001 as a project manager for airport planning and design research. He later took responsibility for program management of the FAA's Wildlife Hazard Mitigation R&D Program.

Now, as program manager for the FAA's Center of Excellence (COE) for General Aviation, he coordinates the team of academics working to make general aviation safer under the PEGASAS partnership. PEGASAS is the name given to this center of excellence which stands for the *Partnership for the Enhancement of General Aviation Safety, Accessibility, and Sustainability*. It is one of six active Air Transpor-

tation Centers of Excellence established by the FAA to create cost-sharing partnerships with academia and industry throughout the United States. PEGASAS comprises six core universities that perform basic research for the FAA, related primarily to GA safety, with additional focus on making GA accessible and sustainable for generations to come.

"What distinguishes a COE from other research grant arrangements is that the core universities of a center of excellence are selected through a vigorous competitive process to exist as a single, cooperating entity for a period of up to 10 years," Ryan explains. "Every dollar of federal money awarded to the COE has to be matched one-to-one, resulting in a win-win relationship for the university researchers, as well as the American taxpayers."

The fleet of GA aircraft are aging. The next generation of GA pilots and stakeholders are following the *magenta line* into the future faster and faster. The airspace is also getting busier with the introduction of autonomous vehicles, the proliferation of unmanned aircraft systems (UAS), and the launching of commercial space transportation. This all puts the future of general aviation in a challenging situation to manage and sustain, which is what drives the PEGASAS researchers to innovate technology in the cockpit.

"The future is wide open," Ryan observes. "We are actually conducting research right now to try and capture what GA will look like in about 15 to 20 years, and we want to know how that vision will influence our research strategy to prepare for that end."

There are many factors actively shaping the future of GA. If you think in terms of safety as a driver, just the idea of a GA recreational enthusiast navigating an airspace full of flying vehicles and UAS is mind-blowing. That means systems, procedures, hardware, and training that focus on the integration and interoperability of an airspace serving a wide range of users are going to be key. It is a good thing we have a team of *real-life*, winged thinkers to keep GA safety moving forward into the future.

Paul Cianciolo is an associate editor and the social media lead for FAA Safety Briefing. He is a U.S. Air Force veteran, and a rated aircrew member and volunteer public affairs officer with Civil Air Patrol.





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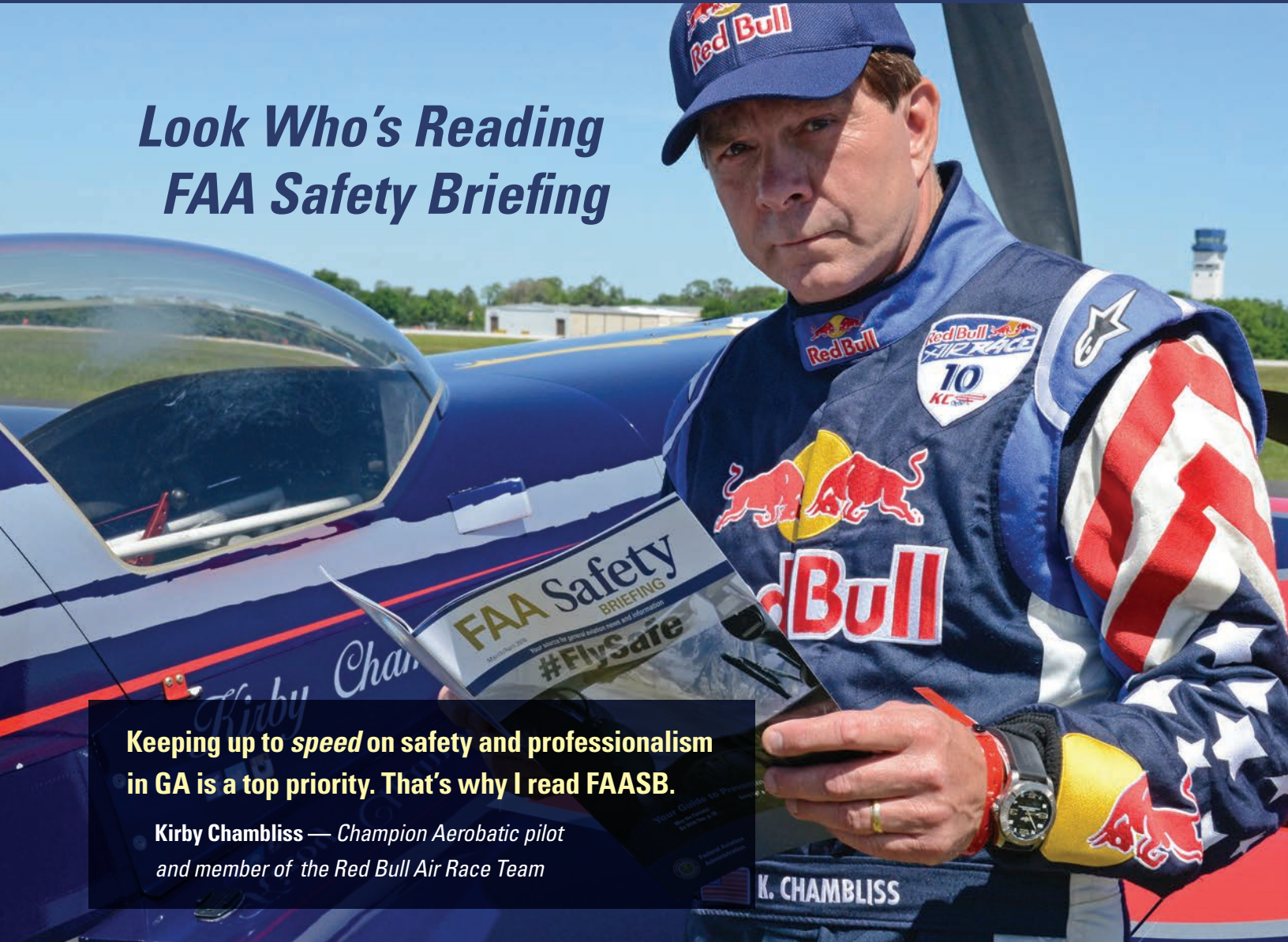


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