Unmanned Aerial Systems & Airspace Safety: Sharing A Crowded Airspace Into The Future

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Unmanned Aerial Vehicles/Systems
MAXIMUM ALTITUDE OF UNMANNED AIRCRAFT SYSTEMS BY CATEGORY

Legend:
- High Altitude
- Medium Altitude
- Tactical
- Mini
- Micro

Maximum Altitude (ft.)

Airspace Class
- Class G
- Class A
- Classes B, C, D, E, G

Maximum Takeoff Weight (lb.)

Source: Roland E. Weibel, MIT Aero/Astro Ph.D. candidate, International Center for Air Transportation
UAS by the Numbers as of 09/26/2018

➢ 431,296 – Total downloads of the B4UFLY app

➢ 955,893 – Online hobby registrations under the FAA's Small UAS registration system

➢ 252,821 – Online commercial registrations

➢ 1,215,318 – Total UAS registrations
UAV/UAS vs Model Aircraft

FAA Advisory Circular 91-57 limits recreational use of airspace by model aircraft to below 400 feet AGL and away from airports and air traffic.

AC 91-97 only applies to aircraft modelers, and excludes individuals or companies flying model aircraft for business purposes.
Model Aircraft for Hobbyist Activities
FAA Aviation Safety Inspector Marcello Mirabelli with the Bell TR918. Vehicles like this are now called unmanned aircraft systems (UASs). The Bell TR918 was developed for commercial use and certified by FAA.
A team at NASA's Langley Research Center is developing a concept of a battery-powered plane that has 10 engines and can take off like a helicopter and fly efficiently like an aircraft.
Phantom Eye
Global Hawk
The Eitan is 79 feet long, has a wingspan of 86 feet — about the size of a Boeing 737 airliner.
There are hundreds of different UAS from over 440 manufacturers.

UAS industries exist currently in 86 countries.

7 countries have used armed UAS in combat and 19 countries have or are acquiring armed UAS.

It is estimated that approximately 1.5 million UAS have been sold over the last 3 years.
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Civil UAS vs Public Use UAS

CIVIL UAS: The FAA issues an *Experimental Airworthiness Certificate* (EAC) for private sector (Civil) UAS to do research and development, training and flight demonstrations.

PUBLIC USE UAS: The FAA issues *Certificate of a Waiver or Authorization* (COA) for public aircraft used for law enforcement, firefighting, border patrol, disaster relief, search and rescue, military training, and other government operational missions.

Routine operation of UAS over densely-populated areas is prohibited.
UAS operations are currently not authorized in Class B airspace, which exists over major urban areas and contains the highest density of manned aircraft in the National Airspace System.
FAA Experimental Airworthiness Certificates for Civil UAS Operations
Today, UAS perform border and port surveillance by the DHS, help with scientific research and environmental monitoring by NASA and NOAA, support public safety by law enforcement agencies, help state universities conduct research, and support various other missions for public (government) entities.
After a comprehensive 10-month selection process involving 25 proposals from 24 states, on December 30, 2013, the FAA selected the following six UAS research and test site operators across the country:

- University of Alaska
- State of Nevada
- New York’s Griffiss International Airport
- North Dakota Department of Commerce
- Texas A&M University in Corpus Christi
- Virginia Polytechnic Institute and State University
FAA UAS Regulations
Chinese e-commerce giant Alibaba Group Holding Ltd began actual deliveries-by-UAV

The three-day, three-city test of the system began in Beijing, with deliveries being made from a single merchant operating through Alibaba's Amazon-like Taobao Marketplace website
UAV used by EasyJet for fuselage inspections
Safety Issues
Hazards Posed by UAS to Aviation Safety

- Physical contact between UAS (fixed wing and rotary wing) and piloted aircraft
- Physical contact between UAS and humans
Alliance for System Safety of UAS through Research Excellence (ASSURE)

- Mississippi State University
- Montana State University
- Ohio State University
- Wichita State University
They evaluated the potential impacts of a 2.7-lb. quadcopter and 4 lb. quadcopter; and a 4-lb. and 8-lb. fixed wing drone on a single-aisle commercial transport jet and a business jet.

They examined impacts to the wing leading edge, the windshield, and the vertical and horizontal stabilizers.

The windshields generally sustained the least damage and the horizontal stabilizers suffered the most serious damage.
Quadcopter Engine Ingestion Damage

UAS & Airspace Safety

Federal Aviation Administration
Quadcopter Vertical Stabilizer Impact

Quadcopter UAS Vertical Stabilizer Impact
Airborne Collision Studies

UAS & Airspace Safety

Federal Aviation Administration
Quadcopter vs Bird Impact
Fixed-Wing Windshield Impact
Quadcopters with exposed propellers can hurt people and they also regularly get damaged in crashes.

Polyhelo created the Nano Tornado that instead of open props it utilizes four ducted fans.
Part 107.9 - Accident Reporting Requirements

No later than 10 days after an operation that meets the criteria of either paragraph (a) or (b) of this section, a remote pilot in command must report to the Federal Aviation Administration in a manner acceptable to the Administrator, any operation of the small unmanned aircraft involving at least:

- a. Serious injury to any person or any loss of consciousness; or
- b. Damage to any property, other than the small unmanned aircraft, unless one of the following conditions is satisfied:
  1. The cost of repair (including materials and labor) does not exceed $500; or
  2. The fair market value of the property does not exceed $500 in the event of total loss.
If a UAS Crashes who is Responsible for Damages?

A few months ago a UAV crashed into spectators at a Virginia bull run - There were three to four minor injuries caused by the falling UAV - The operator claimed his UAV's battery died in midair

During a regional triathlon in Australia a local UAV operator was hired to take aerial photographs of their event - One of the event's triathletes received head injuries from a collision with the UAV - The athlete, organizers, and the cinematographer are arguing over who is responsible for the injuries

This is uncharted legal territory, but experts’ consensus is, at the very least, the pilot will have a lot of explaining to do. Recreational UAV manufacturers usually urge buyers to purchase separate UAV insurance
Researchers at the University of Minnesota are developing a mind-controlled quad-copter using a skullcap fitted with a Brain Computer Interface (BCI)
Researchers from Portugal's Brainflight project successfully demonstrated a drone flight piloted by human thought
Current CAMI Research Objective:

Collect data to support the regulatory and guidance materials that set the minimum requirements for approving:

1) *Ground control stations*

2) *Training and certification of UAS pilots/operators and other crew members*

3) *Ground observers*
Shoulder-mounted SkyWall launcher takes aim at illegal drones.
Thai RPA Regulation

RPA to be registered
- RPA with camera installed must be registered with no exceptions.
- RPA over 2 KGs must be registered with no exceptions.

RPA over 25 KGs
- must receive permission from the Minister of Transport

To fly RPA legally
- DO NOT fly close to any person, vehicle, construction or buildings at distance less than 30 M. horizontally
- DO NOT fly in restricted area, official or state facilities and hospital without authorization
- DO NOT fly within 9 KM (5 nautical miles) from airport or temporary airfield unless it is authorized
- DO NOT fly higher than 90 M.
- Control and take off must always be visible during the flight and DO NOT control UAV by using camera on aeronautics or other device

Any act of violation is subjected to up to 1 year imprisonment or fined up to 40,000 THB or both
Do I need to Register My Drone?

Yes if it weighs between **0.55 lbs** (250 grams) and up to **55 lbs** (25 kg) including payload such as on-board cameras.
B4UFLY is an easy-to-use smartphone app that helps unmanned aircraft operators determine whether there are any restrictions or requirements in effect at the location where they want to fly

- A clear "status" indicator that immediately informs the operator about the current or planned location. For example, it shows flying in the Special Flight Rules Area around Washington, D.C. is prohibited

- Information on the parameters that drive the status indicator

- A "Planner Mode" for future flights in different locations

- Informative, interactive maps with filtering options

- Links to other FAA UAS resources and regulatory information
Planning Mode

This feature allows you to check the flight status for a specified location and time.

**Future Flight Info:**

- **Location:** current GPS location
- **Time:** Jan, 07, 1:43 PM

Start Planner Mode

Map

San Francisco INTL
5 Mile Airport Requirement

Federal Law requires model aircraft operators to notify the airport operator and Air Traffic Control Tower (if one is present) when operating within 5 miles of an airport.

AIRPORTS WITHIN 5 MI

- HALL OF JUSTICE 0.87 mi
- COMMODORE 1.65 mi
- UCSF MEDICAL CENTER AT MISSION BAY 1.79 mi
- ALCATRAZ 2.74 mi

Warning - Action Required

You are located within 5 miles of an airport and/or in airspace that requires permission.

By law, you must contact the airport operator and the air traffic control facility (if one is located at the airport) before flying.

More Status Information
Know Before You Fly

Do:
- Fly your unmanned aircraft below 400 feet
- Fly with local clubs
- Inspect your aircraft before you fly
- Take a lesson before you fly

Don’t:
- Fly near airports or any manned aircraft
- Fly near people or stadiums
- Be careless or reckless, you could be fined if you endanger people or other aircraft
- Fly anything that weighs more than 55 lbs.
- Fly for payment or commercial purposes unless specifically authorized by the FAA

www.faa.gov/uas • www.knowbeforeyoufly.org

Federal Aviation Administration

Small UAV Coalition • AUVSI • AMA
UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION - FEDERAL AVIATION ADMINISTRATION

IV NAME
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V ADDRESS
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VI NATIONALITY USA
SEX HEIGHT WEIGHT HAIR EYES
M 69 220 BLOND BLUE

IVa D.O.B. 
IX HAS BEEN FOUND TO BE PROPERLY QUALIFIED TO EXERCISE THE PRIVILEGES OF

II REMOTE PILOT

III CERTIFICATE NUMBER

X DATE OF ISSUE 1 SEP 2016

XIV

VIII ADMINISTRATOR
Personal Flying Machines
Zapata Flying Board
Zapata Ezfly is a small platform with a series of jet thrusters, with two handgrips that come up from the base and steering is done with bodyweight.
Daedalus Jetpack Suit
(Richard Browning)
Jetpack Aviation unveiled its JB-9 jetpack that runs on kerosene and uses two vectored jet engines.

The JB-9 offers a flight time over 10 minutes, depending on pilot weight.
The JB-10 is some 7 percent more powerful than the JB-9.
The JB-11 takes safety to the next level, as well as speed and power. Using three smaller turbojet engines per side instead of just one, JB-11 can hit speeds over 150 mph (240 km/h).
30-min flight duration
Range of 30 km (19 miles)
1,000 ft per minute climb rate
100 km/h (62 mph) cruise speed
$150,000 for commercial version
Hoversurf Scorpion Hoverbike (Russia)
Workhorse first unveiled its Surefly flying car at the Paris Air Show in June 2017, and has now sent it into the air with a person inside for the first time.
Airbus Vahana is a full-scale version of the electric, autonomous VTOL aircraft that completed its first ever test flight earlier in February.
Lilium Aviation completed its first unmanned test flights of a two-seater version of its electric VTOL jet in early 2017 and is working on a five-seat production version and is targeting 2019 for its first manned flights.
Ehang 184 for the first time carrying out test flights with people onboard