

# Unmanned Aircraft Flights and Research at the United States Air Force Academy

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**Abstract** The United States Air Force Academy is actively involved in unmanned aircraft research across numerous departments involving many projects, aircraft, government agencies, and experimental programs. The importance of these research projects to the Academy, the faculty, the cadets, the Air Force, and to the defense of the nation cannot be understated. In an effort to be proactive in cooperating with recent concerns from the FAA about the growth and proliferation of UAS flights, the Air Force has implemented several new guidelines and requirements. Complying with these guidelines, directives, and regulations has been challenging to the researchers and research activities conducted at USAFA. Finding ways to incorporate these new guidelines effectively and efficiently is critical to research and participation in joint projects and exercises. This paper explores the nature of research at USAFA current restrictions imposed by the various regulations, the current process, short term solutions, and a long term vision for research into UAS at the Academy.

**Keywords** UAV · UAS · Unmanned aircraft · Research · Education · Air force · Flight · Airspace

## 1 Introduction

The United States Air Force Academy (USAFA) is actively engaged in several different areas of research involving Unmanned Aerial Systems (UAS), across many departments, supporting many different projects, agencies, and exercises. Several varieties of unmanned aircraft are flown at the academy, some of them commercially procured and modified for research, and some of them experimental one-of-a-kind

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aircraft. Recent changes to regulations; both FAA and military have necessitated a review of operating procedures of UAS flights at the Air Force Academy. This change has had, and will continue to have a major impact on research, education, development of these new technologies. The current process to approve these flights has arisen from the growing concern for the rapid growth in numbers and types of UAS and remote-controlled aircraft of various sizes airborne, and the safe flight of UAS by the US Military and other government agencies. These regulations, intended for larger scale operational flights, are being adapted for use with UAS, even micro controlled UAS systems used in several research projects.

In this paper we explore the nature of the research projects at USAFA, the goals, regulations affecting UAS operations, agencies involved. In addition, we examine both short term and long term solutions to these hurdles.

Lt Gen Regni, Superintendent of the USAF Academy recently highlighted the importance of UAS research at the Academy in an address to USAFA personnel [3]. The explosive growth in research, funding, scope and attention in recent years is expected to continue for the foreseeable future. Along with the research component of the Air Force Academy, one of the primary missions is producing future Air Force leaders that understand the nature of current technologies, uses, limitations, challenges, and possible avenues for growth and development.

## 2 Background

The United States Air Force Academy is an undergraduate engineering school designed to educate, train, and develop Cadets to become future leaders in the Air Force. Its primary focus is on developing cadets of character and leadership. There is no designated graduate research program at USAFA. However, one of the goals of USAFA is to encourage cadet and faculty research by developing and promoting leading-edge research into critical areas of interest to the US Air Force and the Department of Defense. Cadets are encouraged to explore many facets of UAS operations, including flight characteristics, cockpit design, human computer interaction, data transmissions, tactical use of UAS, persistent UAS, real-time video relay, automated visual and feature recognition, etc. A list of current projects is provided in attachment 1.

The Academy also supports and encourages faculty research and publication. Several researchers work with various other universities, agencies, and government departments on research and development into UAS and UAS related technologies. Part of this research helps to support many different organizations in the Department of Defense, Department of Homeland Security, intelligence agencies, Department of Immigration, and several other federal and state agencies.

### 2.1 Restricting Flight Operations at USAFA

In May, 2007 all UAV/UAS flights at the Academy were halted in response to guidance from the DoD and FAA requiring all UAS to have a Certificate of Authorization (COA) and to meet specific prescribed guidelines to fly in the national airspace system. On 24 Sep 2007, the Deputy Secretary of Defense signed a Memorandum of Agreement (MOA) with the FAA allowing the DoD to conduct

UAS flights without a COA provided that the flights abide by certain restrictions [1]. Current standard FAA regulations are two-tiered regarding UAS flights, one for civilian use and one for government use. Government use, which is broadly defined as public-owned aircraft operated in support of government operations, requires a Certificate of Authorization (COA) to fly in unrestricted airspace. This COA outlines airspace, altitude, and other operating restrictions and is generally granted per airframe as follows:

- Past experience has shown it takes approximately 6 months to receive a COA, but the FAA has agreed to a 60 day process for DoD requests (beginning 24 Sep 2007)
- The COA requires a detailed listing of aircraft performance, operational limitations and procedures, location of operations, and personnel authorized to operate the UAS under the COA.
  - The USAFA has submitted paperwork to the FAA for a blanket COA that would authorize all UAS flights within the AFA airspace. While this is under review Air Force Special Operations Command (AFSOC) is the lead agency in charge of UAS operations.
  - UAS operations with a valid COA require that the pilot and observer hold a valid class III medical certificate, and that the pilot holds a valid pilot certification issued by the FAA (Private Pilot's License, etc.)
- FAA/DoD Memorandum of Agreement, signed 24 Sep 2007 allows for flight of UAS over military reservations without a COA however,
  - Specific DoD guidance applies to all flights conducted over military reservations, and a COA is still required for flights outside of this airspace.
  - MOA delineates between micro UAS (smaller than 20 pounds) and other UASs
    - Micro UASs may operate within Class G airspace under 1,200 ft AGL over military bases provided the operations meet the following criteria:
      - UAS remains within clear visual range of the pilot, or a certified observer in ready contact with the pilot
      - UAS remains more than 5 miles from any civil use airport
      - DoD must publish a Notice to Airmen (NOTAM) no later than 24 h prior to the flight (blanket NOTAMs can be used if justified)
      - Pilots/Observers are qualified by the appropriate Military Department (AFSOC)
  - AFSOC has been designated lead command for developing small UAS guidance for qualification and operation for all USAF UAS.
    - Draft guidance released by AFSOC (AFSOC 11-2) is geared towards operational qualification of UAS pilots on Systems of Record intended for use in combat situations in close coordination with manned aircraft [2]. These requirements are being modified to meet the unique demands of USAFA researchers to meet due to time, manpower and money constraints

- AFRL has begun developing separate guidance for research and development UAS, however AFSOC is the designated lead and must approve any AFRL-developed guidance prior to implementation
- Current AFSOC guidance requires all UAS to obtain certification through a Special Operations Application Request (SOAR) process. Not originally designed for certifying micro UAS, this process is being adapted to accommodate experimental research UAS designed and used at USAFA.

## 2.2 AFSOC Guidance

AFSOC has published guidelines to follow for UAS operators seeking approval for National Airspace Operations. The published checklist states, “on September 24, 2007, FAA and DoD representatives signed a Memorandum of Agreement concerning the operation of DoD Unmanned Aircraft Systems (UAS) in the National Airspace System. Prior to approving such operations certain criteria must be met. The following checklist outlines the necessary requirements for the operation of DoD UAS in Class G Airspace ONLY. A “Yes” answer is required to the following statements in order to process your request.” (AFSOC checklist for UAS operations)

1. This is a DoD or DOD-contracted UAS certified by one of the military departments as airworthy to operate in accordance with applicable DoD and Military Department standards
2. The UAS pilots, operators and observers are trained, certified and medically qualified by the appropriate Military Department to fly in Class G airspace.
3. The Unmanned Aircraft (UA) weighs 20 pounds or less.
4. The UA operations will be contained in Class G airspace, below 1200’ AGL.
5. The Class G airspace is located over a military base, reservation or land protected by purchase, lease or other restrictions.
6. The UA will remain within clear visual range of the pilot, or certified observer in ready contact with the pilot, to ensure separation from other aircraft.
7. The UA operations will remain more than 5 miles from any civil use airport or heliport.
8. The applicant verifies that this operation has been thoroughly coordinated and approved with a government official within the unit and that the applicant has been appointed as the unit requesting authority.

## 2.3 Restrictions Imposed

The net results of these regulations and the military MOA is UAS research operations at the Academy must be revised to meet the new safety related guidelines. Currently applications for Special Operations Airworthiness Release (SOAR) approval on several UAS are under review. Guidance from AFSOC has been clarified to a certain extent, but hurdles remain.

### 2.3.1 Airworthiness Process

The SOAR process, as defined in the Airworthiness Circular dated 24 August 2007, spells out the criteria used to certify UAS as airworthy. The guidance for this process comes from several underlying regulations, including:

Air Force Policy Directive (AFPD) 62-6, *USAF Aircraft Airworthiness Certification*  
 Air Force Instruction 90-901, *Operational Risk Management*  
 Air Force Pamphlet 90-902, *Operational Risk Management (ORM) Guidelines and Tools*  
 Air Force Instruction 11-202V1, *Aircrew Training*  
 Air Force Instruction 11-202 V3, *General Flight Rules*  
 Airworthiness Certification Circular No. 4, *Certification Basis*  
 Airworthiness Certification Circular No. 5, *Risk Evaluation and Acceptance*  
 MIL-HDBK-514, *Operational Safety, Suitability, and Effectiveness (OSS&E) for the Aeronautical Enterprise*  
 MIL-HDBK-516, *Airworthiness Certification Criteria*  
 MIL-STD-882, *Standard Practice for System Safety*

- SOAR process through Aeronautical Systems Center (ASC) at Wright-Patterson AFB, certification:
  - The SOAR process is rapidly evolving to meet these new types of UAS, however the time line for some research projects may be too inflexible for such a review.
    - USAFA-led flight safety reviews, perhaps through the aeronautics department, might be faster, more flexible and still meet the spirit and intent of the FAA and AFSOC requirements
- Pilot Qualification
  - Rated Pilots, either military or FAA certified, may act as POC of flights.
  - USAFA may design student pilot designations as long as FAA ground school requirements have been met.
- UAS flights in other airspace
  - Ft Carson offers a restricted airspace that is available for use. This would preclude the need for COAs and SOAR process review. This is an interim solution as it is not feasible to schedule range time, commute 1.5 h each way to and from the range during the already too full academic day for cadets.
  - USAFA's own class D—initial consideration was given to extended the Academy's class D airspace to include the Cadet Area and proposed UAS flight airspace. From discussions with the FAA this may be very difficult to achieve, however it remains a topic of great interest.

### 3 The Way Ahead

It is essential to come up with a viable solution that meets the needs of the FAA and DoD to maintain safety requirements and to adhere to regulations, while at the same time allowing needed research and development to be conducted at USAFA. Possible solutions include:

- Academy Certification of micro UAS—certify an agency at USAFA, possibly the aerospace engineering department, as a certifier of safety of flight and COA for these micro UAS
- Class D airspace extension—as mentioned above, this is a possibility that would allow USAFA airfield managers to allow UAS flights with prior coordination. Modification of existing airspace designations is being pursued, but this process could take time, if approved at all.

#### 3.1 Short Term Solutions

Working within the framework of the current process, several short term steps can be taken to streamline the approval process for UAS research at USAFA:

- Streamline and expediting of the current approval process if possible
- USAFA local approval authority for flight readiness review process for cadet capstone projects.
- Verbal Approval/Waiver Authority, pending through review of applications

#### 3.2 Long Term Solutions

Many long term solutions have been proposed to ensure that this valuable research proceeds:

- Establishment of a USAFA UAS Research Center that would work closely with all agencies involved
- Establishment of a cadet UAS flight center that would allow all cadets the opportunity to experience UAS flight during their sophomore or junior years.

### 4 Summary

UAV/UAS research at the USAFA has becoming an increasing integral part of the cadet education. New, tighter restrictions and safety considerations have necessitated a review of operating procedures and temporarily halted certain research flights. Several people, agencies, and departments are working to solve the problems; high-level attention has been given to this issue; and the current process is being ironed out to facilitate research needs.

## Samples of UAS Research by USAFA Faculty and Cadets. Revised 5 Apr 2008

Subject	Department	Faculty Point of Contact
Fly Eye	DFB with U of Wyoming	Dr. Mike Wilcox
Atmospheric Research (Requested by USAF Weather Service)	DFP	Dr. Matthew Mcharg
Viper Aircraft ( <i>Versatile Integrated Platform for Experimental Research</i> )	DFAN	Lt Col Carl Hawkins
KC-135 Redesign—design, build and fly scale model	DFAN	Dr. Steve Brandt
Fighter Sized Target Study (design, build and fly scale model)	DFAN	Maj Jeremy Agte
SCARF (collect radio frequency data using software radios)	DFCS	Capt James Lotspeich
Situational Awareness Tool	DFCS	Dr. Steve Hadfield
Summer Space Program	DFCS	Capt James Lotspeich
Robust/Reliable UAV Platforms	DFAN/DFCS	Dr. Steve Brandt/ Capt James Lotspeich
Black Dart Exercise Support	DFCS and DFEM	Lt Col Bushey
Black Dart <i>Red Team</i> UAS Project	DFAN/Sys Engr	Lt Col James Greer
Improved UAV Batteries	DFC	Dr. John Wilkes
Multiple UAVs for Persistent ISR	DFEC	Dr. Daniel Pack
Intelligent Sensors for Persistent Tactical ISR	DFEC	Dr. Daniel Pack
Heterogeneous Active Sensor Network for Efficient Search and Detection of IED/EFP Associated Activities	DFEC	Dr. Daniel Pack
SECAF UAV Project Evaluate/Improve Predator Operator Control Stations	DFBL, DFCS, DFEC, Sys Engr	Lt Col David Bell
Micro Air Vehicles	DFEM	Dr. Dan Jensen

## References

1. DOD–FAA Memorandum, 20070924 OSD 14887-07—DoD–FAA MoA UAS Operations in the NAS, 24 Sep (2007)
2. Air Force Special Operations Command Interim Guidance 11-2, UAV Operations, 1 Oct (2007)
3. Lt Gen Regni: Speech to USAFA personnel, 7 Mar (2008)