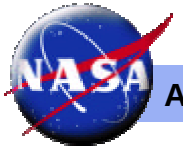
Interim Strategies for Flying UAVs in the U.S. National Airspace System

Proposed by Airborne Science in Cooperation with the Range System Safety Office of Dryden Flight Research Center



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Standard Form 298 (Rev. 8-98)
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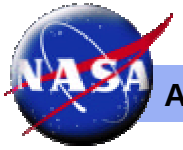
Agenda

- Overview of FAA oversight of UAV operations
- Current Range Safety for Flights in Restricted Airspace
- Proposed Method for Flights in National Airspace System

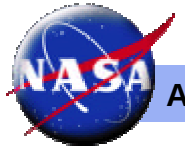


Current US Guidelines for flying UAVs in the NAS

- The FAA defines UAV (Uninhabited Air Vehicles) as aircraft in accordance with FAR (Federal Aviation Regulation) Part-1, Definitions and Abbreviations

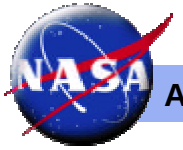
"Aircraft means a device that is used or intended to be used for flight in air"

Adapted from "Regulatory Short Course" presented at the Technical Analysis & Applications Center Symposium 2001 (October 2001) in Las Cruces, New Mexico



UAV FAR Regulations

- Federal Air Regulations (FARs) regulate civil aircraft
- No specific FARs exist for UAVS
- The routine use of civil UAVs hinges on the development of FARs for UAVs

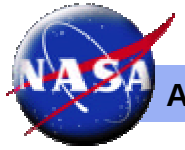


Non-Civilian Operation of UAVs in the NAS

- Guidelines contained in FAA Order 7610.4

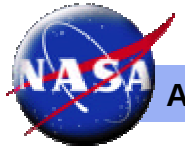
"Special Military Operations"

- Guidelines written for military operations
- Use of 7610.4 by other government organizations is permitted
  - Government organization is responsible for certification



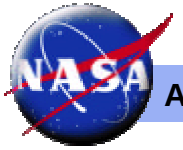
FAR 7610.4 Application

- Submit application to FAA regional office where UAV activity initiates 60 days prior to flight operations
  - Statement by the sponsoring organization that the "UAV is Airworthy"
  - Identify UAV operator organization
  - Physical characteristics of the UAV
  - Operational characteristics of the UAV



FAR 7610.4 Application (2)

- Coordination with ATC field facilities and other airspace users, if any.
- Method of communication between UAV operations team and ATC facilities
- UAV behavior in case of loss of control link with UAV.
- UAV control methodology
- Method to avoid other aircraft
- Detailed description of intended flight operation
- Classification of airspace for flight operations



Certificate of Authorization (COA)

Approval to Fly

- Statement by the sponsoring organization that the "UAV is Airworthy"
- Identify UAV operator organization
- Physical characteristics of the UAV
- Operational characteristics of the UAV
- Coordination with ATC field facilities and other airspace users, if any.
- Method of communication between UAV operations team and ATC facilities
- UAV behavior in case of loss of control link with UAV.
- UAV control methodology
- Method to avoid other aircraft

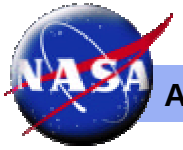
Operational Control

- Detailed description of intended flight operation
- Classification of airspace for flight operations
- Coordination with ATC and other airspace users
- Lost link control

Current Range Safety at DFRC

Airspace Management

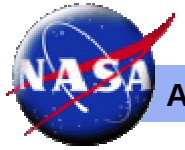
- Flights conducted in restricted airspace
  - All air traffic under positive control
- Reviews ensure aircraft is safe to fly
  - Flight Readiness Review
  - Airworthiness and Flight Safety Review Board
- Aircraft is tracked and monitored throughout flight to ensure predicted impact point never strays outside restricted area (where level of risk is understood and acceptable)



Current Range Safety at DFRC

Public Risk Management

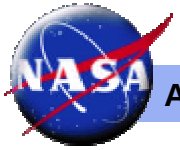
- Probability risk assessment done on aircraft based on performance and predicted breakup characteristics
- Proposed flight path is evaluated to ensure risk to ground does not exceed acceptable risk level
- Breakup prediction footprint (oval) is displayed real-time to ensure acceptable risk is never violated



DFRC Range Safety Strategy in NAS

Airspace Management

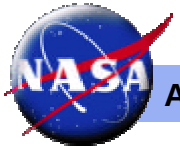
- Flights conducted in FAA positive control (Class A) airspace (typically at 45,000 feet or higher)
  - Take offs/landings occur in restricted airspace
- Aircraft must be approved as airworthy through the Dryden review processes
- Aircraft will be tracked by FAA Air Traffic Control and Dryden Range Safety throughout its flight



DFRC Range Safety in NAS

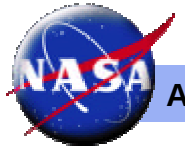
Public Risk Management

- Probability risk assessment done on aircraft based on demonstrated and predicted performance and predicted breakup characteristics
- Proposed flight path evaluated to ensure risk to ground never exceeds acceptable level of risk
  - Risk map identifies stay-out areas (restricted zones, stay out zones, high population areas), and iso-risk areas overlaid on an aeronautical/geographic chart
- Impact prediction footprint (oval) is displayed and monitored real-time to ensure acceptable level of risk is never exceeded

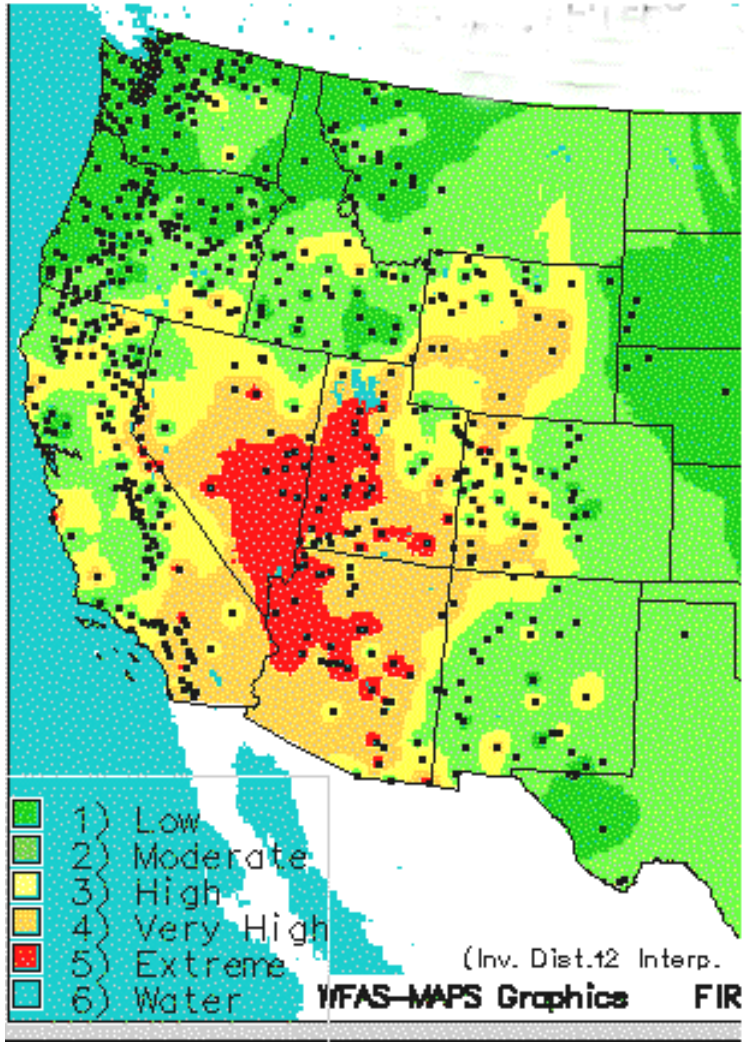


Controlling Risk

- Airworthy aircraft system
  - Design, analysis, testing and demonstration
  - Reliability
  - Robustness
- Safe operations
  - Identifying and understanding risks along flight path
    - Prevent flight over unacceptable risk areas
    - Planning flight paths within the acceptable risk levels
  - Monitoring flight to ensure compliance with risk requirements
    - ATC, Enhanced Air Traffic Management System, NASA or DoD radar

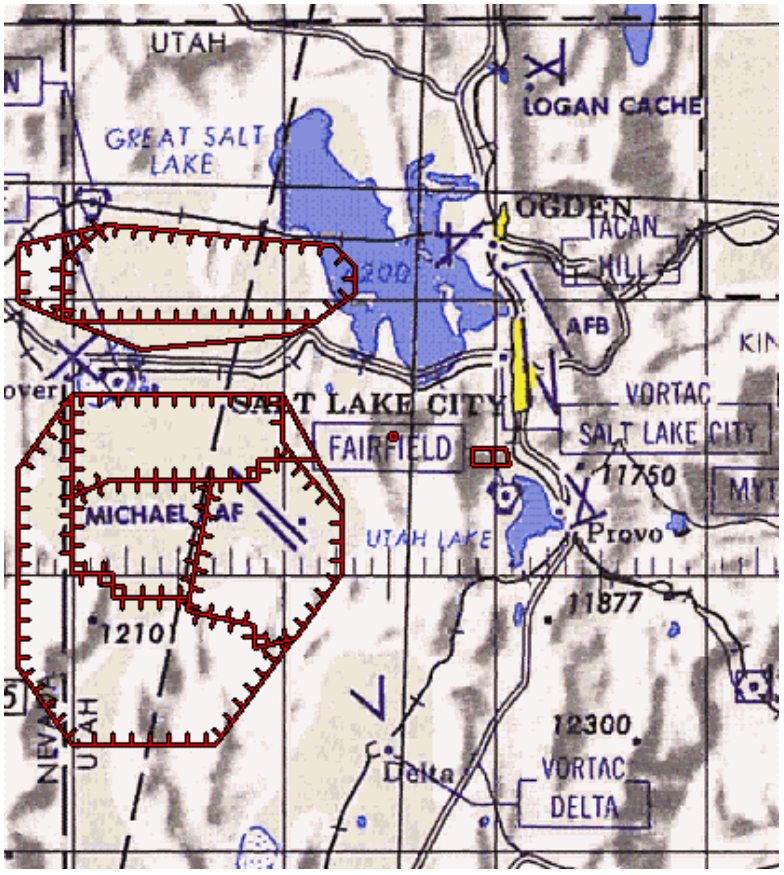


Case Study—Flight in Western US



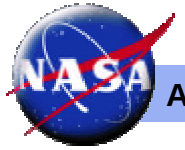
Identify risk areas

- Where don't we want to fly?
  - Over population centers
  - Areas determined to have unacceptably high population densities
  - Airports
  - Restricted airspace
  - Stay out zones
  - Uncontrolled airspace



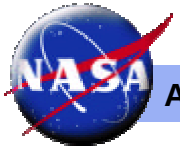
Tools for Risk Identification

- Aeronautical charts
  - Restricted zones, prohibited area, warning areas, stay out zones
- GIS line graph (USGS)
  - Elevation data, terrain features, roads, streams
- U.S. Census data
  - Population areas
- Night Lights database (NOAA)
  - Shows areas of high utility (offices, highways)



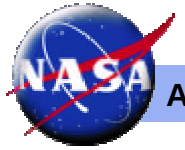
Risk map

- The population information, along with aeronautical information, are overlaid on geo-registered map
- Flight areas can then be identified on the map to locate zones where it safe to fly
- Flight paths are planned within these safe flight zones to ensure impact footprint always stays within the safe flight zones



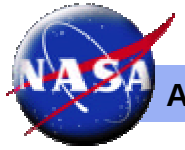
Geo-registered “Risk” Map

- This map is used to ensure ground safety
- The geo-registered map can be used to plan out the flight.
- This map can also be used to study contingencies that may occur during flight
- The map becomes a tool to also monitor the flight to ensure range safety is maintained.
- Emergencies and contingencies can be dealt with real time



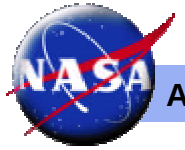
Procedures to Fly in NAS

- Determine desired operational area
- Obtain COA for operations in designated area
  - Include statement of airworthiness
- File flight plan for each flight in COA area
- Fly under Air Traffic Control with Range Safety monitoring flight path



Benefits

- Gain experience and knowledge of operations in the NAS
- Ensure safety is maintained by controlling risk
- Accelerate the development of UAVs by extending testing of their range and operational conditions
- Significantly increase UAV operational experience
- Permit UAV support of airborne science in the NAS
- UAVs enable operational efficiencies and longer duration flights at higher altitudes



Questions?