Next generation, arctic capable, sensor integration research for remotely piloted aircraft

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What is the Alaska Center for UAS Integration (ACUASI)?

• ACUASI is the University of Alaska’s Unmanned Aircraft System (UAS) research program

• Our missions include:
  – Assisting the FAA in the safe integration of UAS into the National Airspace System
  – Supporting Alaskan/Arctic UAS users
  – Conducting scientific research
Alaska Center for UAS Integration (ACUASI)
Who Are We?

We are a combination of:
• Veterans and former defense contractors
• Science and engineering faculty, staff, and students
• Pilots (all pilots are manned aircraft pilots)
• Airframe and Powerplant mechanic
• Retired FAA Air Traffic Control Flight Service Specialist
• Business developer
• Embedded contractors
ACUASI’s Military Experience

- Approximately 124 years of combined military service on the ACUASI team
- Over 24,750 combined hours flying and operating military aircraft, approximately 7,100 of those hours are in combat
- The ACUASI team includes crewmembers qualified on over 28 different manned and unmanned military aircraft
- ACUASI is a place that military skills are a direct transfer to civilian employment
The Arctic Challenge

Figure courtesy of George Backus, Sandia National Laboratories
Arctic Operational Need

The remoteness of the Arctic means that key missions need to be conducted using remote sensing techniques:

• Persistent surveillance for arctic domain awareness
• Remote infrastructure monitoring
• Data collection for meteorological models
• Mammal surveys
• Ship piloting
• Search and Rescue
• And many more
Ice mapping - Ship Piloting
Ice Seal Survey

Relaxed spotted and ribbon seals
(more accurate count potential than manned aircraft)

500 ft AGL

400 ft AGL
Arctic Operational Challenges

- Cold and dark
- Poor GPS
- Poor satellite coverage
- Limited bandwidth
- Icing of airframes and payloads
- Exposed pilots and observers
- Battery life is significantly degraded
- Gravel and icy runways
- Significant manned aircraft activity in surprising areas
Icing Challenges

- Larger military UAS have deicing capabilities
- Smaller systems do not have proven anti-icing capabilities
- Researchers are testing anti-icing coatings and active deicing systems for smaller systems
- Environmental awareness systems like the PEMDAS Atmospheric Sensing & Prediction System (ASAPS) provide icing potential
Testing at NASA Glenn Research Center Icing Research Tunnel
Arctic Operations

- Flights at Kuparkuk, AK in October 2018.
- These flights were part of NOAA’s support of ONR’s 2018 Stratified Ocean Dynamics of the Arctic mission to study the ocean ice during freeze-up.

SeaHunter flying over the North Slope of Alaska in October. Photo courtesy of Jordan W. Murdock and Robert J. Edison.
Transport Canada Operations

SeaHunter in Inuvik, Canada
Transport Canada Operations

- Development of CONOPs for operating in airport environments
- Road and land surveys
- Marine mammal surveys (e.g. Beluga Whales in Inuvik and North Atlantic Right Whales in Gaspé)
- Channel marker locations
- Automatic Identification System (AIS) ship identification
Current Operations

Transport Canada
@Transport_gc

The right of way goes to the #RightWhale! Our #drone is taking off in #Gaspé, #QC to monitor the #NARW population with @FishOceansCAN 🐳

12:00 PM - 30 Aug 2019
Transport Canada Operations

- 110,000 high-resolution images (Summer 2019)
- Artificial Intelligence for whale detection
Transport Canada Operations

- ACUASI has flown >14,000 NM BVLOS in the three years we have worked with Transport Canada
- Temperatures to -35 °C (-31 F)
- Altitudes up to 15,000’
Transport Canada Operations

- GPS has limitations at high latitudes and mountainous terrain
- Iridium satellite coverage that works well in some areas does not in others
- Establish radio line of sight lost link points for command and control of UAS until a lost satellite link can be reestablished
- Command and control links must be redundant and varied (do not assume cell phone/LTE coverage)
The Path Forward

- ACUASI is working with the FAA to obtain BVLOS permissions in Alaska
- Working in similar climates, out of similar airports, and with larger aircraft
  - Transport Canada work
  - DRS HP Sentry operations
  - Larger aircraft usually can carry larger payloads/cargo and fly longer distances
The Path Forward

• ACUASI is working with the FAA, NASA, and commercial entities to develop, test, and evaluate “Detect and Avoid” (DAA) technologies for use on UAS to allow BVLOS

• ACUASI and partners are developing payloads and on-board processing capabilities for exfiltration of data in remote regions
Detect and Avoid Intercomparisons

- UAF has conducted two DAA intercomparisons at the Poker Flat Research Range northeast of Fairbanks
- DAA systems - Iris Casia (onboard optical) and Echodyne Echoguard (ground-based radar)
- Intruders - manned helicopter and fixed-wing and small UAS (and bonus F15s)
Small UAS BVLOS

- First waiver of its kind granted
- Key provision is in ‘operational provisions’ number 8
Part 107 Waiver

Waiver Specific Special Provisions. sUAS operations beyond the visual line of sight (BVLOS) of the remote PIC and VO(s) may be conducted under this waiver when the operation complies with the following provisions:

OPERATIONAL PROVISIONS

8. Operations under this Waiver must utilize at least one VO. The VO may use unaided human vision or the Detect systems described in the application to identify non-participating aircraft;

9. If not using the Detect systems described in the waiver application, the remote PIC must ensure sufficient VO(s) are used to observe the airspace to detect and track all air traffic or hazards;
First BVLOS in the Nation under the Small UAS Rule - July 31, 2019

Alyeska, FAA, Iris, FAA, ACUASI, ACUASI, Echodyne, FAA, FAA, FAA

ACUASI, USAK, ACUASI, ACUASI, ACUASI, ACUASI, ACUASI, Skyfront

since 1917
DRS Sentry HP UAS
Former Naval Postgraduate School Aircraft will support Navy Research Laboratory Arctic mission next year
Future

HAPS
High Altitude Platform Station
Arctic UAS Recommendations

• DOD, DHS, and other agencies should take advantage of the rapid commercial UAS development and associated testing

• Use ACUASI’s work for Transport Canada and NOAA, DOE’s work at Oliktok Point, etc. to develop Arctic CONOPS

• Fly routinely under Arctic conditions - The Russians do!
Recommendations (cont.)

• DOD and DHS must harden their systems and develop CONOPS for securing the U.S. Arctic
  – Leverage civilian activities
  – Test in the Arctic, not in warmer climes

• DOD and DHS must routinely fly updated UAS systems in the Arctic, outside of restricted airspace, BVLOS, under real-world conditions, from icy and gravel runways, and under airspace jamming scenarios like Red Flag in Alaska
Questions?