Airborne Gravity on the Centaur Optionally Piloted Aircraft

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Background

- NGS Mission Statement
  - To define, maintain, and provide access to the National Spatial Reference System (NSRS) to meet our nation’s economic, social, and environmental needs.
  - NSRS is a consistent coordinate system that is the foundation for all geospatial information.
Background

• The GRAV-D (Gravity for the Redefinition of the American Vertical Datum) project is collecting airborne gravity data to support a new vertical datum (reference surface for heights)

• Accurate heights are critical to many applications
  - Ex. transportation and infrastructure development, floodplain mapping, coastal resilience, precision agriculture

• Supports NOAA goals:
  - Coastal resilience
  - Safe and efficient marine transportation

• Supports NOS goals:
  - Safe and efficient transportation and commerce
  - Preparedness and risk reduction
Background

- **Overall Target**: 2 cm accurate orthometric heights from GPS and a geoid model

- **GRAV-D Goal**: Create gravimetric geoid accurate to 1 cm where possible using airborne gravity data

- **GRAV-D**: Two thrusts of the project
  - Airborne gravity survey of entire country and its holdings
  - Long-term monitoring of geoid change
Background

Entire U.S. and territories

- Total Square Kilometers: 15.6 million
- 2022 deadline to complete this area
Project Challenges

• Operational
  – Long, boring flights
  – Large area to cover with some long distances (Aleutians, Pacific Islands)
  – Aircraft stability critical for good data

• Management
  – Efficiently covering the entire country in terms of cost and time

• No known research or operation with gravity on a UAS
SBIR – Phase I

- Small Business Innovation Research (SBIR) Grant
  - Goal to collect airborne gravity data from a UAS
  - Request for proposals and award in 2013
  - Aurora Flight Sciences was selected to with support from Micro-g Lacoste
  - Phase I was a feasibility study
SBIR – Phase I

• Centaur OPA
  – Optionally Piloted Aircraft with three modes (manned, unmanned, and safety pilot)
  – 44 ft wingspan x 28 ft length
  – Ceiling of 27,500 ft
  – 24 hour flight endurance with 200 lb payload
  – Top speed of 175 KTAS, 135-160 typical
SBIR – Phase II

• Phase II involved performing field tests of the instrument/aircraft suite
• Conducted in April 2016 in Manassas, Virginia
  – 5 flights over existing data for comparison
  – Combination of East/West and North/South flights
  – Operated with a safety pilot
SBIR – Phase III

• Phase III is transitioning the technology to operations funded by the project
• A contract is in place to use this technology for operational surveying for the GRAV-D project
  – The first full survey will start March 13th and be the final test
  – Surveying from Winston-Salem, NC over western NC/eastern TN
SBIR – Commercialization

• Benefits to the public
  – Improving airborne gravity surveying through higher quality data, potential cost savings, and lower environmental impact and pilot fatigue
  – Industry uses in Transportation and Oil/Mineral/Gas Exploration

• Example of commercial use
  – Used for a commercial survey for the California Department of Transportation
Collaborators

• SBIR
  – Aurora Flight Sciences
  – Micro-g Lacoste

• NOAA
  – OAR/UASPO
  – OAR/TPO
  – NOS/NGS
Collaboration with UASPO

• Support from UASPO includes
  – Guidance through SBIR process
  – Identifying funding for SBIR Phases I & II
  – Knowledge of UAS capabilities and opportunities
  – Development of transition plan
Scientific/Technical Challenges

• Automation
  – Gravimeter needs to be automated for recording data
  – At a minimum proving to connect and operate from a ground station

• Aircraft range
  – Researching options for longer range aircraft
Future Directions

• Operational Surveys
  – Evaluate first full survey test
  – Incorporate into regular surveying based on results

• Long Range UAS
  – Identify potential opportunities to integrate and test on a longer rather UAS