UAV Magnetometry for Mineral Exploration

Case Study: Île Calumet, QC

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Devbrio UAV magnetometer

- Developed by Devbrio Géophysique/Vision 4K
- Multirotor setup, DJI M600, weight of 9.1 kg
- Weight (load) 3 kg including batteries
- Scintrex CS-VL magnetometer
- Frequency 10 Hz / 1 m resolution at 10 m/s
- Sensor at 5 m below drone
- Sensor height: >15 m AGL / 10 m above obstacles
- GSM-19 magnetometer base station
- Reach RTK DGPS base station

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Onboard Collision Avoidance System

- Maximizes smooth flight path in the presence of obstacles
- Maintains a spatial resolution of 1 m and remains low to the ground
- Flies at constant altitude above ground, trees or other obstacles

\[ \vec{v} = 10 \text{ m/s} \]

Follows drape

Obstacle detected at 45 m

Begins ascent at 20 m

Maintains a safe distance from obstacles while following drape

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Calibration and QC

Test site: Luskville, Quebec

- Flat terrain with trees
- Near headquarters
- Easy Access
- Line of sight
- Flown frequently during project development
- Planned test flights: when major adjustments are made to the UAV and following routine maintenance checks

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Red marks the boundary of the property, blue marks test flight lines
Case Study
September 19, 2017

Île Calumet, QC
Green Palladium Project
Sphinx Resources

Data collected using the Devbrio UAV is compared with ground data acquired using a portable magnetometer and airborne magnetic data.
Case Study – Île Calumet, QC

Survey Block:
- 1 km² Area
- Gently sloping hills
- Intermittent fields and tree cover (tree tops at 20m AGL)
- 20.7 line km’s flown

Polygon geofence:
- Survey area defines a polygon geofence that is loaded into the computer
- Ensures drone remains within boundaries of survey block
- Maximizes survey area
- Allows for customizable grid to avoid roads and buildings

Mission Lines
Tie-Lines
Flown
Polygon geofence marks the boundary of the survey area
Case Study – Île Calumet, QC

- Repeatability – lines flown twice, in opposite directions (southern section of survey block shown here)
- Data not affected by winds up to 6 m/s East (see flight data comparison on the right)

Magnetic data collected on **Westbound** Flight Lines

Magnetic data collected on **Eastbound** Flight Lines

**Flight data comparison – Line L400300 – East vs. West**

Wind 6 m/s E

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Operational Setup

Data QC and Processing are done on-site using in-house software and Geosoft. Left to right: Charles Mercier, Marc Boivin, Jennifer Blanchard
Mission Planning – Collision Avoidance

Mission planning of L401000

- Mission
- Trees
- Ground

Altitude ASL (m)

Distance on line (m)
Mission Planning – Collision Avoidance

Flight path and lasers detections on L401000

- Flight
- Mission
- Trees
- Ground
- Lasers detections
Case Study – Île Calumet, QC

Flight Specs
- Flight lines: east-west
- Line spacing: 25 m
- Total: 20.7 line km
- Duration: 1/2 day
- Terrain clearance (avg.): 29.6 m
- Flight speed (avg.): 9.8 m/s
- Sampling resolution: 1 m
UAV vs Ground survey

Devbrio Géophysique UAV magnetometer

Abitibi Géophysique Ground Survey

Total: 20.7 line km’s flown, Survey Duration: 1/2 day

Total: 19.5 line km’s total (5.2 km shown)
UAV vs Ground survey

UAV magnetic survey - comparative results
drone survey vs ground survey

Technical Specifications
Drone: DJI M600
Surveyed by: Devbrio Géophysique
Survey date: September 19, 2017
Magnetometer: Scintrex CS-VL
Flight lines: east-west
Terrain Clearance: 29.6 m AGL (avg.)

Ground: Walking MAG
Surveyed by: Abitibi Géophysique
Survey date: May 2015
Magnetometer: GEM GSM-19
Survey lines: east-west
Terrain clearance: 1.8 m AGL

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UAV vs Ground survey

UAV Magnetometer vs Ground Survey (1st Vertical Derivative)

Technical Specifications
- Drone: DJI M600
- Surveyed by: Devbrio Géophysique
- Survey date: September 19, 2017
- Magnetometer: Scintrex CS-VL
- Flight lines: east-west
- Terrain Clearance: 29.6 m AGL (avg.)

Ground: Walking MAG
- Surveyed by: Abitibi Géophysique
- Survey date: May 2015
- Magnetometer: GEM GSM-19
- Survey lines: east-west
- Terrain clearance: 1.8 m AGL

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UAV vs Airborne survey

Devbrio UAV magnetometer

- Total Magnetic Intensity Map
- Surveyed by Devbrio Géophysique UAV Magnetometer
- Isle Calumet, Quebec, Canada
- September 19, 2017
- Line spacing 25 m
- Terrain Clearance 29.6 m AGL (avg)

CGG Airborne Survey

- Total Magnetic Intensity Map
- Surveyed by CGG Canada Airborne HELITEM System
- Isle Calumet, Quebec, Canada
- June, 2016
- Line spacing 100 m
- Terrain Clearance 49 m AGL (avg)

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UAV vs Airborne survey

UAV magnetic survey - comparative results
Drone survey vs Helicopter survey

- Residual MAG - HELITEM
- Residual MAG - drone

Technical Specifications

Drone: DJI M600
Surveyed by: Devbrio Géophysique
Survey date: September 19, 2017
Magnetometer: Scintrex CS-VL
Flight lines: east-west
Terrain Clearance: 49 m AGL (avg.)
Followed CGG Helicopter path

Helicopter: CGG HELITEM system
Surveyed by: CGG Canada Services
Survey date: June 2016
Magnetometer: Scintrex CS-2
Survey lines: east-west
Terrain clearance: 49 m AGL (avg.)

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Summary

UAV magnetometers:

➢ can follow drape at low altitudes (10–30 m AGL)
➢ can collect high-resolution data (1m) at high speeds (>10 m/s)
➢ can fly in winds up to 6 m/s or higher, both directions along survey lines
➢ benefit from an onboard collision avoidance system
➢ have the potential to replace ground-based systems, with increased efficiency, lower cost, and no loss of data quality
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