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Unbound: Remotely Piloted Aircraft Systems (Drones) and Geophysics

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Summary

Advances in batteries and electronics have created a revolution in Remotely Piloted Aircraft Systems (RPAS, also known as drones). This revolution has not left the world of geoscience untouched. Many classic long standing geophysical methods have been adapted to be utilized with RPAS.

I hope to outline the current capabilities as well as look at a specific project: an investigation of a historical dump site with a magnetometer attached to a RPAS.

Workflow

The geophysical methods that have been adapted to use RPAS are:

- Magnetics
- VLF
- GPR
- FDEM
- Gamma Ray spectrometry

In addition to these geophysical payloads, photogrammetry tools can be used to generate georeferenced aerial photography as well as digital terrain models.

While using a RPAS for geophysics does have disadvantages to traditional ground surveys, the advantages are quite strong. The most striking is the rate of travel which can be as high as 10 m/s. This allows you to cover a greater area in a shorter amount of time. In addition, RPAS allow you to access areas that couldn't be traversed by foot such as thick brush, open water, or steep terrain. Surveys completed with RPAS will also leave less of a mark on the land being surveyed.

The disadvantages do need to be considered and weighed against the benefits. There is the extra initial cost of the RPAS combined with the increased risk of damage to the RPAS or the geophysical tool can be prohibitive. Depending on the RPAS platform and the geophysical tool, the flight times can be too short to limit the speed advantage. Before flying a RPAS, the operator will requires specialized training and all operations take place under a regulatory framework that can be restricting.

Finally, depending on the method, flying on a platform many metres off the ground will negatively impact the geophysical data by increasing noise and decreasing sensitivity. The FDEM method is particularly sensitive and needs to be flown within 2-4 metres above the surface to be effective which greatly limits access.

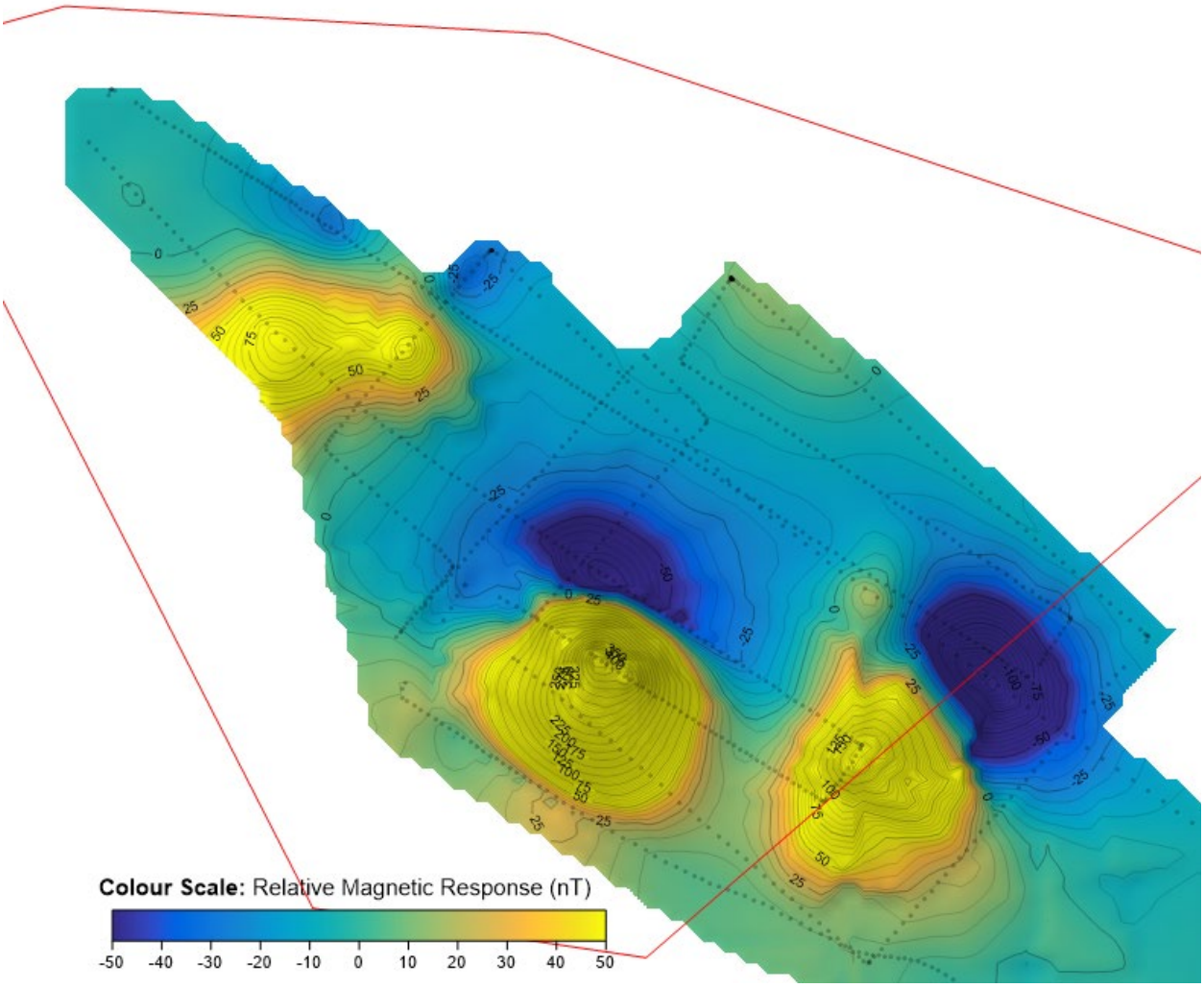
The photo below shows a RPAS with a magnetometer attached taking off.

By combining the geophysical data with photogrammetry, you can improve the quality of the geophysical interpretation. Anomalies in the geophysical data that can be attributed to surface features will be quickly identified without diverting much attention. Photogrammetry tools can easily be added to an existing geophysical survey using a RPAS.

Results, Observations, Conclusions

We conducted a magnetometer survey at an old construction site. The goal of the project was to identify areas where waste may have been buried. The area was large and quite thickly forested. We proposed using a magnetometer attached to RPAS.

We collected magnetometer data at 10hz and flew at about 5 m/s. Our lines were approximately 20 metres apart. The figure shows the strong magnetic response at one of the areas of the site that is a strong candidate for further investigation. Photogrammetry collected at the site confirms no surface features that explain the magnetic anomalies. This survey was a success and would have been much more expensive if we only used a ground survey.


Colour Scale: Relative Magnetic Response (nT)
-50 -40 -30 -20 -10 0 10 20 30 40 50