Drones as a support tool for seismic acquisition

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INTRODUCTION

In last decade aerial drones (UAVs) have gone from just being expensive toys to useful machines for a variety of commercial sectors. This includes, photography, real estate, agriculture and the mining industry. Geophysics has not been blind to these developments.

In fact, the advantages of using UAVs were outlined by Macnae (1995). He suggested that UAVs would provide the potential to acquire airborne magnetics surveys at higher densities with reduced costs and greater safety. This has been demonstrated in the potential-field side of the geophysics industry (e.g. Stoll, 2011) to various extents since the late 90s.

For the seismic industry the applications of UAVs have only recently been recognised. While some groups are looking at using the technology by directly integrating it into seismic systems (e.g. Stewart et al., 2016) there are also many options for using UAVs in a supporting role for seismic surveys.

Some of these include:
- Site photography and planning (e.g. Changqing et al., 2018)
- Use of images and video footage to indicate hazards or direction to acquisition crews
- Node deployment
- QC of seismic deployment
- Equipment scouting and recovery
- Delivery of object to a remote position

The aim of this investigation was to examine the feasibility of some of these.

The drone used for this testing was a DJI Mavic Air (Figure 1). DJI are world leaders in the drone industry and have a great emphasis on safety. The Mavic Air is a foldable drone that is about the same size as a large smartphone when it is folded. It has a stated flight time of 21 minutes and can fly about 4000 m, although in reality, the actual flight time is more like 17 minutes for the type of flights used in this testing. The Mavic Air is a relatively cheap drone at $1100 and is packed with features including all round obstacle avoidance. It is easy to fly and could be classed as a beginner drone.

Figure 1. DJI Mavic Air with protective case.

SAFETY AND REGULATIONS

In Australia, the greatest limiting factors to the use of UAVs are associated with regulatory restrictions. Initially it was unclear as to the extent that standard aviation regulations applied to the commercial use of small drones. However, in recent times specific rulings and procedures have been implemented to make it clearer how these can legally be used. While these are quite restrictive, they do allow more opportunities.

The following standard operating conditions apply to small drones like the one used in this trial (Civil Aviation Safety Authority, 2018):
- Used during daylight
- Must remain within visual line-of-sight. This means being able to see the aircraft with your own eyes rather than through a device.
- Flight must not exceed 120 m (400 ft) above the ground.
- Must be greater than 30 m from another person, and not fly over anybody.
- Drone must not be flown over or near an area affecting public safety or where emergency operations are underway (without prior approval). This could include situations such as a car crash, police operations, a fire and associated firefighting efforts, and search and rescue.
- Operator may only fly one drone at a time.

Key words: UAV, seismic acquisition, drone, quad-copter
If the drone weighs more than 100 g, it cannot fly within 5.5 km of a controlled aerodrome.

It is illegal to fly for money or economic reward unless the operator has completed a drone operator’s certificate, or you are flying an excluded drone in the sub-2 kg or private landholder category.

Do not operate in a way that creates a hazard.

Notification of flight paths with CASA is required for commercial activities.

Velseis had two experienced and licensed operators on staff who ran this trial. It was also decided that some extra controls should be implemented to ensure safety to persons, livestock and company reputations:

- Fly at 30m to avoid trees, powerlines and spooking cattle
- No flying near landholders dwellings
- Maximum of 100 nodes checked per flight when scouting.
- Prior to all operations aerospace restrictions were examined using the CASA online tools (https://casa.dronecomplier.com).

FIELD PROCEDURES

For this trial the UAV was mostly used to QC the deployment of Nodal seismic equipment and assist with the retrieval of the same equipment.

Node Deployment QC

The initial idea was to fly missions over a chosen property then head back to the site office for video analysis.

The first step was to pre-build flight paths using a combination of node deployment files, Google Earth, in-house software and a third party DJI support application.

Deployment-file node information was imported into Google Earth, then using Google Earth’s polygon tool, flight paths areas were created (Figure 2). With the aid of in-house software and a third-party application the flight paths were quickly generated. These consisted of one waypoint for each node location.

Once the flight paths were created it was just a matter of heading to the property and flying the pre-planned missions. Careful consideration was given to finding elevated positions to pilot from, ensuring best possible line of sight. The red crosses on Figure 2 indicate the two positions used for the four missions (blue polygons) shown.

After returning back to the Site Office the drone videos and flight logs were used to extract frames corresponding to the time the drone was over each known node position. Figure 4 compares the typical white square of a node in the correct position/upright with those knocked out of the ground by cattle.

Any nodes out of the ground were recorded to file for spread checkers.

A process was also trialled where one person flew the missions, one person analysed the video and a third person fixed any node issues, with all three in the field together thus dealing with any out-of-ground nodes sooner. The process, while a bit more complicated, showed some promise although to cover large areas it would require setting up a vehicle in order to recharge computers, batteries and remote controllers.

For the area indicated in Figure 2 an increase in productivity of a factor of three was seen after the introduction of the drone to the operation. What previously took about six hours by driving every line was reduced to a little over two hours with drone support.

Lost Node Recovery

Another handy use of the drone was to search for hard to find nodes. On more than one occasion the evidence had suggested that some type of wild animal had pulled the node out and walk away with it. In one particular case, a node was over 50m away from its original position in a rough blade-plough area. After a couple of failed attempts to find it on foot, consisting of about six man-hours, the drone managed to film it while flying a search pattern around its last known location. This took less than half an hour.
DISCUSSION AND CONCLUSIONS

The use of drones to support seismic acquisition showed a number of benefits these included:

- Reduced line crew exposure to all usual hazards
- Reduced footprint on properties
- Reduced fuel, vehicle wear and tear etc.
- Increased efficiency of spread checkers, more so in the case of blade plough or creek riddled properties.
- Assistance to Project Managers with decision making
- Reduced noise on spread

However, there were some limitation that restricted their use especially within the guidelines of the current regulations. These were mostly related to line-of-sight, that is hills and vegetation restricting the ability of the operator to see the drone.

It was also expected that land holders may be hesitant to allow the use of drones. However, in most cases it was found that they were quite supportive of the idea.

This trial has demonstrated that while drones may not be able to be used on all occasions, their advantages suggest that they should be available for use when required.

REFERENCES

Civil Aviation Safety Authority, 2018, Sub 2kg commercial: Australian Government


Figure 4. A sample of images from drone node QC. The images on the left show the square shape of a node that is correctly planted in the ground. The images on the right show the blue-white casing of nodes that have been kicked out of the ground by cattle.