Application of Remotely Piloted Aircraft (Drone) Derived Elevation Data in Floodplain Modelling

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Introduction
Remote Piloted Aircraft Systems (Drones) have recently become common place in both recreational and commercial activities. Systems that are capable of producing elevation data using photogrammetry are relatively cheap (~$1000 DJI Phantom 4) and subscription based processing services produce GIS ready raster datasets for ~$300 per month (DroneDeploy). These systems typically use an automated flying system so the technical requirements for the pilot are relatively low, although it is important abide by CASA operating rules.

HydroSpatial has been operating a drone for approximately one year and have applied it to a range of purposes, including; developing elevation data for use in 2D flood models, inspecting difficult to reach infrastructure for model schematization, asset management and volumetric calculations.

CASA Operating Rules
CASA has two sets of rules for operating a drone commercially. The standard rules involve obtaining a license for the pilot (RePL) and a flying certificate for the organization (ReOC), additionally, public liability insurance is required. The cost of certification and insurance is typically around $8,000. This process is potentially too onerous for flood modelling applications and best left to professional drone operators.

However, if the drone weighs less than 2 kg it can be flown without certification under “standard operating conditions” (although some paper work is required). These operating conditions are largely common sense and are generally associated with the reducing the risk to other people and other aircraft.

Key Findings
Some of the uses we have found for the Drone are shown graphically in Figure 1. From our experience operating the drone and collecting key data, we have a number of key findings regarding the technology.

1. Using a drone allows you to collect high resolution (1 – 2 cm) data over an area of interest. This is useful for measuring distances such as pit sizes, lengths of weirs etc.
2. The drone can reach areas of the floodplain that you cannot reach on foot e.g. crossing watercourses.
3. The drone data capture can provide a new perspective on key hydraulic features
4. The drone can capture data that can be used to create a high resolution DEM.
Digital Elevation Data

Most camera drones are capable of capturing data that can be used to create a DEM using photogrammetric processing. Where available we have compared the drone derived DEM to LiDAR and have found that the degree of accuracy is highly variable – in some cases there is significant error, while in other cases it is fairly accurate. An example long section comparison between LiDAR and Drone derived data is shown in Figure 2.

Overall the Drone derived elevation data is most useful for features that are smaller than LiDAR sampling distance and applied heuristically rather than directly using the data (e.g. the height of kerb and guttering or the height of lintels). Otherwise, given the much lower relative error, the Drone derived DEM can be used for accurate volumetric calculations.

If the DEM is applied directly to a model, the modeler needs to be aware that the drone captures the highest surface in the area of interest, rather than the ground. Therefore trees and other artifacts need to be “stripped” from the DEM.

Key Limitations

The key limitations to relying on a Drone for data capture are:

1. The size of the study area needs to be relatively small, this limitation is primarily due to battery life (typically around 10 Ha per battery) and legally the drone must remain within sight at all times.
2. The area of use is also limited; there are restrictions around airports and residential areas.
3. Operating a drone often elicits a response from onlookers. This is not always a positive response and regardless can be distracting while operating the drone.

Conclusions

Drones are becoming more ubiquitous in modern society and present an opportunity for floodplain modellers and managers to acquire additional data for input into their models. The technology isn’t likely to replace LiDAR or ground survey for the primary means of acquiring elevation data, however there are valuable forms data that can be easily captured by a drone that may be otherwise difficult to obtain.

Drone technology provides valuable insight for field inspections, collecting flood data and under the right circumstances provides an opportunity to augment traditional survey methods for model bathymetries.
Figure 1. Example Drone Applications

Figure 2. Example long section of Drone Data vs. LiDAR