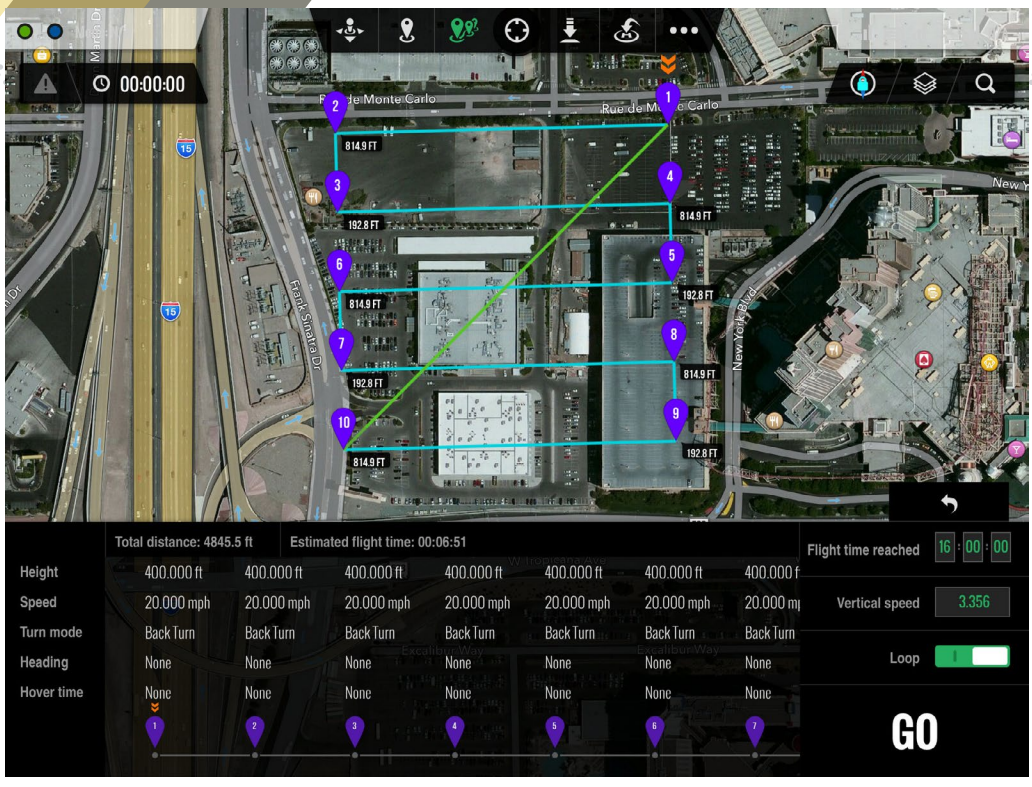


Screenshot from within the DJI ground station app for Ipad.

How Can I Use a Drone, and What Products Can I Create With It?

An Entry Level Perspective for Scanning Companies

BY THAD WESTER

How can I use a drone, and what can I produce with it? Those are the questions that I intended to answer when I bought a drone six months ago. The answers aren't completely known yet, but what I have collected with my drone has made me optimistic about their future as a surveying tool. This article will discuss the costs of using my drone and the basic deliverables that can be created.

At the 30,000 foot view of the drone market in the United States there are a lot of questions that need to be answered; Are they reliable? What do they cost? Are they illegal? What software works? How accurate can they be? The uncertainty surrounding drone use is an opportunity for scanning companies today to add services in a market with few, if any competitors.

Equipment list

I decided to purchase a Phantom 2 quadcopter. It can carry a GoPro camera for 20 minutes and fly at 25 mph. Below is a breakdown of my equipment and the associated costs:

DJI phantom 2	$700
Camera Gimbal	$400
GoPro Camera	$400
DJI ground station (optional)	$200
Spare Battery	$150
First Person Video (optional and not included on my setup)	$600
Total Cost	**~$2,000**

The Phantom 2 is the actual quadcopter. It does the heavy lifting and includes all the motors and "brains" that keep it in the air. The Phantom 2 comes with a

Images from the GoPro onboard our Phantom 2. Panorama stitched in Photoshop.

GPS accurate to within +/-1ft. The GPS keeps the drone in the same place, even when it's windy (making it easier to fly). The camera gimbal keeps the GoPro camera level at all times and reduces vibration. The gimbal makes the drone seem very stable (from the cameras' perspective), when in fact it needs to make a lot of quick adjustments to stay in the air. The gimbal also allows you to shoot orthogonal to the ground as well as at a right angle to the ground.

The GoPro is a lightweight camera that takes reasonably high quality images and video. The DJI ground station provides autonomous flight, by leveraging the GPS onboard the Phantom. With the app you can create a grid flight pattern, set altitude and speed and it will fly and land the route autonomously. I chose not to include first person video on my drone. First person view/video (FPV) allows you to see what the camera is seeing while in flight. It is very useful for lining up photographs of building facades or other similar vertical objects to be later used for photogrammetry, but not as helpful for deliverables like orthophotos of the ground and digital terrain models (DTM's). You have to keep in mind that the more weight you add to your drone the less flight time you have, so it is important to choose features wisely.

What can I collect/create with a drone?

Simply put, you can collect photos with this drone. Sorry, no LiDAR at this price point :). Velodyne's new puck LiDAR is probably light enough, but lifting an $8,000 unit 300 feet in the air would be nerve racking to say the least and from experience, it's scary enough with a $400 GoPro. But photos can do a lot more than you think. Here are a few use cases.

1. Marketing. Think about your clients here too. What a great extra to provide to an architect, or design team. Don't overlook the value of aerial photos.
2. Orthophotography for GIS and Design. Fresh ortho imagery is valuable; valuable to developers, GIS departments, architects providing site plans and many more. The methodology for creating orthos with this drone is not complicated. Setup a grid pattern using the DJI ground station app on the IPad. Take off and aim the GoPro straight down and set it to take images in intervals of one second. Once landed, take the images and flatten them in PT lens (the lens on the GoPro adds a "fish eye" effect which needs to be corrected), then stitch the photographs together as a mosaic (PTGUI works well), or stitch them together as a true orthoimage in photogrammetry capable software (Photoscan and Pix4D are both well reviewed).

This brings up an important point regarding creating orthoimagery from a drone, which is the difference between a mosaic and a true orthoimage. A mosaic is simply stitching the aerial photographs together, whereas a true orthoimage, like you view in google earth or for GIS mapping, shows each pixel as if you are taking the photo

True orthoimage created with a drone.

from directly above it. An easy way to tell between a mosaic and an orthoimage is that ortho images won't include sides of buildings whereas mosaics will. You will need to use photogrammetry software to make an orthoimage.

3. Point Clouds. Yeah that's right, you can create a point cloud with a camera and a drone. While the quality isn't as good as lidar, it is better than you would probably expect. One advantage over lidar is that because you're creating the point cloud from a color photo—you get perfect color mapping to the point cloud.

The quality of the point cloud is basically determined by two things: 1) the distance between the camera and the object/ground 2) the quality of your camera. For our drone, we are stuck with a GoPro which has an average quality sensor. We can, however, influence the distance between the surface of the ground or object easily with a drone. The trade off with distance is that the closer you are the more photographs you will need to cover the same amount of area and the more data you must deal with. To give you a sense of the quality of the point cloud, photos taken from 250 feet altitude produce a point cloud with around 6 inches to 12 inches of "noise" and inaccuracy in the vertical. Photos taken from 100 feet cut the noise to less than 6 inches. This is mainly qualitative analysis so please take it with a grain of salt.

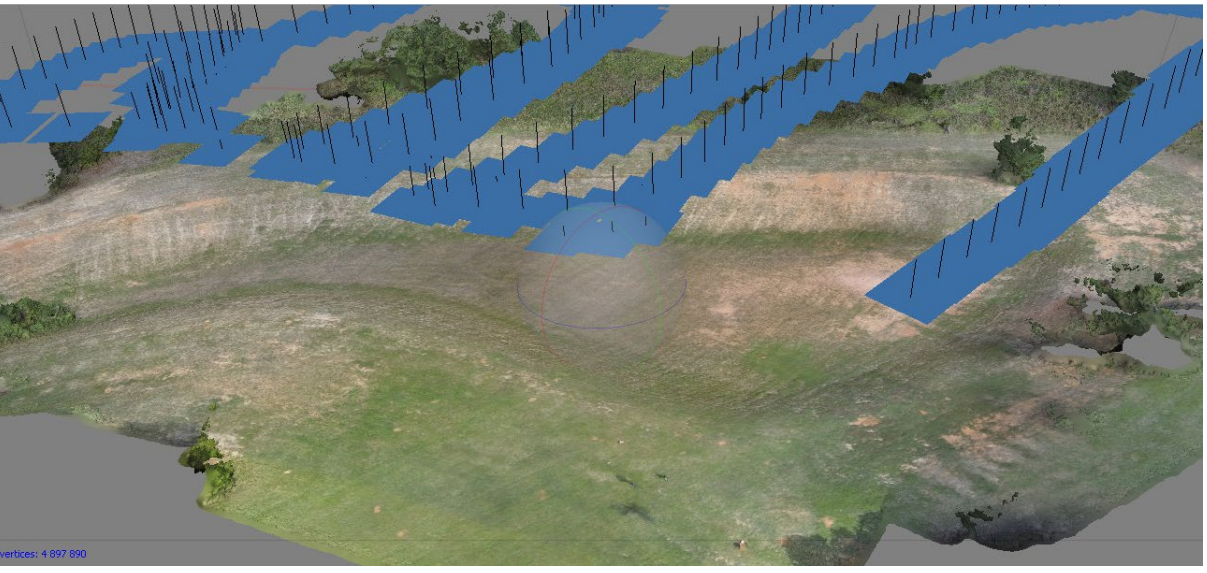
There are two uses for drone point clouds that I see being of value (I'm sure there are more). The first is calculating volumes. The main advantage is speed. The Phantom 2 can cover four linear miles on a single charge. At 250 feet altitude your photos cover about 300 feet. With a few batteries you can cover a lot of ground, much more than a survey crew with a GPS rover.

The second use is for filling voids in static lidar data. One example is rooftops. As an experiment we flew over a building that was previously scanned with the exception of the roof top. The data was collected in less than 2 minutes, processed and registered with previously acquired terrestrial laser scan data to provide rooftop coverage. That is a niche example, but we all know there are many scenarios where project budgets or site logistics keep you from scanning areas that are valuable, and drones may help fill in those areas at a reduced cost.

Issues facing first time users

There many issues facing first time users trying to extract survey data from a drone. Two main obstacles are piloting skills and processing the collected data.

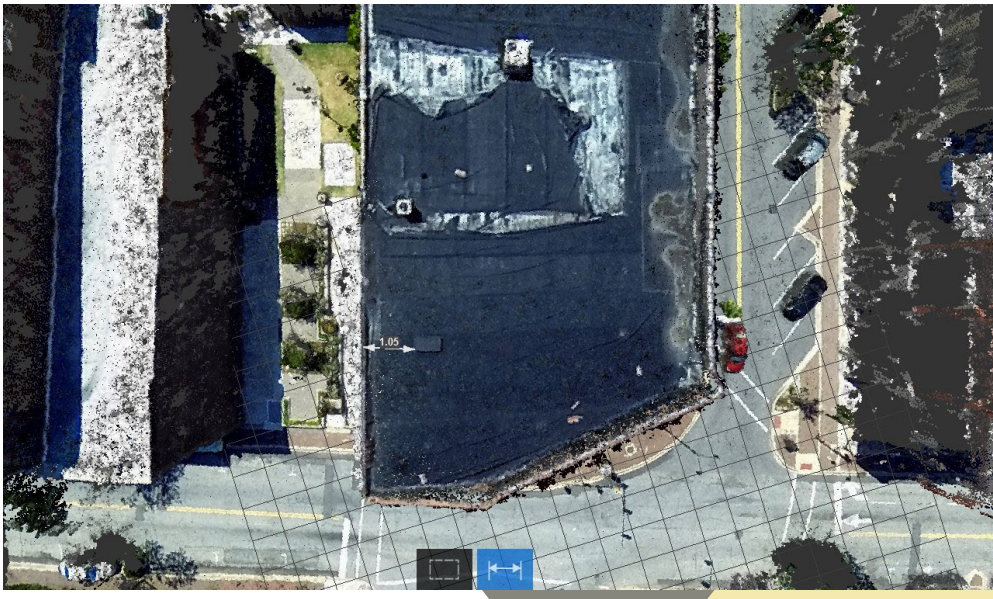
Piloting skills take a long time to develop. It took me 6 months of practice before I was comfortable flying the $2,000 dollar Phantom. For practice, I flew tiny Hubsan x4 quad copters (39.99 on amazon). They are much harder to fly than the phantom and have amazing performance for their size. I would suggest anyone interested in drones to purchase a few of them and get flying.



Point cloud and camera locations for volume calculation of retention pond.

Processing photos into useable data can be cumbersome. Using photogrammetry is different than processing lidar. The processing (similar to lidar registration) of photos into a point cloud or orthophoto is automatic, but computationally very rigorous. One hundred easily collected photos taken from your drone could require several days or more to process.

Drones have captured the zeitgeist of professionals in the mapping and surveying space for similar reasons that laser scanning attracts attention. They are beautiful, they create beautiful data/images and they do it in a beautiful way. Like lidar they also get work done. Drones will be a surveying workhorse in the near future. The uncertainty of how drones work and what they can be used for is an opportunity for those willing to invest in this technology now.



Point cloud created from drone photos in Autodesk ReCap.

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