



# JUST THE TICKET

WANT TO KNOW HOW TO CREATE AN ENTIRE IMAGE LIBRARY USING A UAV AND THEN EASILY DISTRIBUTE IT TO YOUR USERS? ROBERT PARKER RUNS THROUGH A CHECKLIST OF ALL THE THINGS YOU'LL NEED TO GET THE BEST RESULTS

Not long after reliable cameras became available, people were up in the air, taking pictures of the ground, primarily in hot air balloons. Some of the first unmanned aerial photos were taken using kites and it is likely that the first completely unmanned and autonomous aerial system was a pneumatic, timed camera attached to a pigeon.

Today, unmanned aerial vehicles (UAVs) have become a lot more complex. Lightweight aircraft and high-quality cameras are becoming less expensive. It is tempting to buy a high-quality hobby aircraft, attach a decent camera and call it good.

But while it is possible to produce a decent homemade UAV, for the best results, a complete, professional system makes all the difference.

In this article, we'll take a good look at some UAV best practices and provide key information to help you take off in the right direction. The hardware you choose to collect the data is important and the software you use to process and analyse the data is equally as important. In addition, like manned aerial systems, UAVs require a lot of preflight planning and checks. Understanding the weather, site reconnaissance, ground control, equipment checklists, mission planning and other such considerations is vital for a successful experience.

## Hardware

As you begin your adventure, keep the end product in mind. The device that you choose should be able to carry your desired sensor and cover the area of interest (AOI) in a reasonable number of flights – in other words, you're only setting yourself up for disappointment if your multi-rotor aircraft has a 30 minute battery life and you are trying to fly a 3,000 acre ranch with it. After all, high resolution sensors are not as big or expensive as one might think, and with a UAV, you can fly closer to the ground to obtain really high resolution imagery. Using a 16.1MP Sony Nex5, a readily available, lightweight camera with a custom lens, our business partner, CompassData, has obtained 3cm resolution imagery.

## Process and planning

Because UAVs are designed to be very light, they are heavily affected by the weather. Each UAV usually comes with its own weather specification, which you should not exceed.

In bad weather conditions, you may want to increase the amount of overlap between the images that you capture. While cloud cover, visibility, and precipitation are important, winds tend to have the most significant impact. By increasing your forward and side overlap to



Dr Julius Neubronner patented a miniature pigeon camera activated by a timing mechanism in 1903



compensate for the wind, you increase your chances of collecting usable data for your end product. However, be aware that increasing the amount of image overlap also increases the processing time for your images.

When doing your site reconnaissance, it's essential to think in three dimensions. Make sure you have a thorough understanding of the topology of your AOI as well as any neighbouring properties. Are there any obstructions or potential hazards to be aware of?

In addition, stay up to date on temporary flight restrictions that may be in effect in the area. These considerations are important for the entire mission, but especially on launch and recovery.

Perhaps the most important thing you can do to improve the accuracy of your data collection is to incorporate photo-identifiable ground control points (GCP). These are physically surveyed locations on the ground that have been marked so that they can be easily seen or identified in an aerial photo. GCPs increase the accuracy of your final product, providing much better results than you could achieve with GPS alone. Most GPS devices have an accuracy of 10-15m, which is simply not accurate enough for most use cases (unless you just need relative accuracy or are collecting for volumetric work).

However, if you expect your data to line up with other GIS or CAD datasets, GCPs are a must. If you shudder at the thought of establishing GCPs on your own, fret not: there are companies that have already collected GCP data around the world and have made it available for download. You might also consult local surveying organisations to find photogrammetric surveyors.

When investigating companies, ask if they have readily viewable metadata indicating the date of collection, the positional quality, and additional supporting data including a control

point sketch and photographs of the point taken during collection. Do they have timely ground control retrieval in your part of the world? Is it at your desired level of accuracy? Since ground control data is used for quality control and accuracy, it should not just be close, but perfect.

Before you fly, a well prepared checklist helps reduce the chance of errors. Is the camera exposure correct? Is there enough space available on the SD card? Assume nothing and verify everything. Otherwise, you might complete your flight only to find that merely a few images have been captured because the camera's battery has not been completely charged. Even worse, it is entirely possible to fly an entire flight with the lens cap on!

### Processing

After the flight, you will hopefully have collected a large amount of very high resolution images. To take full advantage of high resolution imagery though, you need to have the right tools.

The first goal is to process the collected imagery so that it makes sense geospatially. It is not enough just to georeference the imagery – it must be orthorectified. There are a few tools

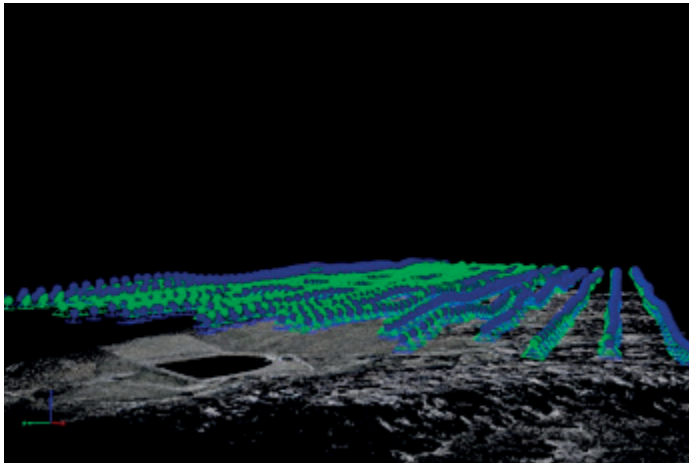


available to handle this type of processing, including UASMaster from Trimble and Pix4D-Mapper from Pix4D. All of them will perform some sort of overlap processing in addition to reading GPs. Overlap processing algorithms attempt to identify and match similar features across multiple images in order to create a mosaic of the given images. The end product will typically be an orthomosaic in GeoTIFF format, but you can also produce a DEM, a point cloud, or other useful geospatial data.

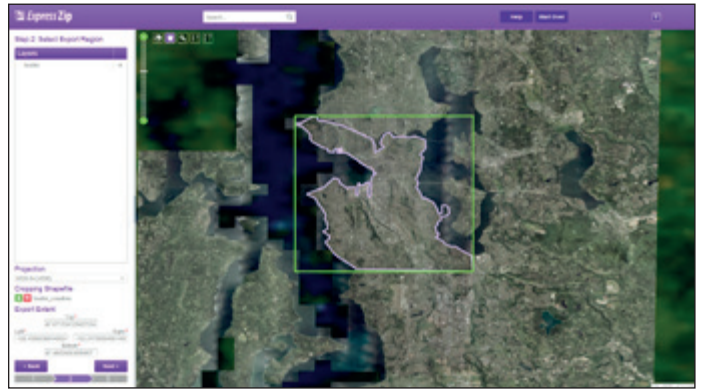
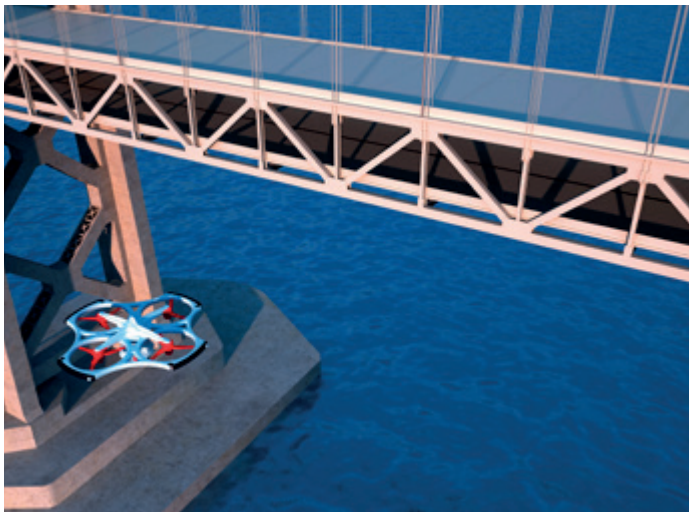


A Trimble UX5 UAV.  
Photo courtesy of CompassTools





An orthomosaic is stitched together from the overlapping images using GCPs and GPS coordinates.



WMS images served through Express Server via a custom web application.



## Storage

As the volume of your collected imagery grows, you may encounter the challenge of efficiently storing and accessing the data. Typically, images from the sensor are in JPEG format, which makes for slightly smaller file sizes (3:1). However, the orthomosaics you produce will be very large GeoTIFFs – although you could potentially save them as JPEGs to try to reduce the file size, this is less common.

When it comes to reducing the storage footprint, LizardTech's compression format, MrSID, makes a dramatic difference, with file sizes 5% of the original file size (20:1) without any noticeable loss of information. MrSID images are efficiently stored so that viewing or accessing any portion of a MrSID image is practically instantaneous in any standard geospatial application, compared to loading the same image data in other formats, such as JPEG or TIFF, as the entire image would need to be loaded into memory to view any portion. Because of this efficiency, not only can you work quickly with images that contain hundreds of gigabytes of data, you can do so on a mobile device.

## Sharing

Finally, once the data has been processed, the final step is to share the data with those that need it. If the file sizes are small, data can be shared "the old-fashioned way" by email or FTP. However, cataloging the data and making it discoverable for your users is still a complex problem.

Therefore, the best way to distribute geospatial image data is to use an image server. These enable users to find what they need in a natural, familiar way. For example, they could browse a map online, stream the imagery via WMS (a geospatial standard) from a geospatial application, or export specific regions of interest.

There are many geospatial image servers on the market. Some distinguishing factors are the speed of image delivery, advanced features

(such as on-the-fly re-projection), compatibility, flexibility, and ease of set-up and management. Most take the orthorectified mosaic that you create in your image processing software, create image tiles at different resolutions, then host the imagery by means of WMS. Image tiles improve rendering speed but also greatly increase the amount of space required for storing imagery. Some examples of tile servers include ArcGIS Server and GeoServer.

As an alternative, if you do decide to use the MrSID format, you can use LizardTech's Express Server to host the imagery directly and without sacrificing the speed of image delivery. Because MrSID images include multiple resolution levels without adding to the size of the image, you can host your imagery without creating image tiles.

## Conclusion

In conclusion, there are many details and steps involved in creating a successful UAV image collection. It starts with having the proper equipment, but before you even get off the ground there is so much to do, such as pre-flight planning, checklists, and collecting ground control points. Once the image data is collected, you will need to process an orthomosaic or other final product and store it in an efficient manner. Once you have the final product, you'll ideally want to invest in an image server that meets both the needs of your administrator as well as your end users.

## THERE ARE MANY DETAILS AND STEPS INVOLVED IN CREATING A SUCCESSFUL UAV IMAGE COLLECTION

*Robert Parker is a sales engineer at LizardTech ([www.lizardtech.com](http://www.lizardtech.com))*