Datumate
Construction Data Analytics

Datumate's Drone Photography Best Practice Document

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Datumate Construction Data Analytics

info@datumate.com | www.datumate.com

1.0 Overview

This document describes the best practices of taking images using drones for the purpose of being processed using one of Datumate's software packages, including DatuSurvey™ and DatuSite™.

Most of DJI drones are supported by Datumate's automatic drone flying application, DatuFly™, for IOS tablet systems. The guidelines specified in this document apply when the drone to be used is not supported by DatuFly™ or when the application is not available to you.

2.0 General Guidelines

Guidelines below are true for any flight type.

1. **Use a high-resolution camera -** It is recommended to use a camera with resolution between 18-megapixel and 36-megapixels. Typically, an 18-megapixel camera provides a 1 to 2-centimeter (3 to 6 hundredth of a foot) measurement accuracy at an altitude of about 100 to 150 meters (110 to 160 yards, 330 to 480 feet). Make sure your camera is set to the maximum resolution available.
2. **Use a camera with a large sensor -** It is recommended to use a camera with a CCD/CMOS sensor size larger than 100 mm^2.
3. **Use a camera with a manual mechanical shutter -** If you are using a camera with a rolling shutter, make sure the drone is set to stand still at each image taking location. In the DatuFly™ application this mode is called "Stationary".
4. **Set the drone speed properly -** When you use a camera with a mechanical shutter it is possible to take images while the drone is moving ("In-motion" mode) without having to stop and take each image, which is the case when cameras with rolling shutter are used. The speed of the drone should be set to a speed suitable for taking sharp images. This may require a trial and error process. Taking images while the drone is moving is a big battery power saver, yet going too fast may still cause images to be blurry. For DJI drones using 20 megapixel cameras with mechanical shutter, the optimum speed is 6m/sec.
5. **Set Focus and Shutter speed to automatic -** It is strongly recommended to at least set the camera to autofocus.
6. **Save Geo-Tagging information -** Make sure your camera is set to save the Geo-location of the images. In general it is not possible to process images that do not have geo-tagging information, especially images that are taken vertically. If your camera does not allow this, you may want to consider changing the camera, or finding a way to add the geo-tagging information in offline.
7. **Use a lens with a fixed focal length** - DatuSurvey™ requires that the camera's focal length will not change after the calibration of the camera and during the photographing of the survey area. Thus, it is strongly recommended to use a fixed focal length lens, i.e., a lens without an optical zoom. If the camera does have zoom, make sure that the zoom is on the same setting throughout the whole photography session.
8. **Make sure GCP's are clearly visible -** If you are photographing an area where Ground Control Points are marked, make sure that most of the control points are clearly visible and that each appears in several images. It is strongly recommended to scan the area in person to make sure that GCP's are clearly marked. This is especially important when you photograph construction areas multiple times for progress reporting as GCP's may be erased, covered by dirt or dust, or totally removed in such sites.
9. **Take your images in good and consistent lighting conditions -** Take all images in similar lighting conditions, preferably at the same time of the day and preferably close to noon. Avoid photographing the survey area during different times of the day. This will minimize changes in shadings and lighting

conditions that may degrade the performance of the automatic image processing algorithms employed by DatuSurvey™. Do not take or use images of dark areas.

10. **Set Cloudy/Sunny properly –** If the application you are using to fly the drone has a Cloudy/Sunny setting option, make sure it is set to the proper option based on what you see in the area you are about to photograph.
11. **Take images only in landscape format -** DatuSurvey™ does not support images in portrait format. If your camera is equipped with *Auto Rotate* functionality, set it on "*Off*" so that all images remain in landscape format.
12. **Make sure you have enough batteries -** As mentioned above, it is recommended to take -images as much as possible in the same lighting conditions, so make sure you have enough batteries to cover the whole area as quickly as possible so you will not need to wait for the battery to recharge.
13. **Consider drone flying regulations –** Local drone flying regulations may limit the height, the distance of drone from the controller, the distance of the drone from urban areas, and possibly other limitations. To avoid issues review your local drone flying regulations regularly and make sure you follow them.

3.0 Guidelines for Vertical Image Taking

In addition to the general guidelines above, the guidelines below are true for taking images in vertical mode. Vertical or Nadir image taking is when the camera is pointing straight down to the ground and the drone flies over an area scanning it back and forth in straight lines taking images at set intervals. There should be a good overlap percentages between images in the same row, as well as overlap between rows.

Vertical flight mode is used to generate precise orthophotos of large areas as well as elevation color maps. This flight mode is typically used in infrastructure construction sites for tracking progress of work.

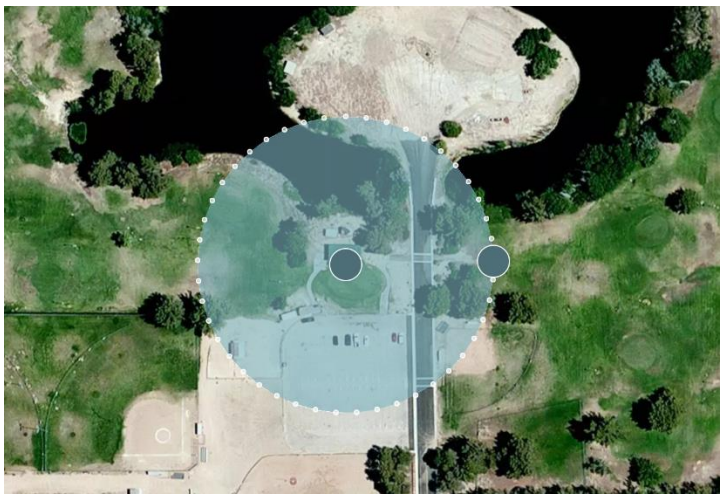
1. **Maintain proper and constant overlap -** It is recommended to maintain at least 75% overlap along the flight path and 60% overlap in the orthogonal direction. (80% front overlap and 65% side overlap is recommended).
2. **Set the height of the drone properly -** The height of the drone determines the pixel resolution. For example, if you are looking to get a sub 2cm sample resolution (GSD) using a 20-megapixel camera (5472x3648) that has an 84 degree Field of View (FOV), then you should set the height at about 60 meters.

3. **Maintain a uniform distance from the ground as much as possible -** If you are flying a hilly area that has large differences in elevation you may want to consider splitting the area into several flights where each flight covers an area that has a smaller variance in elevation. Consequently, if you are flying at 60-meter altitude relative to the take-off point, then make sure the area covered has elevations of +/- 10 meters. This will give you a consistent GSD.
4. **Watch for areas with traffic or moving objects -** If you are photographing an elongated area, such as a road, it is normally recommended to define your flying pattern with the rows of flying running down the long side of the area. This is usually more efficient as far as battery usage. Yet, if you are flying a road with traffic in it, it may be better to photograph it going back and forth across the road. This will assure cars will not appear in images over and over because you are flying in the same direction as the traffic.
5. **Split the flying mission -** If you are flying an area with narrow legs, such as a **T** shaped area, or an **H** shaped area, sometimes you may want to consider defining multiple flight missions where each one covers one leg. This may be more efficient as far as battery usage, and also it makes sure you photograph only areas of interest.

4.0 Guidelines for Oblique Image Taking missions

In addition to the general guidelines above, the guidelines below are true for taking images in oblique mode. Oblique image taking is when the drone flies in a circle and the camera is pointing to the center of the circle while the camera is angled in a way that the center point of the circle on the ground stays in the center of the image.

Oblique flight mode is used to generate precise 3D models with more accurate elevations. It is not possible to cover very large areas in oblique mode.



1. **Maintain proper overlap -** It is recommended take enough images at a constant distance on the circle between them to maintain a good overlap. For example, for a 40 meter radius circle at a height of 40 meters, take about 45 images.
2. **Set the height of the drone and the radius of the circle properly -** The height of the drone and the circle radius set the pixel resolution at the center of the image. For example, if you are looking to get a sub 2cm sample resolution (GSD) using a 20-megapixel camera (5472x3648) that has an 84 degree Field of View (FOV), then you should set the altitude at about 42 meters and the radius at about 42 meters.
3. **Maintain a uniform image spread on the circle as much as possible -** This will give you a consistent overlap and a more accurate model.