

# Case Studies

## Getting Under Control!

### AirGon



Lewis Graham  
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An important aspect of planning and executing a small Unmanned Aerial Systems (sUAS) mapping project is planning and collecting ground control and check points. We are a software and systems company, not a services company so we have limited tools (and knowledge, for that matter) for carrying out this part of a mission. Nevertheless, we really like to make sure we know at least a little bit about what we are preaching so in June, we set off on a control collection project.

Jim Meadlock, chairman of GeoCue Group, owns a farm about 20 miles from the GeoCue offices. This serves as a nice testing ground for our various outdoor projects. I don't know if Jim has a name for the farm but we will refer to it as AirGon Proving Grounds (APG)! We recently visited APG to do some field testing. Our mission was to collect some ground control and check points ("ground truth").

We are not a survey firm so we had no equipment to collect ground truth. We started shopping for some Global Navigation Satellite System (GNSS) base station/rover survey gear but were quickly dissuaded by the high cost (about \$40,000 for a good kit). Of course the cost is justified if you do this sort of thing for a living but we are just doing proof of concept. We had heard of a GNSS receiver designed to work in conjunction with the National Geodetic Survey (NGS) Online Positioning User Service (OPUS). If you tuned in to our ["Conversation with the NGS"](#) webinar a few weeks ago, you know all about OPUS! After reading a review in Professional Surveyor, we decided to purchase the X90-OPUS X90 GPS (receiver) from iGage Mapping Corporation ([www.igage.com](http://www.igage.com)). iGage has great customer support (they answer the phone, just like we do!). This is a base station, GPS only, that is designed to collect data specifically for processing through the NGS OPUS solution. This means that you have to be within range of stationary Continuously Operating Reference Stations (CORS) to obtain a useful solution. You also have to be incredibly patient since you have to occupy each point for no less than 20 minutes for a "rapid" solution and two hours for a static solution. We knew all of this going in but for \$1,650, we were willing to make some compromises!

Since we knew we would be collecting control over several visits, we wanted something a bit more durable than portable plastic sheet targets (north Alabama has frequent and ferocious wind storms). We decided to build a target template from lightweight plywood and use athletic field marking paint (nontoxic, water soluble and completely safe for the environment). We bought a case of this for less than \$60 from Amazon (where else?).

We have had a very rainy spring, early summer and APG was saturated. Fortunately I have my trusty 15 year old 4 wheel drive truck so we were able to drive in to our staging area (where we located point 1). Cotton is down and corn is up so APG is fully covered in maize. Growth conditions must be very good since the corn at APG is about 7 feet tall already!

We found a nice, bare spot and proceeded to paint marker 1. We used a bar template, 6" wide and 48" long. We simply paint this, rotate the template by 90 degrees and paint again to obtain a "plus" sign target. The size target that you will need will depend on the Ground Sample Distance (GSD) of the project. As a rule of thumb, we recommend a bar length of 30 times the GSD and a bar width of 2.5 times the GSD. In Figure 1 is illustrated placement of a target. We used a large nail (available from Lowes) as

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the center of the mark locator. This allows us to place the tip of the plumb rod in the correct location and ensures it will not sink into the ground during the measurement collection.



*Figure 1: Creating a control mark*

We also recommend labeling the targets such that the labels appear in the collecting imagery (see Figure 2). Of course, you will know which control is which once the data are collected but errors are exceedingly easy to make! We did a two-step process since we did not have the luxury of a Real Time Kinematic (RTK) collection rover. We set the collector on Point 1 while we painted targets for the remaining nine. As we placed targets, we used a free iPhone application (“Where Am I”) to collect approximate locations and mail them to ourselves. Cell coverages is not necessary since the email will simply queue up until coverage is available. We later used our email labels to correlate with the visible target labels as a sanity check.

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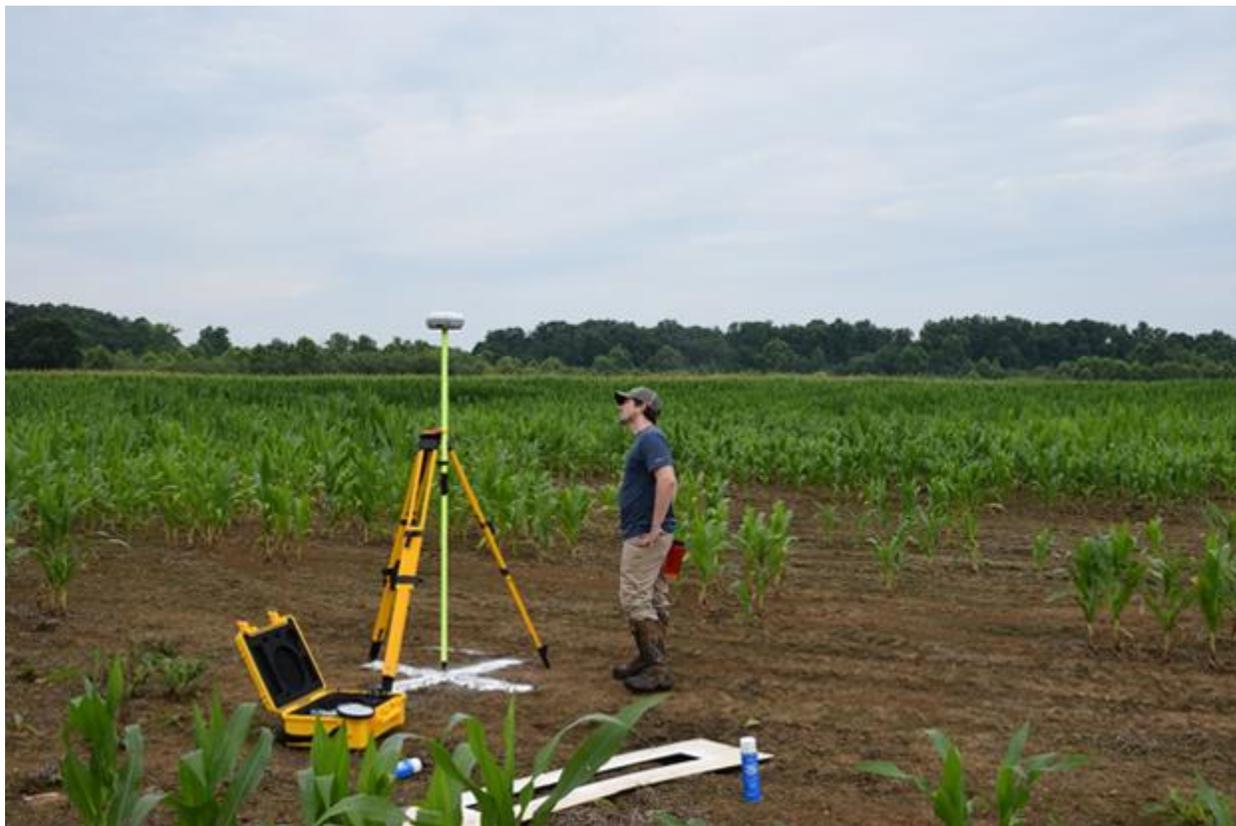


*Figure 2: Labeling control*

For our test setup, we placed 10 targets – nine around the perimeter and one toward the center. For a project of this nature (agricultural area), target placement can be a real challenge since fields tend to be planted right up to the edge of forested areas. We ran a three hour static collection on our initial control point and a 20 minute plus rapid static on the remaining nine (Figure 3).

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*Figure 3: Collecting a point*

We were able to obtain a valid OPUS solution for all 10 targets with horizontal uncertainties under 1 cm and vertical uncertainties under 2 cm. The lessons learned for next time (which, of course, would be well known to any surveyor) were:

- Carefully plan the control layout prior to arriving at the project location. Plan alternative targets since it can be difficult to access or place in some locations
- Wear good, high, waterproof boots (we forded a stream twice in our collection project) and bring a raincoat (it rained during most of our field time, of course) and a good straw hat
- Take plenty of drinking water
- Cut grass, weeds to as short a height as possible at the target location (we had several large vertical uncertainties in the aerotriangulation solution due to targets painted on grass that was too tall)
- Devise a handle for the target template. Although our template wasn't heavy, it was awkward to carry through our several mile hike. We were all well painted by the end!
- If you do not need to leave your targets overnight and are not facing potential high winds, portable plastic sheet or cloth targets are probably a lot more convenient than painting.

Overall, we had a very successful target placing experiment. Due to the rain, Alabama humidity, mud and mosquitoes, we all had a much better appreciation for our normal desk jobs when the project was complete!