10.1071/PVv2016n185p31

Environmental geophysics

Mike Hatch
Associate Editor for
Environmental Geophysics
michael.hatch@adelaide.edu.au

Using drones to create base maps

Welcome readers to this issue's column on geophysics applied to the environment. In this issue we are looking at a subject that gets a lot of press these days: unmanned aerial vehicles, better known as UAVs or drones. I won't be showing anything revolutionary here – pretty much run-of-the-mill use of a drone's camera to make a base map. Nevertheless I was impressed, it took less than two hours to fly and some time to process, but the product was impressive and would have taken much more time and money without the drone (not to mention an aeroplane).

Anyway, one day in late winter this year my friend Justin Payne (geology lecturer at University of South Australia) called me to say that he needed 'help' (mostly he was showing off his work toys) making a base map and 3D model of a beach near Adelaide that he wanted to use as a mapping project for a first year class that he was teaching. So we went to this great exposure on a beach south of Adelaide (the beach in the rocks just to the north of the 'north bay' part of Carrickalinga if anyone knows the area).

The UAV that we used was a DJI Inspire (here is the base model website: http://www.dji.com/inspire-1), which according to Justin is one of the best medium-sized, ready-to-fly drones available for the professional market, and is often used by videographers. It's a battery-powered quad copter, with an approximately 15 minute flight time (we had four spare batteries for our project). And it can cruise along at up to 80 km/h. To make the map and 3-D model Justin used a commercially available software package called Pix4D (there are some nice mining related videos and fly-through models on their website https://pix4d.com/industry/mining/). To vastly oversimplify, this type of software takes all of the captured photos (and their GPS locations) and searches for common points within the photos. It then creates a point cloud based on the 3D position of each common point as determined from the different viewing angles (ray paths) of each photo that has the identified point. The point density from this starting grid is increased (probably splined) to produce a much denser point cloud which forms a pseudo-surface of closely spaced points. This dense cloud then has a mesh overlain over it that then is coloured either as a DEM or drapes the photos of the area over the model to make the photo-realistic model.

So, on to our project. Figure 1 shows the field area (the rocky beach below us), with Justin and me flying the UAV (Justin was the pilot, I was the camera operator – at least I got my own console). Justin would hover the UAV at a location, I would snap the shutter on the camera to get a straight-down shot of part of the area, and he would move on. Figure 2 shows Justin landing the UAV.

For this area, approximately 40 m × 150 m, we took something like 125 pictures at a nominal elevation of 30 m. We spent about an hour 'in the field'. Justin spent about another hour processing the data. Figure 3 shows the locations of the photos that we shot on the day and the path that the drone took. Figure 4 is the photo-realist model of the area. Justin used a subset of the whole area for his class, specifically the nice rock exposure in the lower right with the fold features showing on the surface. The 3D model has around a million faces with just over half a million vertices and can be explored here: https://skfb.ly/VTYr (press Ctrl and, left and right click to zoom in and out if you don't have a scroll wheel).

I'm sure that many of you already know about this type of application of UAV technology; to me it's new, and I was mostly impressed with the relative ease of making a high quality base map of an area. There are lots of companies out there that make the hardware as well as the software and people are working on new payloads for UAVs all the time. I'm aware of a few geophysicists who are working on systems to collect data (not just take photos) using UAVs and will see if I can't convince one or two of them to divulge some of their secrets over the next few months.

Figure 1. *Justin and me hard at work. The field area is that rocky beach below us.*

Figure 2. *Justin landing the chopper to change the batteries.*

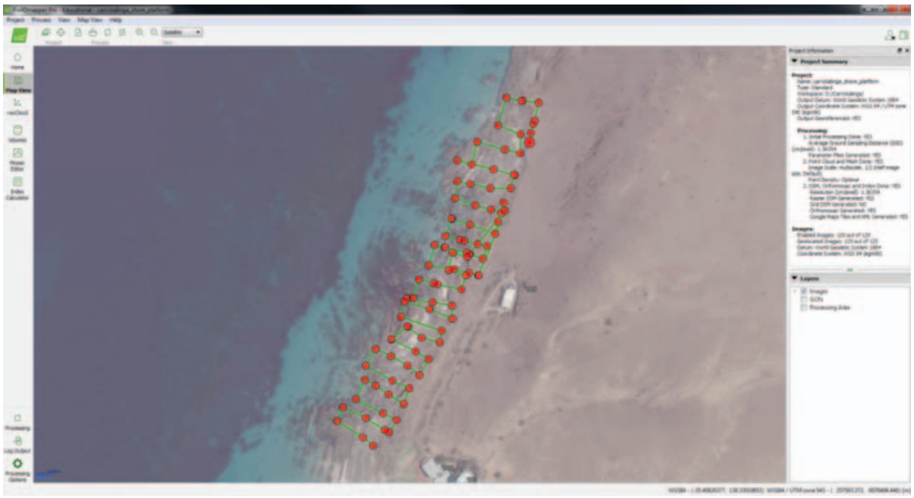

Figure 3. *Screen grab from the processing program showing locations of source images.*

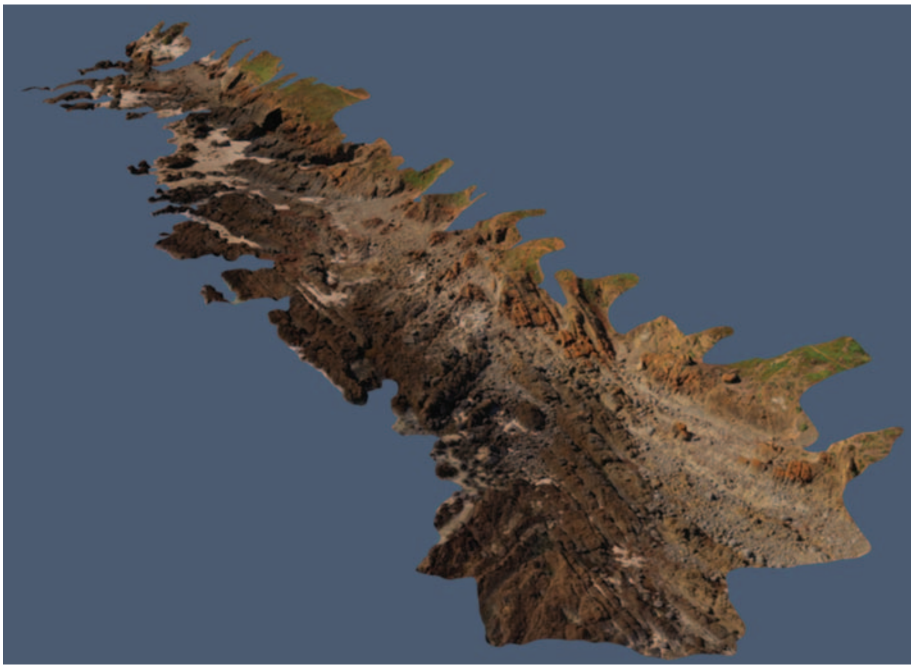

Figure 4. *Screen grab of final 'photorealist' model.*