Mapping Bulletin

Orienteering NZ Mapping Committee 17 Dec 2018

Summary: Developments in open topographical data and software provide more information about the ground and the vegetation than ever before. We summarise the process, its benefits and limitations.

Raw Lidar Data for NZ Orienteering – A Brief Overview

Introduction

An orienteering basemap once consisted of contours from a stereoplotter. Only as good as the photos and whether the ground was visible. "Lidar" surveys instead use laser pulses that can penetrate the tree canopy to the ground. New Zealand is gradually being covered – starting with places with population, floods and earthquakes. Councils are generally happy to give us their Lidar-based contours; and much of it doesn't even need asking – it's free on the LINZ website.

The next development involves the laser pulses which are reflected from the vegetation. They are all recorded, and the raw Lidar data can tell us a lot about the trees. The full Lidar dataset is called "point-cloud data", and we can use this for better basemaps: here, and now.

The following is a magazine-level description of the inputs and outputs that orienteering mappers are beginning to use. It does not purport to be a technical guide. The writers may not be the most expert in NZ – our objective is to summarise and encourage experimentation.

We dive off to an online tutorial – ignore the detail, just look at the pictures. We comment on what's useful and what's not. We list some places where you can get this new data. Finally, the workflow to utilise it, depending on whether you are an OCAD or OOM user

Lidar Definition

If you don't know anything about Lidar, view this first: https://www.youtube.com/watch?v=H2-Yp30TGk4

To cut a long story short, the process captures X, Y and Z and R in the New Zealand grid system NZTM. R is the "return number", the first reflection is from any tree canopy or roof and the last is from the ground. Software including OCAD can create ground contours of whatever interval you choose. There's so much data (5-6 pulses per sq.m for Wgtn) that it can also depict sudden folds in the land, cliffs, and things that might be rocks and knolls (or sheep😊)

What you can Get from Raw Lidar

The additional reflections can also tell us something about the vegetation. The first reflections can give us a tree height plot which often correlates with runnability changes. Scandinavia has even

produced training maps with no fieldwork, though this isn't likely here. Our surveys may not have the points per square metre, and our vegetation may be denser. What this does is give mappers a head start with a better basemap.

Read this tutorial. Skip over the screen details, just look at the pretty pictures.

https://www.ocad.com/wiki/ocad/en/index.php?title=Using_Airborne_Laserscanning_Data_for_Orienteering_Base_Map_Generation

What's great:

- The unsmoothed contours. Contain a myriad of wiggles, the result of data error (compare it to static on the radio). But in a forest, a much better base for where the ground is than old-style photogrammetry.
- Distinction of hollows from hills
- The smoothed contours. Gets rid of a lot of the "noise". The more smoothing, the greater chance of throwing away something that is useful.
- The vegetation height picture. A change in runnability is often associated with a change in tree height.
- The hill shading and slope gradient pictures. The "slope gradient" highlights sudden changes in slope, and these are often folds in the land where we would wish to have a kink in a contour, rather than allowing smoothing to take it away.

What Doesn't Seem to be great

- Hypsometric plot
- Intensity. Distinguishes different tree types but the eye can usually do this on ordinary photos
- Automated feature recognition such as depressions, distinctive trees and cliffs. There are many causes for false positives here. May depend on higher Lidar densities than our data.
- Vegetation classification. Attempts to use reflections from various levels to infer open land, undergrowth, white forest etc. A presentation at the IOF Mapping Conference talked about 60 pulses per sq.m, we are lucky to have 6.

Where to get this Data

Strangely, a lot of this NZ Point-cloud data is not on LINZ but has ended up on the Open Topography website at the University of California https://opentopography.org. It's free for download in the same way as the LINZ website for photos and contours etc. You register with the site, pick "point-cloud data", filter by location to New Zealand, and hey presto, 18 datasets of NZ areas. More are on the way.

Some NZ councils are broad-minded with their data and happy to share it on the LINZ and Open Topo websites. Others may not be. It's always worth asking. Michael Croxford knows a lot about datasets in the South Island. In fact, NOC got their council to survey extra areas for them.

Warning: these datasets are massive. A registered OpenTopo user can download 250 million points, but for Wellington that's only 7kmX7km. You need to be selective. It will take a while to download and longer to process. We are talking hundreds of megabytes. The format to ask for is LAS, or its compressed form LAZ.

Computer processing of Raw Lidar

OCAD Users

You'll need OCAD 12 or better still OCAD 2018. Go to the DEM menu and let the DEM wizard help you. It will produce contours, and a number of background maps.

Re-read this tutorial. Its the same link as above but this time look at the details of each screen

https://www.ocad.com/wiki/ocad/en/index.php?title=Using_Airborne_Laserscanning_Data_for_Orienteering_Base_Map_Generation

OOM Users

OOM doesn't have point-cloud processing built in. But the software Kartapullautin is the pioneering software for point-cloud processing for orienteering, and its free from http://www.routegadget.net/karttapullautin/ The download includes a "readme" text file. The software produces contours in DXF format which can be imported to OOM, and raster files which can be put in the background.

Raw Lidar data is sometimes provided as "tiles" ie lots of separate rectangular files. Tools for handling tiles and merging them together are available from the LAStools website. http://www.cs.unc.edu/~isenburg/lastools/

The best English-language source of help is from Greg Wilson's postings on the Medium website - https://medium.com/@somegreg

Both methods

1. These files are massive. Depending on your RAM and the area you have downloaded, some of the steps can take ages. It can be worth leaving it running while you do something else.
2. If you've struggled with the wiggliness of Lidar-based contours, OCAD 2018 has a smoothing routine that is quite impressive. You might want them unsmoothed for a fieldwork base, or you might want them smoothed for a MTBO or rogaine map where you're not going to go over every spur and re-entrant. You can get both
3. Lidar data is not error-free. You can get strange errors especially near water bodies (riverbanks). Completely wrong deep holes or hills are possible.
4. The relation between tree height and runnability depends on the vegetation. Once you've been in the field you can begin to understand what its telling you, and some of the runnability boundaries can be traced
5. Don't forget regular aerial photos. The LINZ website is regularly putting up more recent, and higher resolution photos. Some are so fine (10cm pixels) that half or quarter resolution is enough. By switching your backgrounds between photo and the various other backgrounds that Lidar gives you, you can produce a first approximation of your map before setting foot in the field.

Conclusion

An orienteering basemap is no longer produced by a human operator looking at photos (but thank you Stewart Hyslop!) It comes from data measured from the sky. The government has recognised

the importance of topographical measurement and is funding more surveys. There is generally an open data policy and this data can be used for orienteering maps. Councils may have more data than is openly published, and may be prepared to extend their surveys at modest cost.

Every mapper doesn't need to be an expert in this technology. We can expect some mappers to specialise in basemap production. Or in the difficult task of upgrading older maps in the light of better contours. Club decision-makers should have an overview of these processes.

This technology doe not replace fieldwork. And it doesn't replace judgement in what to put on maps and what to leave off. In fact there's a danger that too much detail can make its way onto maps just because it is there. Producing a legible map remains a vital skill.

Get further information from authors Michael Croxford for Kartapullautin/OOM, or Michael Wood (OCAD).

Distribution

This bulletin goes to regular mappers known to the Mapping Committee, and ONZ clubs