

## An experience with LiDAR

LiDAR shares many commonalities with RADAR - a more familiar technology. The principle difference is the use of lasers (Li-ght) instead of radio as the means of range finding. Working at the speed of light is pretty quick, so LiDAR mounted in an aircraft is able to survey at flight speeds in stripes over 500m wide with astonishing resolution of surface detail.

LiDAR has advantages over conventional photography - it can be flown in most weather conditions, it does not depend on high sun (or any sun at all, and can even be flown at night). With accurate GPS and careful route planning the job might even be done almost pilotless. These differences amount to a dramatic reduction of the cost of LiDAR compared with aerial photography. Of course there are currently some start-up costs being recovered but it may be expected that in future costs will be greatly reduced.

The Tasmanian government spent some money last year having a LiDAR survey of the settled parts of the Tasmanian coast. The project covers more than 4000 sqkm and was flown in 6 days (4-9 Mar 2008). Production of the data files was complete in 30 working days and the only manual editing required was for the identification of water bodies (presumably the laser frequencies used do not detect water surfaces). It is understood that the Tasmanian project cost an average of about \$90 per square kilometre.

Notionally this was to cover areas lying below the 10m contour but of course the survey covers many parts at higher levels within that general area. The data is available as an XYZ digital terrain model (DTM) of the unvegetated surface with a 1m grid to GDA and may be downloaded in 1km square 'tiles' without charge.

The survey information files suggest that the spot locations and heights are generally accurate to within a few centimetres of the unvegetated surface (it appears that vegetation is semi-transparent at the laser frequencies used). It is also apparent that the data is somehow interpolated to estimate the levels under buildings but the info file does not explain how.

The DTM was loaded into OCAD 10 and a set of contours produced. The resulting 5m contours were surprisingly busy with details and tiny convolutions which frankly did not appear to reliably represent the surface - the plot looks poor and does not inspire confidence, but that may be only for lack of appropriate generalisation.

When the contours are produced at 1m intervals they are too close to discriminate in OCAD on steep slopes at a scale of 1:10000 - however if the contour symbol is reduced in width (to .01mm) the on-screen result is revealing, with outcrops and individual large rocks being easily recognisable and providing a very close representation of the surface.

This image of 1m contours shows an 80m x 56m sample of the data contoured at 1m intervals in OCAD (with reduced line width) covering a steep area becoming flat at the top to the west with several rock faces. The lighter coloured contours are the 5m lines.

A short search located QuikGrid (available only at <http://www.perspectiveedge.com/>), a GNU General Public License utility which reads the XYZ data and

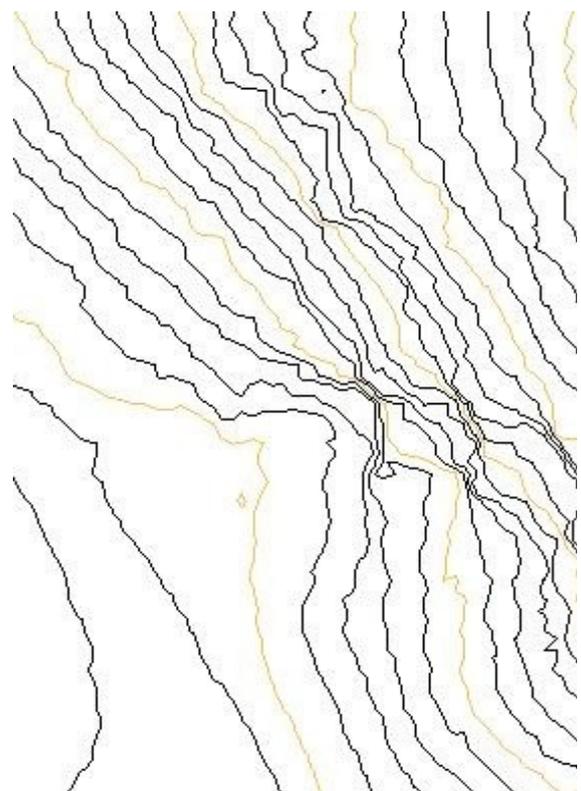
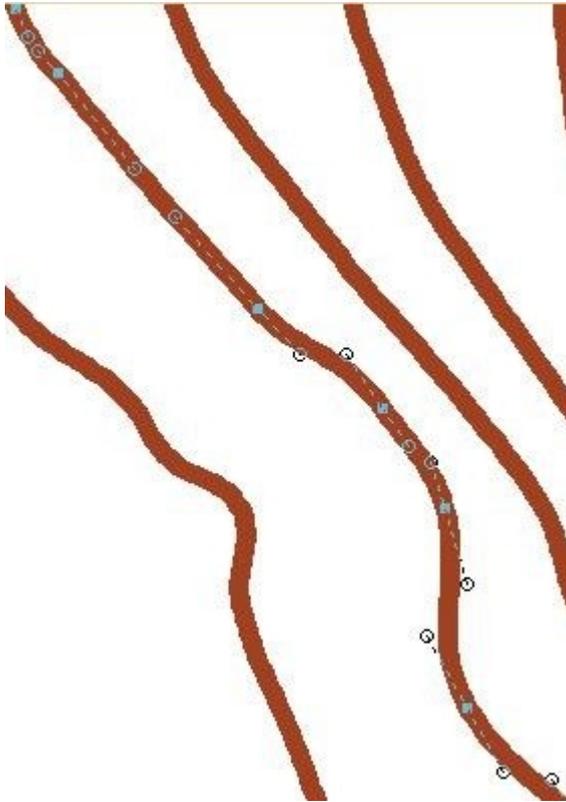


Fig 1: 1m contours

produces contours as a georeferenced dxf file which imports directly to OCAD. This software offers a variable degree of generalisation (there is a variable grid spacing which determines the amount of generalisation) and the result is much less noisy than the contours produced by OCAD. Using a 10m grid they still include much small detail (but not individual rocks), and they look much better.



*Fig 2: Smoothed 5m contours of the same surface*

The QuikGrid contours also end appropriately at the boundary of the plot (unlike the OCAD result which generated spurious lines to the corner of the plot as though there were a vertical cliff at the edge of the data and which require some tidying).

The smoothed 5m contours shown in Fig2 cover the same area at the same scale with the QuikGrid output converted to curves in OCAD. As you can see the conversion has provided a very satisfactory density of points, making the line easy to adjust where that is necessary and having a reasonable file size (after it was optimised).

The accuracy of the LiDAR data is astonishing. The information files include comparison lists with about 1000 points of accurately known height. While the horizontal and vertical accuracy is claimed to be no worse than 25cm the comparison points show about 99% are within 2 cm (remembering that known datum points need to be at easily accessible and widely visible locations, often concrete slabs) and some of the few larger differences are clearly attributable to one of the measurements being on a structure and not on the ground.

Some differences will be expected as the reference points will usually fall somewhere between the LiDAR data points (which in this case lie in a 1m rectangular grid pattern) and not right on them so the LiDAR height must be interpolated for each comparison point. It is also noted that some (or all) of the comparison points may have been used for height datum reference and the closeness at those points would be spurious.

The significance of this is that very accurate surface modelling is becoming available and the technology to use it is readily affordable, on any desktop or notebook computer. Having spent some time on the map I am very impressed. The contours generated appear excellent.

While some would be tempted to modify the contours shown in Fig 2 my own preference would be to use form lines and feature symbols to show the shape and leave the contours pretty much as they are confident that they represent the surface as accurately as is practical.

Constructive comment or questions invited.

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