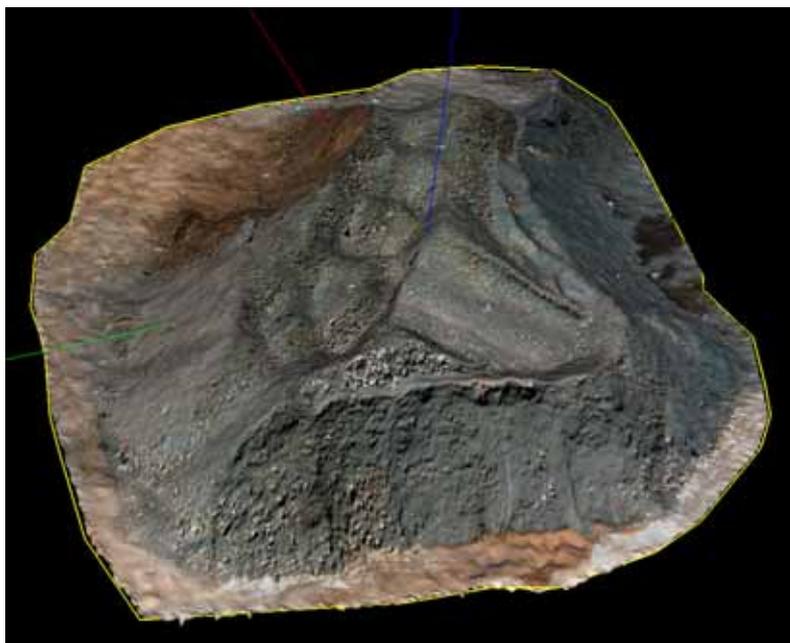


A Cost Effective Method for Stockpile Volume Estimation using Aerial Photogrammetry



geophysical innovation

*Unit 2, Ocean House,
Hunter Street, Cardiff CF10 5FR UK*
Tel: +44(0)8707 303050 nick.russill@terradat.co.uk
www.terrageomatics.com





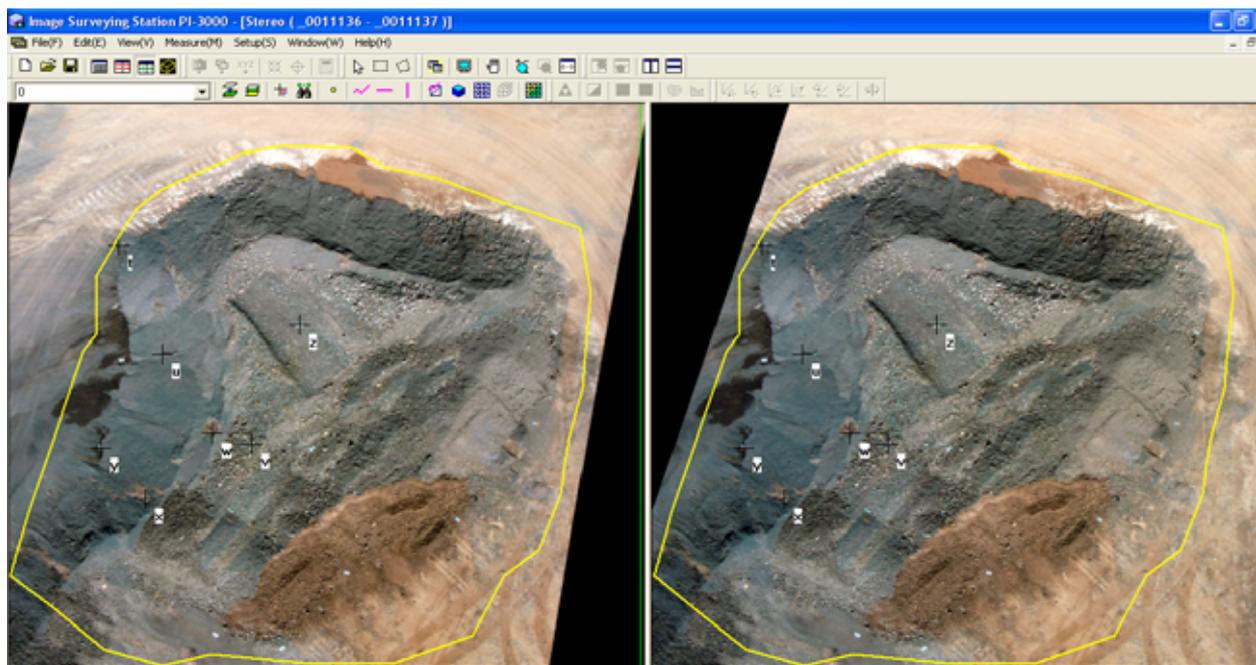
Photogrammetry is a computer based process that performs 3-D measurement from digital photographs. The software conducts 3-D measurements from stereo images - two images taken from different angles to the left and a right - of the object of measurement.

The resulting model 3-D surface is accurate often on a sub-centimetre level which makes it ideal for field mapping.

An aerial perspective is best for large targets such as stockpiles, and we have developed a highly stable all-weather helium balloon / kite hybrid photographic platform.

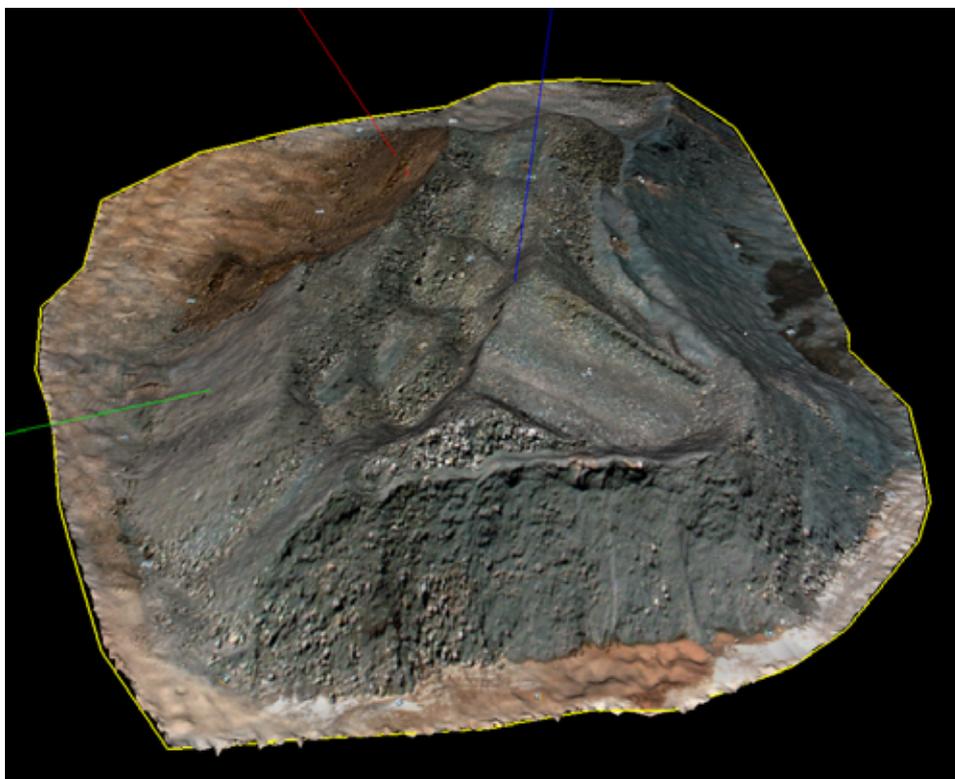
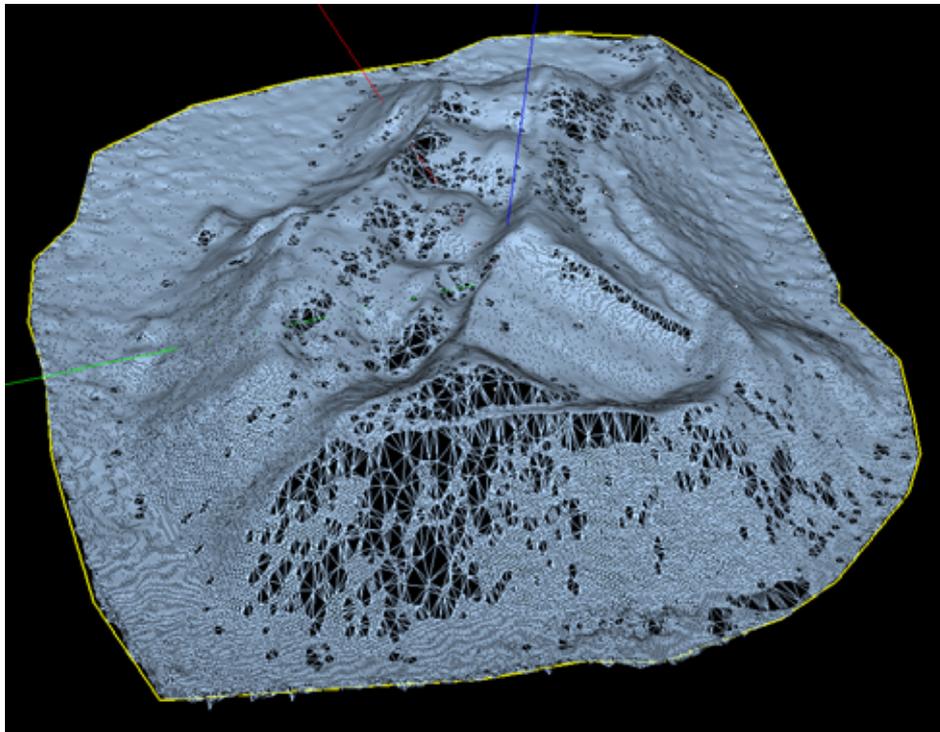
The data is co-ordinated into the real world through the use of wooden targets placed on the ground and surveyed using GPS.

Left: TerraDat's aerial platform enables an unrestricted birds eye view of a target.

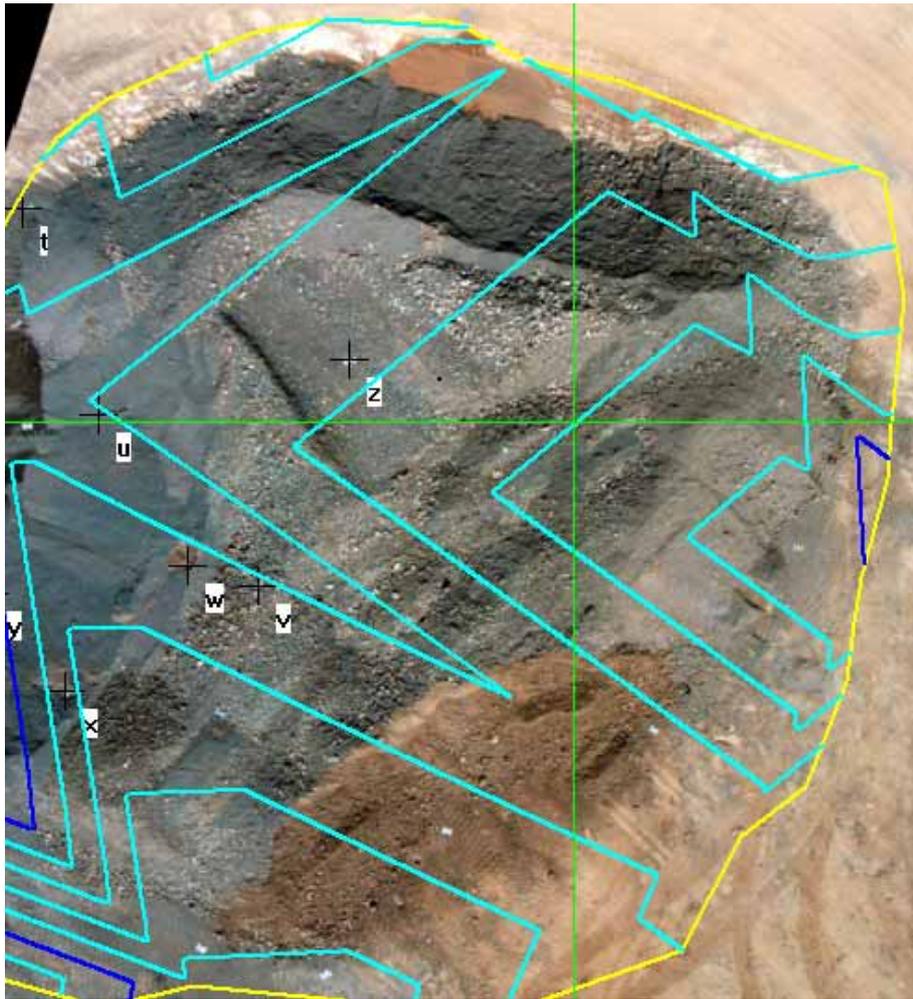


Above: Orthorectified stereo images of the stockpile. Note the GPS targets and yellow Polygon defining the limits of the photogrammetric model

The workflow for generation of 3-D models from stereo imagery is very efficient and can be completed by an experienced operator in under one hour. Once the image pair is related to the ground control points, a model area is defined via a polygon. The software then carried out an automatic surface measurement at a pre-defined mesh (5cm in this example) to produce the TIN (triangular irregular network). The original photography can be warped onto the TIN as show below.



Volumetric Analysis



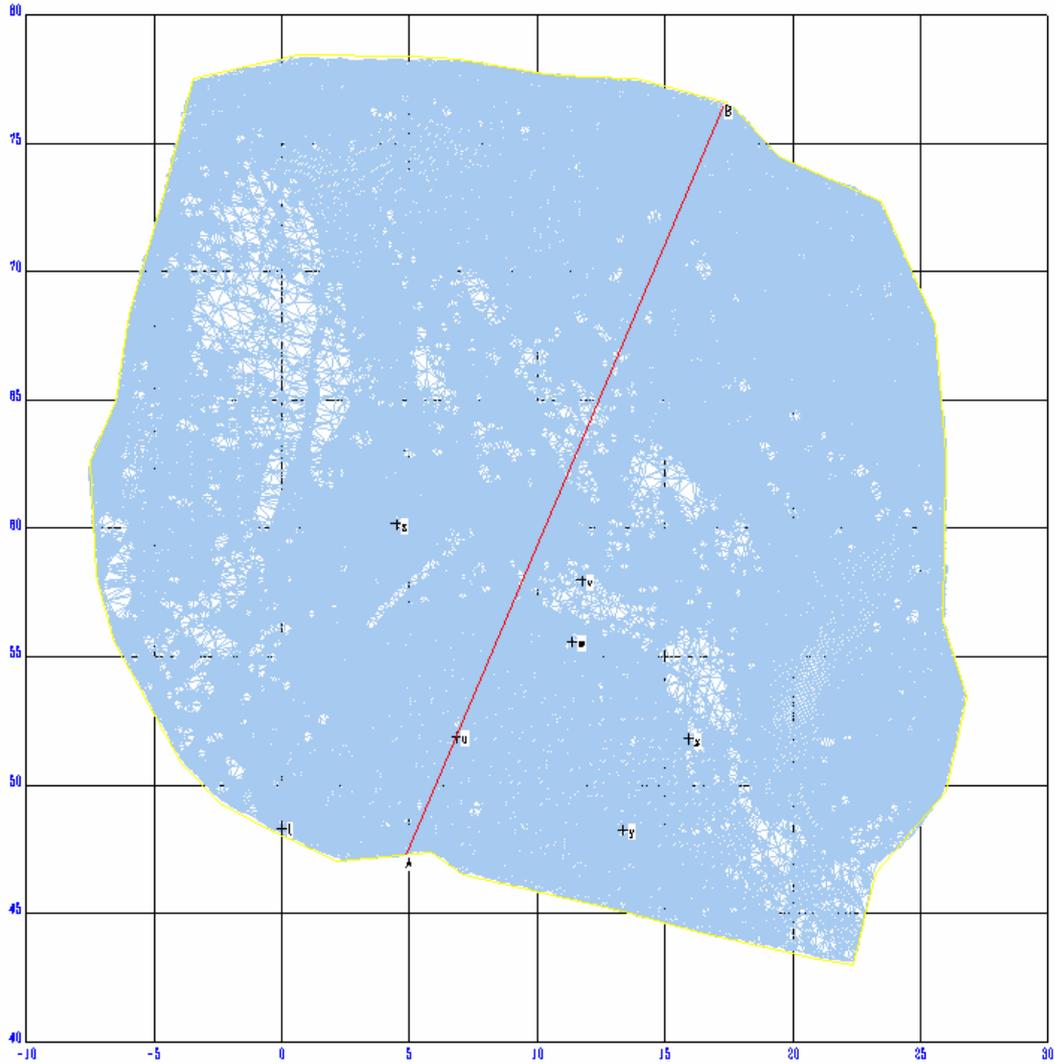
Contours of the original stock yard surface derived from polygon edge elevations

Volumetric analysis is carried out by subtracting the generated 3-D surface of the stockpile from the original ground surface. Either the original ground surface prior to the stockpile can be used, or a flat ground surface can be generated from the stereo photographs using the elevations of the edge of the polygon (see yellow line above).

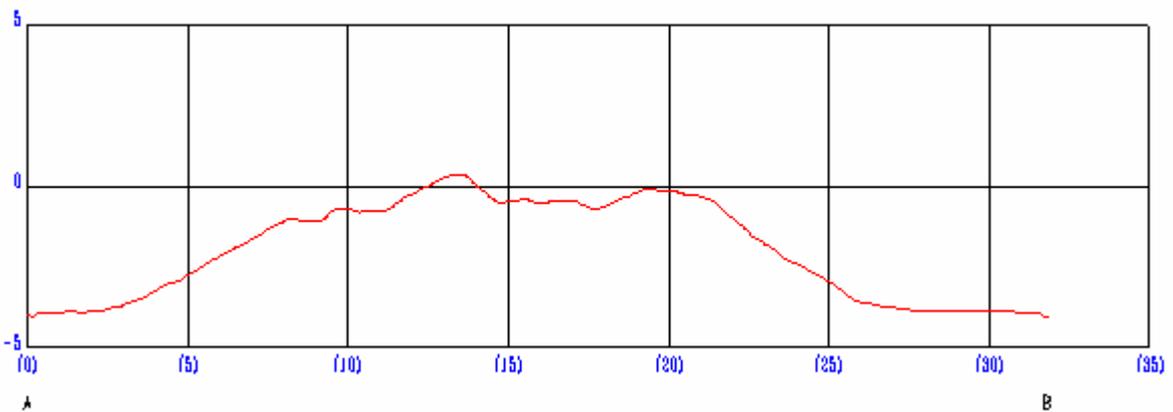
A screenshot of a software dialog box titled "Volume Difference". It has a blue header bar with a close button (X) in the top right corner. The dialog contains two input fields: "TIN 1" with the value "SURFACE-2.0001" and "TIN 2" with the value "SURFACE-1.0001". Below these is a field for "Volume Difference" showing the value "1435.366122" followed by "[m3]". Underneath that is the text "(TIN2 - TIN1)". At the bottom center is an "OK" button.

The volume of the stockpile in this example, using the surface difference model is 1435 cubic metres. Given a representative density, the mass can be easily worked out.

Cross Sections



The photogrammetry software also has a useful function for drawing cross sections. The plan above shows an X_Y plot of the stockpile surface model (TIN) and the line of the cross section in red.



Stockpile cross section A-B derived from the surface model.

The software used to generate the model presented in this case study was produced by Topcon. PI-3000 image station is available from authorised Topcon distributor: TerraDat. See www.terrageomatics.com for further information.