'Brecks from Above': Using Aerial Photographs for Archaeology

By: Norfolk Historic Environment Service

Rectification

Aerial photographs, both vertical and oblique, contain inherent distortions due to tilt (the angle of the camera in relation to the ground surface) and height (features being displaced the further they are from the 'nadir' point directly below the camera). This means that features on the photograph are also distorted: features nearer the camera are at a larger scale than those further away, parallel lines appear to converge, and shapes are distorted.

In order to create an accurate map of archaeological features from aerial photographs, it is necessary to 'rectify' them. This process compensates for the distortions inherent in the photograph, and effectively turns them into a map. Rectification is particularly necessary to enable accurate mapping from oblique aerial photographs, where the tilt distortion is greater than in vertical photography, but vertical photographs also require rectification, particularly when the features to be mapped are located towards the edge of the photograph, where height displacement is greatest. Digital sources, such as Google Earth and lidar, do not usually need to be rectified.

Most rectification is now done using computer programs. The Norfolk Air Photo Interpretation Team use a program called Aerial, but similar principles are used by a more freely available program called Air Photo. The latter is part of the Bonn Archaeological Software Package and can be downloaded for free from http://www.uni-koeln.de/~al001/. The current version is AirPhotoSE, and includes a detailed Help manual.

There are also manual methods of transcription, but these are generally less accurate than computer methods. The most common methods of manual transcription are the 'network' method and 'paper strip' method. Details of these are given in Wilson (2000) *Air Photo Interpretation for Archaeologists*, and Connolly *Beginners Guide to Aerial Survey and Rectification*.
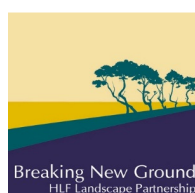
All methods of rectification require at least four, and (depending on which method you're using) preferably six or more, features on the photograph that correspond to features on the map you want to rectify the photo to; the 'map' can be a digital source that is already rectified, such as a digital photo layer or lidar, for example. In computer methods, control points are assigned to corresponding locations on the photo and map, and the program then transforms the original image to fit the map.

In manual rectification, lines are drawn between corresponding points on the photo and the map. The network of lines then provides a guide, enabling archaeological features to be drawn on the map in something close to their ground position. NB. Never draw on the original photograph as this damages the photo and may obscure the archaeological features; use a copy of the photo, or a transparent overlay secured on top of the photo.

When considering whether and how to rectify photographs for mapping, consider the following:

- How accurate does the mapping need to be? Will sketch plotting, without rectification, be sufficient? This may depend on whether any further work is planned, for example excavation, where trenches need to be located over features. It will also depend on the scale of the mapping; if the mapping is at a small scale, the benefits of a high-level of accuracy may be lost. How 'busy' or complicated is the mapping? If lots of features need to be mapped from multiple sources, a higher level of accuracy is needed to be certain of the spatial relationship between them.
- If you do need to rectify a photo, use a computer program such as Air Photo if possible.
- A primary consideration when selecting photos for rectification is whether they have an adequate number of control points. These will usually be the junction of field boundaries or roads, buildings or other features identifiable on the map. The photo chosen for rectification may not be the 'best' photo of the site or features. It is often necessary to map from one photo, while referring back to others which show the features more clearly.
- Try to select vertical photos, or oblique photos that are close to vertical. Very oblique photos tend to be difficult to rectify, and will not result in a good level of accuracy.
- Try to select photographs that have the features you want to map at or close to their centre; the distortion due to height displacement is greater towards the edges of the photo, and this will reduce the level of accuracy.
- Your control points should create a polygon around the features you want to map, and extend across the whole area. Any features lying outside of this polygon or network will not be within the rectification and therefore cannot be mapped accurately.
- Where possible, use 'hard' control points, such as the junction of field boundaries or the corner of fields, rather than 'soft' control points, such as the edges of woodland or slight bends in a hedge. Be aware that on older and small scale maps (*e.g.* 1:10,000), roads were often drawn as wider than they really are.
- As far as possible, space control points evenly across the area you want to map. In computer methods, avoid clustering control points in one particular

area, as this will skew the rectification. Also avoid placing three or more control points in a line, as this can also skew the results.

- The accuracy of any rectification and mapping is also dependent on the accuracy of the base map; a 1:10,000 scale base map will result in a lower level of accuracy than one at 1:2500, for example.
- Be clear in any records or reports about how accurate the mapping is likely to be.

References

- Connolly, D., *Beginners Guide to Aerial Survey and Rectification. Guide 7*. Downloadable from the British Archaeological Jobs Resource (BAJR) website http://www.bajr.org/BAJRread/BAJRGuides.asp
- Wilson, D.R., 2000 (2nd ed.). *Air Photo Interpretation for Archaeologists*. Tempus, Stroud.

- ***Manual transcription using the 'network' method:***

  o Choose an aerial photo. This should be covered with drawing film or an overhead film.
  o Select a corresponding map extract or digital source that is already rectified. You will also need a sharp 4H pencil, eraser, ruler and, if using an overhead film, a fine marker pen.
  o Look at the photo and identify some control points that correspond to features on the map.
  o Use the ruler to draw a line between two of the points on the photo and then on the map. Repeat to create a network of points across the area you want to map. You can use the junctions of lines as new control points, to enhance the network.
  o Once you are happy that the features to be drawn are sufficiently well-located by the network to be accurately mapped, start to sketch the features onto the map, using the network of lines as guidance.
  o If you have more than one photo, the same network can be used, just re-draw it on the new photo.

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