Algorithms and 'feature-extraction' - what role in landscape survey?

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This paper looks at the challenges of how archaeologists engage with 'Big' 3D landscape-scaled data, such as airborne laser scanning, and complex data, such as hyperspectral imaging. These provide opportunities for rapid and extensive topographic recording and many (new) ways of seeing through multiple visualisations and analyses.
However, these data beg some questions.

- How effective are established techniques for feature identification (a basic building-block of landscape survey)?
- What role for 'computer vision' in landscape survey? (computer vision is used here as umbrella term for all methods by which imagery/data can be processed, analysed and understood using algorithms, with reference to the replication of the abilities of human ocular perception)
- What are the synergies between established approaches to survey and how do we deal with different sources of information/knowledge?

Extensive image processing and feature enhancement/extraction have a relatively long history in Remote Sensing Archaeology, where they were mainly introduced by satellite specialists. Initially, there was widespread hostile reception by archaeological practitioners (mainly aerial photo interpreters) to often naive applications, but the last decade has seen slow development towards mutual understanding, in tandem with rapid developments in computer vision techniques (simple = number plate recognition / complex = medical imaging). At the heart of the debates in this area of archaeological practice are tensions between those who believe that 'computers' have a limited or no role in feature extraction, to those who believe that computer vision is a valuable tool to help with complex analyses of complex, highly variable data. However, polarised positions are inherently unhelpful, and increasingly sophisticated medical applications demonstrate the potential as they routinely combine multiple datasets within a suite of approaches to diagnosis (see for e.g., http://www.comp.leeds.ac.uk/drm/).

Given this potential and the increasing availability of complex/extensive landscape data it is important to look critically and reflexively at landscape survey practice, in particular to address the following questions.

- Does the human observer have the same ability as a computer vision based system to order large amounts of information and to be entirely systematic?
- Should human/field observation have primacy over all other forms of observation?
- Do we privilege sources of information/forms of observation?
- How prejudiced are we about different/new approaches– and does this get in the way of creating reliable knowledge?
- Do we see such developments as opportunity or threat – and why?

It is my view that traditional observation alone will fail to exploit the complexity and scale of data such as Airborne Laser Scanning. Moreover, with the rapid developments in computer vision landscape archaeologists will do well to engage in exploring this area of practice where the potential to fuse field experience and observation and novel imaging and feature extraction techniques is enormous.

Further Reading:

General

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Archaeological examples

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Risbøl, O, OM Bollandsas, A Nesbakken, H Ørka, E Næsset & T Gobakken 2013 Interpreting cultural remains in airborne laser scanning generated digital terrain models: effects of size and shape on detection success rates *Journal of Archaeological Science* **40** 4688–700. http://dx.doi.org/10.1016/j.jas.2013.07.002

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Trier, Ø, S Larsen & R Solberg 2009 Automatic detection of circular structures in high-resolution satellite images of agricultural land *Archaeological Prospection* **16** 1–15. http://dx.doi.org/10.1002/arp.339